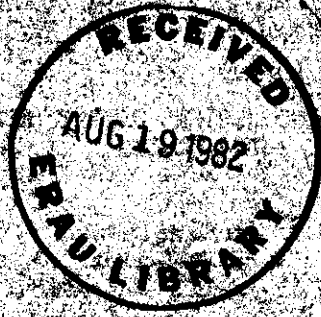


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AIR TRAFFIC CONTROLLER

HEALTH CHANGE STUDY:

A Prospective Investigation of
Physical, Psychological and Work-Related
Changes

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Boston University School of Medicine

August, 1978

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I. SUMMARY

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Acknowledgment

The inspiration and support for the Air Traffic Controller Health Change Study came from many sources. The need for such a study was clearly one of the recommendations of the Corson Report (1970). The questions regarding the implications of air traffic control work on employee health were, and remain, an important issue for the Office of Aviation Medicine of the FAA. Factors leading to health change in air traffic controllers were of great interest to many individuals in the agency. Administrators responsible for the maintenance of the air traffic control system and those in the Office of Personnel were vitally interested in the problems of air traffic controllers and the factors that might represent a risk for their health change.

We received a great deal of support from many individuals in many different parts of the FAA, both nationally and at different facilities, ranging from their backing for the development of such a study to their crucial suggestions for design of the study and their help in its execution.

We are also much indebted to the administrative officers of the Professional Air Traffic Controller's Organization (PATCO). Without their support and endorsement, it would have been impossible for us to complete this study.

We are perhaps, however, most indebted to the air traffic controllers who participated at a cost to themselves, but yet with enthusiasm, openness and sustained dedication. Without their cooperation, investment, perseverance, and honesty, there would have been no study. Many individual controllers also participated in making suggestions about the various questions that might be asked, helped educate us about some of the intricacies of air traffic control work and helped us to overcome the difficulties in scheduling. Because our study required controllers to be away from their job at least once every nine months, we are also indebted to the various facility chiefs and their assistants who helped us schedule the controllers' visits to Boston.

An enormous amount of information was collected on the 416 men that we studied for three calendar years. Our participants were an unusually cooperative and dedicated subject group, representing an 80% volunteer rate from a stratified sample of ATCs in New York and New England. They averaged a 95% return rate on the monthly mood and health check-ups. Although, of the 416 men who started the study, many were either transferred to other facilities or promoted, 388 men, or 93%, of the original group returned for a final examination visit. They came from across the

country and as far away as Guam and Hawaii. Only 24 men dropped from the study for personal reasons during the entire three years, and even some of them came back for a final visit.

We are grateful for the excellent cooperation we received during our visits to the facilities to study the men while they were actually controlling traffic. We were able to complete 2,626 men-days of observation during the course of the study, each day lasting approximately 5 to 6 hours. As collection of data on a man took place every 20 minutes during this time, we made almost 40,000 individual observations on controllers while at work.

Nature of the Study

The main goal of the study was to determine the nature and extent of health changes in the air traffic controllers and by what characteristics these health changes might be predicted. We were interested in both physical and psychological health changes. As documented in the body of the report, we established rigorous criteria for both classes of health changes, and defined health change operationally in such a way that the reader could understand clearly what was classified as an illness episode.

Many variables were included in the study as possible predictors. We selected men with as broad a range of experience and years of age as possible. We selected men from two major centers, the Boston Center in Nashua, New Hampshire and the New York Center in Islip, New York, and from Boston Tower (Logan Airport) and the Common IFR Room (Kennedy Airport), providing radar control for the entire New York metroplex area. We also studied in smaller facilities located at Bradley International Airport (Windsor Locks, Conn.), and at two enroute radar centers (Quonset Naval Air Station at Quonset Point, Rhode Island and Otis Air Force Base at Cape Cod, Mass.) and also included a few men from Providence Airport in Rhode Island.

The data used to determine health change were gathered in several ways. Men filled out a medical history questionnaire reviewing personal and family health histories, health habits and symptomatic complaints and had an interview and physical exam with the study physician five times over the course of the study. During the same visit, chest X-rays and electrocardiograms were made, blood chemistries were measured and urinalyses performed. We learned about most of the mild and moderate illnesses and injuries by sending each man a monthly health checklist on which to report illness episodes, continuing health problems or injuries that occurred during the past month, as well as whether he saw a physician or was hospitalized. Psychiatric health change was assessed primarily in two ways: first, by use of a widely accepted structured psychiatric interview, the Psychiatric Status

Schedule (PSS), and second, by use of a monthly checklist designed to detect troubling episodes of depression or anxiety.

From these sources of information, we were able to diagnose old and new cases of hypertension, along with the occurrence of major illnesses such as peptic ulcer, diabetes, etc. The vast bulk of the physical health changes, however, related to more short term respiratory illness and accidents which were associated with moderate degrees of disability.

The major clusters of predictor of risk variables included stable personality characteristics to determine whether or not particular traits raised one's risk for developing physical or psychological problems. We were particularly interested in men's attitudes and perspectives about work, such as their feelings about the "costs" of working as a controller in terms of its interference with the rest of their lives, their feelings of investment in the work, concerns about burnout, ability to bounce back after periods of being away from working the boards, anxiety at work, and ability to cope with the problems of being a controller. We also employed a number of standard questionnaires to assess worker satisfaction and perception of on-the-job relationships in comparison with other groups. We were interested in how competent, amicable and "ideal" as a work team member each of our participants was as perceived by his coworkers. We also inquired about life changes individuals experienced throughout the study inasmuch as major events such as deaths, marriages, and divorce have been shown to place individuals at increased risk for physical and psychiatric illness.

The other major category of predictors assessed were responses to air traffic controlling itself. While they were on the job actually separating aircraft, we measured the controllers' blood pressure and endocrine responses at work and rated their overt behavior or arousal while controlling. Work load variables were also recorded, including the peak number of planes controlled, complexity of the controlling task in terms of planes transitioning, type of sector worked, type of position worked (radar, hand off, data, training or other) and number of observation points on the boards during the study day. Thus, we were able to compare men with respect to workload on the days they were studied, as well as on their subjective responses to work, changes in overt behavior, blood pressure or hormone levels.

The design of this study also allowed comparison of those who were promoted, those who were disqualified for medical or psychiatric reasons, and those who remained as active journeymen controllers to see if any predictor variables could discriminate among these outcomes. We also defined burnout operationally and determined what characteristics accompanied it.

Our main focus was to search among this rather large array of potential predictors for what was indeed associated with health change.

Most of these variables were studied in a predictive fashion using data collected before the person manifested health problems. Some of the data, however, was collected over the course of the study, and for this data, any relationships found with health changes were concurrent associations.

Health Changes

The largest single chronic illness condition among air traffic controllers was hypertension. The findings of this study parallel previous reports which documented the increased prevalence and incidence of hypertension in controllers compared to other individuals. Regardless of the criterion used to define hypertension, the ATCs had a significantly increased prevalence and incidence of hypertension over comparison groups. Using a rigorous definition the average of two readings over criterion levels on two successive visits to the physician, we found that about 32% (135) of the men entering the study already had borderline or definite hypertension. In addition, 36 men developed hypertension during the course of the study. When other criteria were used such as that of the Framingham Heart Study, the controllers showed a substantially increased rate of hypertension compared to similar age males in this comparison population. We concluded that there was an increased risk for hypertension among the air traffic controller population. Some of this increased risk was associated with (but not necessarily caused by) cardiovascular responsibility to work, as will be discussed later.

A second major category of health change relates to the annual rate of mild to moderate illness. The average number of acute health change episodes for the controller population was approximately 2.5 per year. However, individuals varied significantly with approximately 20% of the men averaged more than five episodes per year and another 20% having had less than one episode per year. These illness episodes were primarily accounted for by upper respiratory infections, minor or moderate injuries, non-specific viral disorders, and acute gastrointestinal syndromes. Although the occurrence of these mild or moderate illnesses did not present a significant risk for future mortality, they were associated with significant numbers of days of restricted activity and could be expected to be a major source of absenteeism.

Although numbers were not large enough to facilitate significant statistical comparisons, we did find that there was a slightly increased risk for developing peptic ulcer in our population. We were unable to study new cases of ulcer disease systematically in terms of what variables were predictive of onset.

Although the methodology for determining psychological health change is not as standardized as that for diagnosing physical health

change, nevertheless we employed a methodology which provided objective assessments by psychology professionals of the prevalence and incidence of psychiatric problems among the men studied, so that we could contrast men who did and did not develop significant psychiatric problems during the course of the study.

About half of the men in our study had at least one psychiatric problem, as defined by our criteria, although most of these did not receive professional treatment. The most prevalent psychiatric difficulty was impulse control disturbances, reflecting the relatively high number of men who manifested an inability to control overt anger, anti-social impulses, or illicit drug use. Alcohol use was quite high, but alcohol abuse was about the same as derived from other survey data. Anxiety and depression were experienced at levels equal to or less than that experienced in general populations of non-patients. The experience of psychiatric problems was not particularly related to FAA performance criteria. Mate role impairment because of psychiatric problems was experienced at approximately the same rate as among an urban community group, and therefore, we would conclude that mate role difficulties caused by psychiatric problems were not more common among air traffic controllers than among others.

Predictors and Correlates of Health Change

Hypertension

We tested many variables to establish their ability to discriminate men who developed hypertension during the course of the study from those who remained normotensive.

One of the best discriminators was the systolic blood pressure responses to work. The men who showed significantly elevated systolic and diastolic blood pressure on the job during their first field study had higher risk of developing hypertension. This was prior to the diagnosis being made by the internist. We also found that future hypertensives were characterized by having less hard driving, more Type B personality, and by having experienced less life change in the past nine months than the individuals who remained normotensive. As a group they were somewhat lower in marital resources. We also found that although their blood pressures in the clinician's office were still normotensive during their first visit, they did show significantly elevated blood pressures compared to those who remained normotensive.

Not only at the first field study, but at field studies throughout the three-year surveillance, the individuals who developed hypertension during the course of the study showed blood pressure responses to work that were greater than the responses of those who

remained normotensive. Their average systolic and diastolic blood pressure at work was significantly elevated. Their blood pressure responses to and at work were just as high as those who already were hypertensive when they came into the study. When the men did more work, those who developed hypertension also exceeded their own average blood pressure level by a greater amount than those who remained normotensive.

When we took into account all factors that were significant predictors of hypertension, i.e., psychological variables, blood pressure levels in the physician's office on intake examination, as well as blood pressure responses to work, we could correctly predict 86% of new cases of hypertension and 82% of those who remained normotensive.

Although these results were clearly highly significant, some qualifications must be added. It is inappropriate to conclude that hypertension is caused by air traffic control work per se. Our interpretation of these findings is that for individuals who are predisposed to developing hypertension by reason of a host of possible genetic and biological factors, exposure to air traffic control work increases the risk or perhaps hastens the rate of their developing hypertension. Given the increased prevalence and incidence of hypertension among air traffic controllers and the evidence that those who develop hypertension have greater physiological responsivity to the work environment, an appropriate conclusion might be that air traffic controlling represents a risk factor interacting with other risk factors in development of hypertension.

It is also important to note several factors that were not associated with the risk for developing hypertension. Controllers who developed hypertension were considered neither more nor less competent than those who did not. They did neither more nor less work than those who remained normotensive, nor did they spend either more or less time on position during the days they were monitored. With respect to the quality of their work, they were neither more nor less likely to receive awards, nor promoted more or less than those who remained normotensive.

However, it should be noted that developing hypertension carried with it a risk for future disqualification. The issue of whether or not controllers should be disqualified for being hypertensive or for being treated for hypertension should be reconsidered. We found that the significant number of men who were hypertensive did as much work on study days and received as high a frequency of competency nominations as those who remained normotensive. We concluded that hypertension per se did not interfere with a person's abilities to control traffic.

Mild and Moderate Health Changes

Although the illnesses and injuries that comprise mild and moderate health changes represent a much less serious risk to future health compared with hypertension, they do account for a very significant amount of time lost from normal activities.

Four diagnostic categories accounted for almost two-thirds of all mild and moderate health changes - respiratory, acute gastrointestinal, non-specific viral syndromes and injuries. As increased incidence of these different mild and moderate health changes was associated with many similar factors, we combined their incidence into an average annualized rate of mild and moderate health change and focused on determining those factors that predicted differences in this rate. We found that there was a tendency for men in the high illness group to be younger and to have less experience with the FAA for their ages. Men in the older groups tended to have less minor illness compared to those in the younger group.

The men who experienced more mild and moderate health change were more invested in their work, and they stated that ATC work "cost" them a lot subjectively (expenditure of efforts to adjust). They reported increased symptoms of anxiety before, during and after work. As with the other variables discussed, their ratings of group morale, made before the collection of illness data, was lower. The high illness group also reported least satisfaction with management and consistently rated their supervisors as showing less than adequate amounts of consideration for others.

Men in the highest illness group were least often chosen as the most amicable or as ideal team members by their co-workers. However, they were not considered less competent by peers, indicating that competence per se is not associated with the risk for more illness.

Men who had higher illness rates were found to be more Type A, i.e., more competitive, hurried, and achievement-oriented than those with lower illness rates, who were more Type B.

One of the strongest predictors of total mild and moderate illness rates was the amount of life change and life stress encountered in the period of time immediately preceding the collection of illness data. Those with higher illness rates had more life changes that distressed them.

The men with higher illness rates also differed significantly in terms of their cardiovascular and endocrine responses in the field. The high illness group showed significantly lower levels of plasma cortisol at work and were more likely to drop in plasma

cortisol levels when there was an increased amount of work, compared to those in the lower illness group. Those men with more illnesses also had lower blood pressure variability at work and, similar to cortisol, showed a diminished responsivity in terms of cardiovascular changes with varying levels of work load. Both of these findings, however, were not predictive in that the lower cortisol and lowered blood pressure variability were observed in the same periods of time as the occurrences of illness. However, men who developed more illness had a lower level of cortisol during the first field study before illness data were collected. Thus, it is likely that the diminished cortisol responsivity is a predictive as well as a correlational finding.

It is also of note that men who showed lower cortisol and blood pressure variability during work and an increased rate of mild to moderate illness also tended to minimize their estimate of the amount of work performed on a given day during field study. In contrast, those with higher levels of cortisol and higher blood pressure variability tended either to report accurately or to exaggerate the amount of work done compared to objective indices of work load.

The fact that individuals who showed lower physiological responses also tended to minimize the amount of work they were doing, and were often among those with more frequent illness, suggests that this increased frequency of illness was not primarily a reflection of a tendency to exaggerate or complain. Other checks that were made supported this conclusion.

We found no relationship between a "faking bad" scale on the California Psychological Inventory (CPI) and various measures of job attitude. This finding suggests that the ATCs responded honestly to questions concerning their job satisfaction and their answers were not part of an attempt to exaggerate difficulties as measured by this scale on the CPI.

We also found that when we compared reported gastrointestinal symptoms with measurements of serum pepsinogen level, individuals who reported continuing gastrointestinal problems had significantly higher levels of serum pepsinogen than others. This supported the interpretation that they were not exaggerating their symptoms, but were experiencing greater GI distress. With respect to upper respiratory infections, we found that among those persons who had greater frequency of this illness, there was increased use of medical care and increased proportion of episodes involving 4 or more days lost from usual activities. In addition, reports of URI symptoms followed known seasonal variations. There was no relationship between the average annual rate of illness and scores on the MMPI hypochondriasis and hysteria scales, indicating that greater frequency of symptoms reported was not a reflection of a psycho-

logical propensity for complaint behavior. Actually the air traffic controllers in our study had a lower score on the hypochondriasis scale than the MMPI standardizing population.

To summarize those variables most related to ATC work, men in the highest illness group tended to be more invested in their work but felt that it cost them a lot, had lower satisfaction with management, had lower group morale, and were more dissatisfied with their supervisors.

Psychiatric Problems

Slightly over one-half of the men experienced one or more significant psychiatric problems during the three years. This finding was not anticipated in light of the information gathered at intake when controllers were not found to have a great excess of psychiatric problems except for the relatively high rate of impulse control difficulties. However, as the study continued we found that more men developed problems and although a relatively few number of men showed chronic problems throughout the entire study, a significant number did show some problem at one time or another. These data suggest that the development of a psychiatric problem was not limited to a very small percentage of controllers, but that over time a larger number of the men did develop some difficulty, even though it may have been resolved by the time of a later examination. This may not be a finding specific to air traffic controllers, but we cannot make comparisons with other groups because no other occupational group has, to our knowledge, been studied so intensively over so long a period with the PSS.

Five areas of psychological problems were assessed systematically. The first was subjective distress, involving significant problems of depression, anxiety, disturbed daily function, disturbed eating and sleeping. Over the three years, only 12.5% of the men had, or developed, a problem in this area. Another major type of psychiatric problem assessed was impulse control disturbances: the inability to control overt anger, anti-social impulses, and illicit drug use. Although illicit drug use was not serious among controllers, there were significant difficulties in controlling anger and anti-social impulses. We found that 12.7% of the controllers had significant impulse control disturbances at the first exam at intake, and over the three years, 30% of the controllers developed significant impulse control disturbances at least once. We also evaluated work role disturbances associated with psychiatric problems and assessed difficulty in mate role relationship. Twenty percent of the controllers did experience some mate role problems over the three years in the study.

Alcohol use was high. Over 50% of the controllers were classi-

fied as heavy drinkers, a higher rate than that derived from survey data. However, only 7.5% of the men at intake had significant problems in alcohol abuse despite the high use of alcohol often associated with social drinking after work. Only four men had physiological symptoms of alcoholism, a low rate of 1%.

Although these data clearly support the conclusion that there was a significant amount of emotional distress in our controller population, perhaps the impact of this area of difficulty can best be appreciated by the relationship between the findings on our psychiatric evaluations and the rate of medical disqualifications. We found that of all the men who completed all 5 of the psychiatric evaluations in this study, 20 were subsequently medically disqualified by the FAA. Of these 20, 19 were found to have had significant psychiatric problems. Thus, the risk for disqualification was greatly enhanced in those individuals who developed psychiatric problems. Some of those who were disqualified had psychiatric problems at intake and hence, this was a correlational and not predictive finding. However, those who developed psychiatric problems during the course of the study also had a significant risk of being disqualified later and hence a predictive relationship was also suggested.

There were many variables that predicted psychiatric problems. Although the predictors assessed at intake were not uniformly associated with all five problem areas (subjective distress, impulse disorders, alcohol abuse, male and work role pathology), there were a sufficient number common to more than one area so that a general pattern emerged.

The men who developed psychiatric problems were significantly lower in their satisfaction at work, their satisfaction with co-workers and their ability to discharge tensions following work. Similar to the finding for mild to moderate illness, these men had high investment in work and reported high subjective cost associated with being air traffic controllers. They also reported an increased tendency to cope with stress on the job by drinking after work and showed lower amounts of coping by other activities such as physical exercise.

From the perspective of stable personality characteristics, they also showed more Type A behavior - more competitive and hard driving, and experienced more life change in the period of time prior to the development of problems. Thus, in many ways the men who developed psychiatric problems showed significant similarities with those who had higher rate of mild to moderate illness. One might ask, therefore, if these were the same men. Were difficulties in the psychiatric area and medical area showing up in the same individuals? Was there one healthy and one sick group. This turned out not to be

the case. The men who developed psychiatric problems did not have significantly more mild or moderate illnesses, nor did they have more hypertension. We found essentially no relationship between these three major categories of health outcome. That is to say, the men who developed hypertension were no more likely than others to have mild and moderate illnesses and no more likely than others to develop psychiatric problems.

This finding supports the specificity hypothesis in psychosomatic medicine which, simply stated, emphasizes that different individuals will develop different problems despite the fact that they may be exposed to similar difficulties or similar problems in their psychosocial environment. For psychiatric illness and mild to moderate illness, several common themes clearly emerge. The work environment seems to be more implicated in the risk for developing health change than the work activity itself. Men who developed more mild or moderate illness or who developed psychiatric problems did neither more nor less work when observed during the field studies. They spent neither more nor less time on position nor did they control more or fewer planes. It was also noted that they were not considered less competent by their peers, although they may have been less frequently chosen as amicable or less likely to be nominated as an ideal team member. Because of these findings, one may not conclude that individuals who develop more mild or moderate illness such as flu or psychiatric problems were poorer controllers or did less work.

One is led to the conclusion that these individuals are more at odds with their work environment. As noted, they are often highly invested in being controllers although they find themselves less able to discharge tensions associated with work. Hence they find that functioning as controllers is associated with an increased cost in terms of their personal lives and psychological health. This finding of "It's not so much what they are doing as the context in which they are doing it" holds definite implications for changes that might be considered in the work environment to reduce the risk for future morbidity.

Job Outcome

We analyzed our findings to see if we could predict job outcomes that clearly involved important career changes. We looked at individuals who were disqualified for medical reasons during the course of the study, those who were promoted, and those who developed signs or symptoms of burnout.

We compared the disqualification rate for our controllers with that of controllers from the same facilities who were not studied, and found significant differences. It was clear that our controllers

experienced a lower disqualification rate as compared to those not studied, although we were not able to control statistically for age and years of experience in the two groups. This finding suggests that at least our men were not sicker or in worse health than those who were not studied and also suggests that our findings are on the conservative side. If we included those other men who were not in our study, we might have found a higher disqualification rate. We also found that the men whom we studied had 1.7 times the promotion rate of those not studied. This finding also suggests that we may well have studied controllers who were as good as, if not more competent, than those in the same facilities who were not studied.

Men in our study group who became disqualified were nominated less often for ideal team choices and were also nominated less often for competence. They showed lower investment in their jobs compared to those who remained active journeymen. They also showed lower marital resources and were different on four scales of the CPI. They had diminished feelings of well being, lower responsibility, lower tolerance, and lower intellectual efficiency. As some of the men were disqualified following the first round, and were already in disqualification procedure, their answers at the entry exam were no doubt in some ways affected by the proceedings underway.

We were able to compare the 49 men who received promotions to supervisor during the course of the study with those who remained in the study and were not promoted. Many factors that predicted promotion were consistent with expectation. The controllers who were promoted were slightly older and had slightly more years of experience. They were highly invested in their job and they were also chosen more frequently by their peers for increased competence as controllers. They showed higher self and group morale and more satisfaction with management policy, specifically satisfaction with promotion and pay. They were higher on the dominance scale of the CPI. They were also more Type A, with more job involvement and more hard driving behavior. However, the controllers who were promoted also manifested increased concern for burnout during the entry examination. They reported that they had less ability to bounce back to full controlling capabilities when the workload changed from light to heavy and were more likely to burnout than those who remained active controllers. This increased concern with burnout occurred at about the same time that they received increased competence nominations. Therefore, one might conclude that although their peers rated them higher than those who were not promoted, the men themselves reported increased concern about burning out and less ability to bounce back on the job.

In summary, these data support the view that the controllers who were promoted were doing a good job as judged by their peers, regarded as more competent, were highly involved in their work, were more satisfied with management, were slightly older and had more experience

and were more hard driving. However, it is also noteworthy that they showed increased concern about burnout despite the fact that they were considered more competent by their peers and were chosen for promotion by management.

We were interested in knowing whether or not we could discriminate between those who developed burnout and those who did not by means of data collected in the first two rounds of exam. We found that those individuals who later developed burnout, by our definition, scored significantly higher on a number of positive factors or variables early in the study. They had more vigor, friendliness, and elation on the Profile of Moods State (POMS). They showed less anxiety regarding work and a higher tension discharge rate. They coped by drinking less often and showed less anxiety. They also showed more assertiveness (interested in doing a good job as a controller) and they showed more coping by physical activity. It thus appeared that individuals who later developed burnout showed more psychological health early in the study than the comparison group. They did not start out as dissatisfied or having more anxiety but rather were committed and, from their own estimation as well as that of peers, were functioning as well or better than others.

However, the men who developed burnout by Round 5 showed an increased incidence of subjective distress. It is apparent that although they started out feeling good about themselves and scoring low on psychological distress in the beginning, during the course of the study they showed increased psychological problems.

It is notable that individuals who developed burnout did not show any differences in the average amount of work done or in time spent on position during field studies. Furthermore, they showed no differences in physiological measures taken at work, i.e., cortisol levels or blood pressure responses. Nor did they show a higher incidence of hypertension or higher incidence of mild to moderate health change. From these data it is apparent that their physical health, at least during the three years that they were studied, did not show deterioration. However, as their burnout status was associated with increased incidence of psychological problems, if they were followed for a longer period of time, the effect of increasing psychological problems might place them at risk for future medical disqualification.

In some ways the men who developed burnout showed some of the characteristics observed in the men at intake who were later promoted. This suggests that competent controllers can and do experience concern about burnout and as a matter of fact, air traffic controllers with such concerns may frequently be represented among individuals who are promoted. These findings suggest that burnout is not necessarily characteristic of individuals who are considered less competent.

controllers, but may be related to an apprehension that one will not be as good as one has been, and will fall in the estimation of one's peers. The anticipation of this fact may function in some ways as a self-fulfilling prophecy such that some of the men may convince themselves that they will not function as well and, in time, it turns out to be correct.

Implications

Our study was oriented toward the task of discriminating between men who showed a deterioration in health and those who remained essentially without symptoms or illnesses in any given category. For some of the illnesses we observed, such as hypertension, we could compare controllers to other groups. With respect to psychiatric illness, this was more difficult as prevalence data is not as readily available.

We did find that the controllers had more hypertension than other groups, and possibly some forms of psychiatric problems were also more prevalent. However, the implications of our findings are based primarily on the differences we observed between men who developed health changes in a given area and those who did not.

Our findings are in many ways different from our expectations, especially with regard to the predictors of psychiatric illness and mild to moderate physical health problems. However, despite the fact that different men had different illness problems and relatively few had no problems at all, several themes emerged from our data. One cannot help but be impressed that controllers who perceived their work environment negatively, who were dissatisfied with work, with their co-workers, or with the FAA, showed a significantly increased risk for developing either psychological disorders or mild medical illness. We did not find that those men who developed more physical or psychological problems spent less time working, nor were they rated less competent by their peers. We did find that they felt estranged or alienated from their work and this occurred despite the fact that they said they enjoyed air traffic controller work. They were usually more invested in doing a good job, even though they could not discharge their tensions well after work, and too often they used alcohol as a way of coping.

These findings suggest that it was not so much what they were doing but the context in which they were doing it and the attitudes and feelings they had about their situation that influenced their risk for health change. We were surprised by the relative importance of attitudes about work in predicting health change. We had expected that the work load itself during field studies would have stronger predictive power than it turned out to have. The consistency of these results, which might be summarized as the alienation controllers

experience from their work environment, suggests that changes should be made in this environment and in the way it is experienced. We believe that dissatisfaction with FAA management policies are a significant problem and represent part of the negative set associated with an increased risk for health change.

We also believe that some of the divisiveness that the controllers experience may in part derive from union-management interactions. Thus, despite controllers' perceptions of many positive benefits derived from the growing strength of PATCO, some of the alienation and divisiveness controllers often experience may be an unexpected and unwanted side effect of the adversary relationship between union and management. One of the recommendations for change coming from this study is that attempts be made to improve the work environment, to diminish the degree of dissatisfaction or alienation that controllers feel. Our interpretation is that this is not solely a matter of working hours or of pay, but that there is a need to improve the communication between management and individual controllers and to attempt to limit the adversary nature of their relationship. It is our view that this could be accomplished by a cooperative effort between the FAA and union management and that individual controllers would significantly benefit from such a reduction of controversy in their work environment.

The predictors of hypertension are in a different cluster and have different implications from those predicting psychological problems and mild or moderate illnesses. Air traffic control work per se has a closer relationship to development of hypertension than for other illnesses. Individuals who developed hypertension did not report as high a degree of work dissatisfaction or general alienation with management as those who developed other problems. It does appear that for individuals who, for a variety of genetic and as yet poorly understood biological factors are predisposed to develop hypertension, increased workload adds to the risk for developing hypertension. These men do show greater blood pressure responses to increased work and this increased cardiovascular responsiveness to work is a major predictor of developing hypertension. This finding, taken along with the observation that hypertension is generally more prevalent among controllers than among others, suggests the possibility that interventions might be attempted on an experimental basis to try to minimize this increased cardiovascular responsiveness. Perhaps controllers could be taught procedures to minimize cardiovascular responses to work, by using relaxation or biofeedback techniques. Various interventions might be employed on a trial basis to see whether any might be effective.

Other interventions of more proven benefit should be provided on a voluntary basis to attempt to reduce psychiatric morbidity. For example, provision might be made for counseling of individuals who

are at increased risk for developing psychological or physical health.

By the time an individual becomes a journeyman controller, he has undergone three to five years of training as a developmental. There has been a considerable investment of time and money to help him acquire his controlling skills. Our data support the notion that controllers are concerned with burning out and being less able to control aircraft efficiently. The period of maximum productivity as controller is a limited one, perhaps 10, 15, but not more than 20 years. Medical disqualification is a problem for the individual controller and represents a significant burden financially to the agency and the government. It is one of our conclusions that interventions be attempted to maximize the period of time that controllers can function productively. A variety of interventions might be considered, and we can do no more than suggest them as our study was not primarily oriented toward a trial of interventions but toward a determination of the nature of the problems and the factors that might predict them. We know that individual controllers who are at increased risk for psychiatric problems can be identified early and provided counseling or treatment. We feel that some selection process might be employed to select controllers who are more mature, with a lower propensity for impulsiveness. Some interventions to reduce blood pressure variability in those controllers who experienced it at work are worth trying in an effort to delay the onset of hypertension. These are strategies designed to help the individual controllers.

Our data also suggest another intervention not oriented toward the individual but toward the relationship of the controller to management and the agency. There seems to be considerable general dissatisfaction among the controllers with FAA management. Those who showed the most dissatisfaction towards work, co-workers, and the FAA had a significantly increased risk for health change. We feel that some union activities may inadvertently have contributed to the alienation and divisiveness many controllers experience in the ongoing adversarial relations with the agency. We therefore suggest that an organizational development program be undertaken with joint union management cooperation to improve work life. If successful, such a change might be most beneficial for reducing the risk for future health change among controllers.

II. INTRODUCTION

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A. Background of Problems and Rationale for the Study

This study of health change in air traffic controllers was preceded by years of controversy over alleged difficulties and effects of the work on the health of the controllers. Although the popular press gave dramatic attention to the struggles of air traffic controllers to perform their job through manifold difficulties, emphasizing the negative effects on the health of these men, no comprehensive study of the physical and psychological health changes in controllers had been made. Several events occurring in close proximity, however, focused on a need for such a study and led eventually to the initiation of the present study in 1973.

Although air operations in the United States had increased 100% between 1960 and 1970, the number of qualified controllers increased only 10% during that same period, according to Federal Aviation Administration (FAA) data (Walton, 1977). This discrepancy arose in part because of the length of training required and in part because of a moratorium on hiring during the previous several years. As a consequence, journeyman controllers were required to work extra shifts, long hours, more aircraft per controller, and often without even a lunch break. By 1968-1969, the increase in difficulties resulted in a series of work slowdowns, in which controllers enforced air traffic regulations strictly, regardless of the inconvenience caused. In addition large numbers of men called in sick over a period of several months, exacerbating the effect of the slowdowns. When the labor-management disputes were settled sufficiently to get air traffic moving again, a commission was set up to investigate many of the issues that had been raised. The commission's findings were published in the Corson Report (Corson et al., 1970), and among a multitude of recommendations was one which suggested that the FAA needed to document not only the degree of job stress in air traffic control work, but also the impact this stress might have on the physical and psychological health of controllers.

The Office of Aviation Medicine at the FAA and the Professional Air Traffic Controllers Organization (PATCO) subsequently sponsored several studies in an attempt to answer some of the questions raised in the Corson Report.

One of these studies (Cobb and Rose, 1973) was a retrospective comparison of illness rates among controllers with those of other men involved in the aviation industry. The retrospective comparison was made by examining the medical records of 4,325 air traffic controllers and those of 8,435 other men involved in the aviation industry. Comparable records were available because both groups of men were required to obtain yearly medical examinations from the same group of designated physicians (Aeromedical Examiners) for relicensure in

commercial or general aviation. This medical record study revealed a number of important differences between the controllers and the others in disease prevalence (existing cases) and disease incidence (new cases).

The largest difference between controllers and the other aviation group occurred for hypertensive disease. The controllers were found to have 5.6 times the incidence of new cases of hypertension in 1969 to 1970 that the other group of aviation men had. The prevalence of diagnosed hypertension in the air traffic controllers was found to be 4 times that in the control group. Some of the difference in the prevalence rate could have been attributable to a preselection factor since 17% of candidates for relicensure in aviation jobs other than controller had been disqualified because they had pre-existing hypertension, and were not, therefore, in the control group. In contrast, only 3% had been excluded because of pre-existing hypertension from the air traffic controller group. However, the six-fold difference in the incidence of hypertension could not be explained by the possible selection bias. That is, the occurrence of new cases of hypertension was independent, by definition, of any possible bias before relicensure, all men in both groups starting off after relicensure with a clean bill of health.

Controllers were found to have ulcer disease and diabetes more frequently than the control group, although the comparative rates of these diseases were less dramatic than hypertension. These findings strongly suggested that a prospective study should be undertaken to clarify what factors might be relevant to the increased rate of illness from these diseases among controllers, as well as to determine risks for other health changes.

As a result of the Corson Report, the several retrospective studies, and the limitations inherent in existing findings, a five and one-half year contract was awarded to Boston University School of Medicine in 1973 to conduct a biomedical, prospective study to determine the kinds and degree of health changes occurring in air traffic controllers and the extent to which these health changes might be predicted by other factors.

B. General Hypotheses and Specific Issues to be Investigated

The study was designed to assess the individual and interactive relationship between health change and the following major factors, whose relevance was suggested by available information: work environment, years on the job, physiological differences in response to stress, occurrence of significant life events, work attitude and morale, availability and usefulness of psychosocial supports, job commitment, job performance and enduring personality traits and characteristics. Moreover, it was specified that the factual data collected and the interpretation of the data should be in a form readily addressable to the following questions and issues:

1. What is the nature, derivation, extent and significance of health changes among air traffic controllers? How do these health changes affect performance and career longevity?
2. Do controllers experience stress? If so, what is the nature and extent of the stress? How much is related to the job? What causes it? To what job conditions, including social and psychological forces or factors, does it relate?
3. To what extent do management, supervision and manpower management policies, practices, programs or procedures contribute to health changes and especially to the degree of stress present in the air traffic controller job; e.g., does how work is defined, work schedules, hours on duty, and the length of work periods, etc., relate to stress, and if so, how?
4. Are there predictive factors or measures that could be applied before employment of air traffic controllers which would indicate to management officials which candidates might be more prone to deleterious health changes?
5. Are there ways by which individuals can be identified who need counseling or help due to their increased potential risk for illness? Is this risk increased because of their particular personalities, their family problems or the nature of the working environment they are in?
6. How do the stress levels in the air traffic occupation compare with other occupations, e.g., pilots, business executives, etc.? Although the data collected in this study may not provide for direct comparison of air traffic controllers with other individuals in other occupations,

attempts should be made to compare the results that are obtained with those from other investigators studying other occupations.

7. Is there a "burnout" phenomenon? If so, what is it?
 - a. Can the individuals who are more prone to early physical deterioration be identified?
 - b. Can we identify work situations that are more prone to produce widespread early physical deterioration than other work situations may be, so that early counseling and other career possibilities can be identified and considered?

Although specific questions and issues of concern to the FAA were framed for our information, we were directed to proceed with the study of factors we considered to be relevant. We attempted to heed, however the advice that our data should be presented in a way that would allow these questions and issues to be answered by the sponsors (FAA) and collaborating supporters (PATCO) of the study.

C. Overview of Methodology

Previous Research Findings Providing a Focus for the ATC HCS

The concepts that social, psychological, vocational, environmental and other events may influence health is an ancient one, but more intense interest and increasingly rigorous scientific studies emerged only relatively recently. Flanders Dunbar and other clinicians and researchers who were interested in what is now known as psychosomatic medicine reported numerous clinical case histories from which clues emerge regarding potentially relevant variables to be studied systematically (Alexander, 1934, 1939; Cobb, 1943; Dunbar, 1954; Hinkle, et al., 1957, 1958; Engel, et al., 1956). Based on the many suggestive findings of these earlier investigators, recent rchars have selected and rigorously pursued certain areas of investigation which may be crucial in determining the extent to which social and psychological factors influence health (Weiner, 1977). Included among these crucial areas individual differences in hormonal (Wolff et al., 1964; Mason, 1968; Rose et al., 1968) and cardiovascular (Murawski et al., 1968; Riess et al., 1968; Herd et al., 1969; Reiser et al., 1962) responses to stressful stimuli, the impact of life events (Rahe et al., 1964; Rahe, 1968; Dohrenwend and Dohrenwend, 1974), individual differences in ability to adapt to changes in environmental demands (Carlestam, 1971; Stokols, 1972; Henry, 1956; Sandberg and Barding, 1976), and individual differences in behavioral life styles (Paffenbarger, 1968; Jenkins, 1971; Jorgensen and Gyntelberg, 1976). Most of these areas have, besides important theoretical underpinnings, an associated methodology for reliable measurement. There is evidence that each of these areas may be related to the risk for future health change. Given reliable methodology and evidence of their relevance to health change, these areas served to focus our selection of variables for this study.

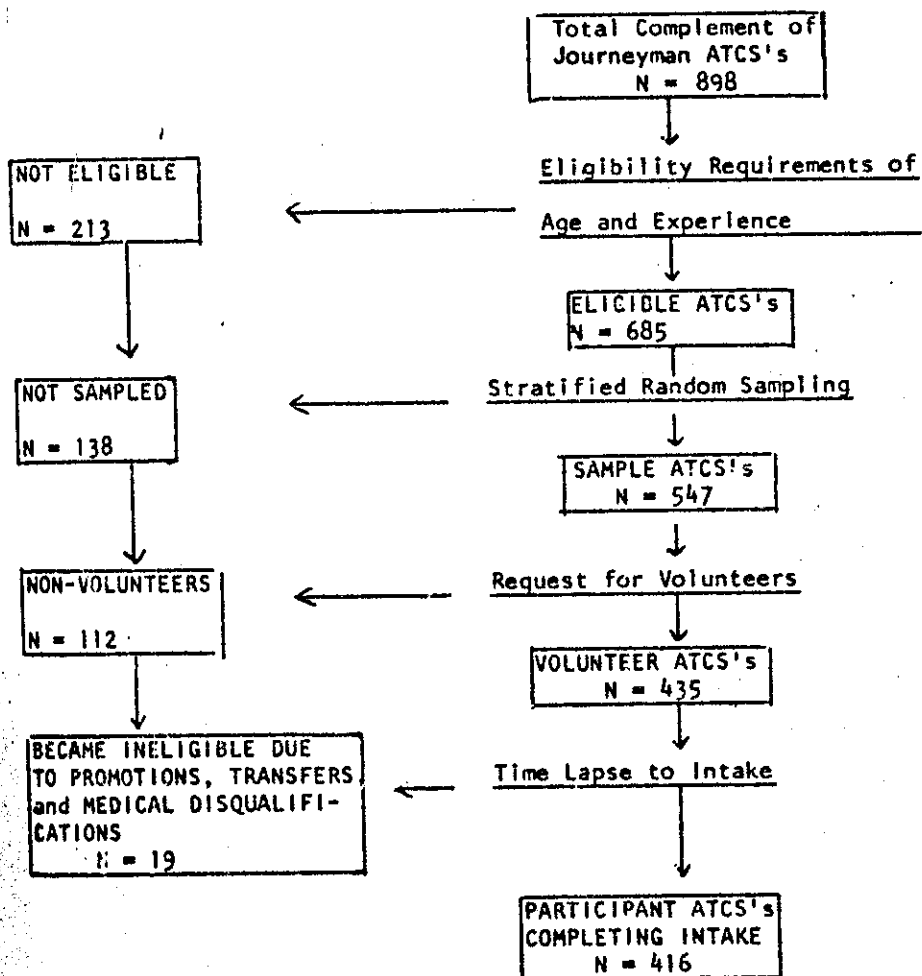
Epidemiological Model - Population at Risk

In order to assess the contribution of biological, psychological and social variables to risk for future illness among air traffic controllers, an epidemiological model was chosen in planning this study. Implementation of the research model would require that the study be prospective and longitudinal in design, with concurrent measurement in all of the participants of all variables considered to be relevant and that the data to be collected would be specified in advance. In addition, all subjects would receive equal surveillance for the detection of any illness.

The study was to be based on a probability sample of journeyman controllers from various facilities in New York and New England. The overall sampling procedure is shown in Table 1. Since we

TABLE 1

Overall Sampling for
the Air Traffic Control Specialist (ATCS)
Health Change Study



wished to assess the possible independent influence of age and years of experience on the job upon the risk for becoming ill, we attempted to dissociate age and years of experience, although the two are highly correlated. We therefore sought to include as many younger men as possible with many years of experience, as well as older men with fewer years of experience. In addition, we needed to study men who would continue on the job over the course of the study. Therefore, trainees (who might be washed out) and men who could retire before the end of the study (by becoming 55 years of age or by having more than 20 years of experience) were excluded. Journeyman controllers assigned to positions without continual responsibilities for actively separating aircraft (supervisors, data specialists, and so on) were excluded because they were not exposed sufficiently to the main risk factor of the study: controlling aircraft. Finally men on medical waivers were not eligible because of their pre-existing conditions.

After we applied these criteria, 635 men were eligible for the study. Stratified random sampling was applied to maximize the age and experience dissociation. A sample of 547 journeyman air traffic controllers in selected sites in New England and New York was identified. After extensive briefing on the nature of the study, 435 men volunteered to participate and signed informed consent forms, a 79.5% volunteer rate from the 547 men invited to participate. For various reasons (see Table 1), 19 of the 435 volunteers dropped out and 416 (95.6%) completed their intake examinations. The average age of the 416 participants was 36.2 years with a range of 25 to 49 years. In spite of the differences in sampling, this figure compares well with the average of 36.6 years reported by Karson and O'Dell (1974) for a national sample of 11,047 center and tower controllers. The average years of experience of our sample was 11.2 with a range of 3 to 20 years.

Although it would have been more desirable to study a national sample of controllers, the logistics of the study dictated that facilities from which men were drawn should be restricted to the New York and New England regions. The participants were drawn to represent both major categories of facilities where most controllers work -- centers and towers (airports). Among the Air Route Traffic Control Centers (ARTCCs) responsible throughout the country for separating aircraft en route from one airport to another, the Center located in Nashua, New Hampshire controls most of the air space over New England. One hundred and seven men (26% of our sample) volunteered from this facility to participate in our study. The other Center from which men were selected to participate is responsible for the air space between the New England and Washington Centers, including New York, most of Pennsylvania and New Jersey and parts of other states. The New York ARTCC is located in Islip, Long Island, and is one of the busiest Centers in the country, averaging approximately 40% more operations per year than in New

England. The New York ARTCC provided 41% of our sample, or 172 men. The remaining 33% of the sample (137 men) were selected from the Boston Tower at Logan Airport (34 men), from the New York Common IFR Room (66 men), which provides radar control for the entire New York City area, and from a number of smaller facilities with less dense air traffic, all located in New England. A total of 37 men were drawn from the Hartford-Springfield Airport (Bradley Field), Otis and Quonset radar facilities and Providence Tower (Green Airport). The total selection represented facilities with higher and lower traffic density, including centers, airports and small radar en route facilities (TRACONS). A summary of the sampling results by facility, age, and experience groupings is given in Table 2.

Throughout the study there was a continuing gradual attrition of participants. The attrition after intake into the study is summarized in Table 3. Most of the men who discontinued their participation were forced to do so because of promotion to supervisory or data systems specialist jobs which were not included in the study, or because of transfer to other facilities not represented in the study. Of the 133 men who had withdrawn between Rounds 1 and 5 of the physical examinations, only 24 did so for personal reasons, while the others were required to withdraw by the eligibility criteria. However most of the men who withdrew at various times after the intake examination agreed to return for the final examination three years after intake. The report therefore includes data on their major health changes but not on more minor transient health changes.

In order to assure that the continuing attrition did not bias unduly the sample remaining an analysis was made of the age and years of service of those who dropped out. Table 4 displays this data. Although there are apparent differences in the age and experience between the participants and those who had been disqualified from the study by any given examination, the differences were not significant statistically ($p > .10$). There were significant differences in the age and experience of men from different facilities ($p < .02$), with younger and less experienced men at smaller facilities. This was due to the composition and stratified sampling procedure. However, this difference between facilities was maintained in spite of the disqualified volunteers at each examination. Consequently these data clearly indicate that no bias was introduced in our original age and experience sampling by subsequent disqualifications from the study.

Later in this report we compare the disqualified men on a number of characteristics. These comparisons are made to investigate differences between those promoted and those not promoted; those transferred and those not; those medically disqualified and those

TABLE 2
Summary of Volunteer Rate As Of September 1974

FACILITY	STATUS	GROUP:				TOTAL
		25-37 1-7	11 25-37 10-15	111 38-49 10-15	IV 38-49 16-20	
ISLIP	# eligible # volunteered	64 55	59 57	39 34	48 42	210 188
HASHUA	# eligible # volunteered	33 28	29 23	57 35	32 23	151 109
LOGAN	# eligible # volunteered	17 14	15 9	13 8	8 4	53 35
OTHER	# eligible # volunteered	23 17	6 5	16 9	10 5	55 36
IFR ROOM	# eligible # volunteered	25 22	23 21	18 14	12 10	78 67
TOTALS	# eligible # volunteered	162 136	132 115	143 100	110 84	547 435

TABLE 4

Comparison Of Age And Experience Between Participants And Disqualified Volunteers Cumulatively Across Examinations

Examination Number	Subject Status	FACILITY					Overall Mean
		Boston ARICC	New York ARICC	Logan	Others	Common IFR Room	
2	Participants	37.5	35.9	34.9	36.1	35.1	36.1
	Disqualified	37.2	39.6	36.0	32.3	37.4	37.3
3	Participants	37.4	35.7	34.6	36.2	34.6	35.9
	Disqualified	37.7	38.0	36.7	32.0	38.3	37.5
4	Participants	37.3	35.6	35.7	36.5	34.9	36.0
	Disqualified	37.9	37.8	33.9	33.3	36.3	36.6
5	Participants	37.3	35.4	35.5	35.9	35.0	35.9
	Disqualified	37.9	37.8	34.4	35.4	35.9	36.8
2	Participants	12.0	11.3	10.0	10.0	10.3	11.1
	Disqualified	11.0	13.8	12.5	7.3	14.2	12.2
3	Participants	11.9	11.2	9.6	10.1	9.9	10.9
	Disqualified	12.3	13.1	12.5	6.8	13.5	12.5
4	Participants	11.7	11.0	10.7	10.4	10.2	11.0
	Disqualified	12.7	13.2	9.3	7.5	11.5	11.7
5	Participants	11.6	10.7	10.5	10.0	10.3	10.8
	Disqualified	12.6	13.4	9.7	9.3	11.1	11.9

not; and those who withdrew for personal reasons. As these comparisons are made on the criterion variables, physical health change, psychological health change, and job outcomes, they are discussed in the sections on study findings.

Domains of Data

The predictor variables selected for their suggested relevance to health changes were classified into the following ten domains for data collection and analysis:

1. Socio-demographic characteristics, including social background and early life, as well as current life variables,
2. Health history and health-related behavior, including family history of disease, personal health, illness at intake, health-related behaviors,
3. Personality characteristics measured by such tests and surveys as the California Psychological Inventory, the Jenkins Activity Survey, the Cattell 16 Personality Factors Questionnaire, and scales for measurement of such characteristics as anomie and "connectedness";
4. Marital, family and social supports, each assessed by several different coping scales;
5. Job-related characteristics, including specific ATC variables such as attitudes about skills and investment in the job, affective discomfort, including work anxiety, subjective costs, burnout-bounceback, shift change costs, training anxiety, incident anxiety and adaptive styles including coping by drinking, work avoidance, tension discharge rate, coping by physical activity, and attitudes toward the FAA including satisfactions with management, training and promotions. Other job-related variables included are general satisfactions such as self morale or group morale, and specific satisfactions including work, co-worker and pay satisfactions and supervisory descriptions including initiation of structure, consideration of others and tolerance of freedom;
6. Life changes in work, relocation, education, legal, financial, marital, family, children, personal and interpersonal areas of life,
7. Measurement of air traffic controller work load and special problems such as weather, traffic blockages and equipment failure;

8. Psychological and behavioral measures at work;
9. Cardiovascular measures at work;
10. Endocrine measures at work;

Table 5 lists the predictor variables and the instrument or technique used to measure them as well as the frequency of observation. Each variable is described in turn in Section III, Descriptive Findings, and the rationale for its selection is reported along with the descriptive findings. Those variables found to have predictive value are discussed in this respect in Section V, Predictive Findings.

Plan for Data Analysis

The prospective, repeated-measures design of this study suggested five basic models for analysis using both parametric and non-parametric techniques. These included (1) predictions from intake status, (2) predictions from early dynamic changes, (3) retrospective group comparisons, (4) combinations of these three, and (5) what we called "sliding interval analyses".

The predictions of health change from predictor variables measured at intake were based on parametric forms of statistical analysis such as multiple regression and canonical analysis where outcomes were continuous or multi-variate, or the predictions were tested by simple chi-square analyses where predictors and outcomes were both categorical. The strength of this model lay in its simplicity for clarifying relationships between independent and criterion variables in a time-dependent, though not necessarily causal, sequence.

The second model for analysis was based on the fact that we had repeated measures of our independent variables. The prototypical question to be raised with this model was: Does early change predict later change? The same types of statistical analyses that were applicable for the first model applied to this second model as well. However, since changes were analyzed with respect to other changes, adjustments for initial levels and the reliability of assessments were important. The importance of such adjustments stems from the heightened probability of correlating chance fluctuations with other chance fluctuations in dynamic predictions. We did not emphasize this model of analysis for these reasons.

The third model for analysis was based on criterion group comparisons of prospective intake data. In this type of analysis we attempted to answer such questions as: What was different three years ago between those who have become ill and those who have

TABLE 5

Predictor Variables

Generic Variable	Instrument or Technique	Frequency of Observation				
		1	2	3	4	5
					Yearly	
					Twice	
					Four times	
1. Socio-demographic characteristics (e.g. social background and early life, current life situation)	Biographical Questionnaire	X				
2. Health history and health-related behavior (e.g. family history of disease, personal health history, health-related behavior)	Medical Questionnaire Medical history (family and personal) Update on medical history Smoking eating, drinking habits, medications and review of systems in the interim SMA - 12, Rd.1, Audiological Exam	X	X	X	X	X
3. Personality characteristics, including anomie, "connectedness"	CPI, JAS Boston Health Study Questionnaire MMPI subscales Interview ratings ATC Questionnaire "anomie" scale		X	X	X	
4. Marital, family and social supports including marital resources, social coping, biographical items	ATC Questionnaire	X	X	X	X	X

TABLE 5 cont'd.

Predictor Variables

Generic Variable	Instrument or Technique	Frequency of Observation				
		1	2	3	4	5
		Yearly	Twice	Yearly	Twice	Four times
5. Job-related characteristics, including:						
a. Attitudes, investment;		X	X	X	X	X
b. Affective discomfort, including anxiety factor, subjective costs, burnout-bouncetack, shift change costs, training anxiety, incident anxiety;	ATC Questionnaire Job Description Inventory, including Leadership Behavior Scale, Kavanagh Life Attitude Profile, Satisfaction with FAA Policies scale	X	X	X	X	X
c. Adaptive styles; including coping by drinking, work avoidance, tension discharge rate, coping by physical activity;	Sociometric Questionnaire	X	X	X	X	X
d. Attitudes toward FAA including satisfactions with management, training and promotions;						
e. General satisfactions including self-morale or group morale;						
f. Specific satisfactions including work, co-worker and pay satisfactions. Supervisory descriptions including initiation of structure, consideration of others tolerance of freedom;						
g. Work competence - peer competence, amicability, ideal team choice						
6. Impact of life changes	Review of Life Experiences (ROLE), life change inventory with standardized and individual adjustment and distress ratings	X	X	X	X	X

TABLE 5 cont'd.

Predictor Variables

Generic Variable	Instrument or Technique	Frequency of Observation				
		Visit	Yearly	Twice	Four times	
7. Air traffic controller work load including work, pace, and time loads, and special problems of weather, traffic blockages, equipment failure. Exposure to ATC work	Measures of workload made by trained observe's. Subjective Difficulty (of day's work) Questionnaire Questionnaire on assignment to tasks other than ATC					X
8. Psychological and behavioral measures at work including relationship of workload to self-report of difficulty	Profile of Mood State Questionnaire (before start of work) Behavior Rating Scale Subjective Difficulty Questionnaire Measures of workload		X			X X X X
9. Cardiovascular measures at work	BP and HR responses each 20 min. for 5 hrs. while working					X
10. Endocrine measures at work	Cortisol and growth hormone levels each 20 min. for 5 hrs. while working					X

remained disease-free? In this model, the groups of interest were defined at the end of the study and then their data at the beginning of the study were compared by means of analysis of variance, chi-square, or discriminant/classification analysis. This model of analysis was a primary one since it yielded more easily presentable results.

The fourth model for analysis was an amalgam of those presented thus far: that is, two prospective groups were formed, one composed of those subjects who were relatively healthy at intake and one composed of those who were ill in some way. The two groups were then studied using the predictive intake and retrospective criterion models. The results from the study of the healthy group indicated what variables may have an etiological role as risk factors in the development and onset of more acute illnesses. Since both groups were part of the same initial study population and since both would have been exposed to essentially the same occupational environment, variables that showed significant relationship to health change in both groups should be of highest priority for further research and action.

Probably our most important and robust model for analysis was what we called "sliding interval analysis." This model was needed for several reasons. Major illnesses and injuries are relatively infrequent in healthy persons ages 25 to 50 years. This fact, coupled with the size of the study sample in the ATC HCS meant that there were relatively few cases of severe illness or major injury occurring in any one interval (the approximate 9-month span between examinations at Boston University Medical Center) of the three-year surveillance period of the ATC HCS. It was necessary, therefore, to combine new health change events over several intervals to obtain a sufficient sample of cases for an adequate statistical search for predictors of the health changes. In addition, it was necessary to use measurements made as close in time as possible to the onset of illness or injury while still avoiding data which was collected after the subject was aware of the presence of a health change. These methodological necessities were resolved by use of a technique standard to epidemiologic studies of acute conditions. This technique has often been used to trace the specific cause of common-source infections. In this method, the time of the onset of symptoms is designated Time 0. Even though the actual onset of symptoms may differ widely for different individuals, for purposes of study the onset is designated as Time 0 for each. Antecedent behaviors and exposures for each case are gathered by interview or other means, and placed in a time frame, which for each individual counts backward from Time 0.

Using the same approach, we designated the interval in which a serious illness or injury occurred as Time 0 for each man, and

then used as predictors all information gathered at the preceding physical and psychological examination.

The question then arose as to which data were to be selected as comparable predictors for the control group of ATCs who remained healthy. One possible approach was to use predictor data from the intake examination for all healthy persons, and compare it to the data for the illness cases. This introduced time biases inasmuch as the predictor data for the illness cases were derived from examinations 1 through 4. Another approach was to select all data for healthy persons from the second or third examination inasmuch as it was midway in the series. This also introduced a number of biases, such as the familiarization effect which occurs with repeated visits to the examination site, changes in interviewers and modification of the test forms over time, and secular changes at local facilities and in agency policies. In many facilities and for many controllers, conditions were different at Examination 2 from those at Examination 1 or 4.

A procedure that eliminated all of these problems -- and the methodological approach that we finally selected -- was to determine the proportion of cases for whom the pre-onset examination was the first, second, third or fourth round of examinations in the study. We then applied these same proportions to the control sample which remained free of disease, and selected the relative frequency of data from Rounds 1, 2, 3 and 4 for the healthy controls that would provide a match for the rounds contributing data for the men with health changes. Thus, if 10%, 20%, 40%, and 30% of cases had Rounds 1, 2, 3, 4, respectively, as their pre-onset examination, the healthy control group would be identified and a random 10%, 20%, 40%, 30% would have their "predictor data" drawn from examinations 1, 2, 3, 4, respectively. This procedure controlled for learning and familiarization effects of repeated visits to the examination center and repeated administration of the same and similar test forms. It also controlled for such changes in interviewers as occurred over the course of the study, the different contexts in which questions and scales were imbedded at different examination periods, and the changes that occurred over the three years of the study at local facilities and in agency policies. In addition, there were substantial changes in amount of traffic being handled over the course of the study, as exemplified by the year of the fuel shortage in which aircraft traffic was much diminished. This, in turn, might have affected either the answers to the predictor questions, or the probability of psychological or physical health change if, as hypothesized, work-load conditions were in some way related to these changes.

The technique of sliding interval analysis was used in all instances where the onset of disease could be clearly specified

and the frequency of health change in the average interval was not sufficiently great to permit data analysis for single intervals.

Within all five general models for analysis we also studied moderating variables such as social and marital supports. In this way we were able, for example, to ascertain whether those who experienced equal amounts of physiological arousal at work but who had more social or marital support experienced less health change.

This report has been organized to facilitate rapid comprehension of the main points. Tables and figures required to convey understanding or clarity are included with the narrative in each section. Other tables lending supportive evidence, and background to the narrative, are included in Appendix I. Copies of instruments, questionnaires, forms, etc., used in the study are presented in the Exhibits appended. Copies of papers published under auspices of this study and contract are presented in Appendix II.

SUMMARY

Sociodemographic Characteristics of Sample

Responses on the ATC Biographical Questionnaire revealed the following sociodemographic characteristics of the sample:

- 1) The majority grew up in cities or suburbs;
- 2) More grew up in average neighborhoods (47%) than in "better" (35%) or "poorer" (10%) ones;
- 3) Most came from a similar socioeconomic background as their wives;
- 4) Most (66%) came from a 2-parent home,
- 5) Fathers and fathers-in-law were, for a majority, skilled, semi-skilled, manual or service workers;
- 6) At least half of the mothers and mothers-in-law were occupied mainly as homemakers;
- 7) Parental education was considerably lower than that of the ATCs,
- 8) About half of the ATCs and 27% of their wives had some college or a degree;
- 9) The majority (56%) were reared in the Roman Catholic religion,
- 10) Most (79%) were currently living in a "good" or "one of the best" neighborhoods;
- 11) Most (89%) were married and had children;
- 12) Most (almost 60%) of the wives were fully occupied as homemakers;
- 13) Almost all (99%) of the men had served in the Armed Forces, 96% of them as enlisted men, 69% worked in Air Traffic Control during military service.

III. DESCRIPTIVE FINDINGS

1. Sociodemographic Characteristics of Sample

The Air Traffic Controller Biographical Questionnaire (ATC BQ) administered at the intake examination yielded the following information on the general characteristics of our sample: Cities, or suburbs of these cities, provided the community setting for about 61% of the participating ATCs while they were growing up; another 27% grew up in small towns and 12% in rural areas. Forty-seven percent of the men said that they grew up in "about average" neighborhoods, about 35% in "better than average" neighborhoods, while only 10% reported that they came from "poorer" areas. However, about half said that their families were limited to necessities only while the other half reported that they were able to live comfortably. It appeared that growing up in "about average" neighborhoods meant being able to afford the necessities only. About 17% of the ATCs came from a higher socioeconomic background than their wives, and 19% from a lower one.

The family backgrounds of our sample were varied. Two-thirds of the study subjects lived with both natural parents until at least age 18. For 10%, a parent died and for about 12%, a divorce or separation (greater than a year) occurred. The average age at the time of such parental losses was 8.1 years. The fathers of 60% and the fathers-in-law of 62% of the men were either skilled or semi-skilled, manual or service workers. Eight percent of the fathers were professionals and 14% were managers and proprietors, and approximately the same total percentage of fathers-in-law were professional or business men. Among the mothers, slightly more than half were fully occupied as homemakers and 63% of the mothers-in-law were reported to be housewives. Forty percent of the mothers and 33% of the mothers-in-law were divided among clerical, manual and service occupations, usually as part-time employment shared with homemaking duties.

Parental education was considerably lower than that of the ATCs, reflecting the generally higher educational levels of the younger age cohort. About 50% of the ATCs had some college or a degree, while only 13% of their fathers, 9% of their mothers and 27% of their wives reached this level of education. Only 4% of the ATCs were not high school graduates, while 57% of their fathers and 44% of their mothers did not graduate from high school. Thirty-seven percent of the ATCs had more education than their wives, and 20% had less.

The parental family size differed greatly for our sample, ranging from 11 children to an only child (the ATC). The study subjects tended to be in the middle of their parents' family, having on the average 1.3 older siblings and 1.3 younger siblings. These were equally divided between the two sexes, but on the average these men were more likely to have an older sister and a younger brother than the reverse.

The majority of our sample (56%) were reared in the Roman Catholic religion. Thirty-three percent were reared in a Protestant religion, 6% in the Jewish religion, and 5% in either no religion or one not included in our listing. Somewhat the same current religious identification was reported, except that the organized religions were endorsed by a slightly lower percentage in each case and no religion at all was claimed by 14%. It should be noted, however, that 55% of these men reported going to religious services twice a year or less, so the religious identification was nominal in many instances. Only 20% of the group reported attending church services once a week or more.

Less than 1% of our sample reported that they currently were living in a section of town described as "one of the poorer ones," 20% were currently living in average neighborhoods, and 79% were living in either a "good" or "one of the best" neighborhoods. The ATC study group was upwardly mobile. Not only did they have higher occupational and educational levels than their parents (91% were at a higher educational and occupational level than their fathers), but they were also more likely to be living in a better section of town than they did when they were children, 59% of them reporting that they currently lived in better neighborhoods than they did as children, and only 10% reporting that they now lived in worse neighborhoods. The ATCs were also quite stable in their residence. Although we did not ask for the number of times they had changed their residence, we did collect information on how long they had lived in the county of their present address. The mean length of time was 10.2 years, and 76% had lived for five or more years in the county of their present address.

The majority of the sample were married and had children. Eighty-eight percent had been married once, 8% more than once, and 4% had not been married. At entry into the study, 89% were married, 4% were unattached, and 7% were separated, divorced or widowed. Eighty-seven percent had children living with them (an average of 2.3 children at time of entry into the study).

Among the wives living with their husbands, 30% had full or part-time jobs, but almost 60% were fully occupied as homemakers (another 12% were engaged in volunteer and other activities). The employed wives were largely in clerical and sales positions (84% of those employed); another 16% were pursuing a "Level 2 Profession" such as school teacher, technician (with college degree), social worker, registered nurse.

More than 99% of the men had served in the Armed Forces. Their tours of duty ranged from two to fifteen years with median and mode both at four years. Ninety-seven percent of the men were in enlisted ranks throughout their careers and only 3% were officers. For 69% of those who served in the Armed Forces, air traffic control was included

in their military services; 2% had been pilots or navigators, and another 18% engaged in other activities related to aviation. Eleven percent were in military positions other than aviation-related ones. The history of a military career was the most uniform of all the life history information in our study; most were non-commissioned officers doing ATC work.

SUMMARY

Comparability of ATC HCS Subjects and ATCs in Other Studies

To assure credibility and applicability of results of this study, comparisons were made with other available studies: a nationwide testing, beginning in 1966, of all operational controllers in ARTCCs and airport towers using the 16 Personality Factor Questionnaire (16 PF), and a study that included 125 controllers from large and small airports in the vicinity of the University of Michigan, using scales measuring boredom, job future ambiguity, social supports and role conflicts.

The comparisons showed that:

- 1) The 16 PF profiles of the ATC HCS controllers matched the national sample profiles reasonably well, suggesting that the subjects in this study were reasonably representative of controllers nationwide in terms of this test;
- 2) ATC HCS controllers had more boredom than the Michigan area controllers, but were not greatly different in job ambiguity, social supports or role conflict, suggesting that Northeastern ATCs were reasonably similar to Midwest controllers in these respects.

2. Comparability of ATC HCS Subjects and ATCs in Other Studies

To assure credibility and applicability of the results of this study, it was important to determine whether or not the participating controllers, all of whom were from the New York and New England region, were similar to controllers around the country or to the controller subjects in previously published studies. There were two major sources of data for comparison.

Karson and O'Dell (1974) published the results of a nation-wide testing of all operational controllers in Air Route Traffic Control Centers (ARTCCs) and airport towers beginning in 1966. They used the Sixteen Personality Factor Questionnaire (16PF), 1962 Form A, of Cattell (1962) and obtained data from 6,231 ARTCC controllers and 4,816 tower controllers.

The second source of comparative data was the work of Caplan, Cobb, French, Van Harrison, and Pinneau (1975). They reported a large number of findings for 82 controllers from large airports and 43 controllers from small airports. These controllers were a convenience sample (as opposed to either a total or random sample) of controllers in the vicinity of the University of Michigan and therefore represent a sample for regional comparison. The 82 controllers from large airports were most comparable to our tower controllers in age, experience and Civil Service Grade (GS13), and therefore this particular sub-group provides the best regional comparison.

Although we could not expect that our controllers would be identical in all respects to either the national or regional comparison groups, a reasonable similarity would suggest that the findings of the present study might be applicable to controllers not in the region or study.

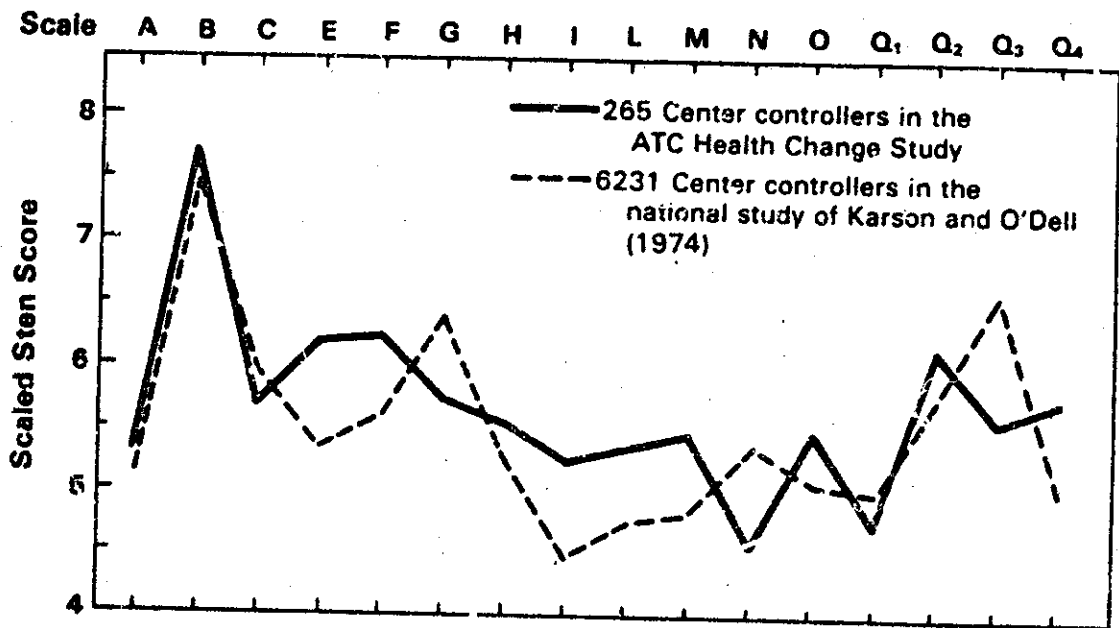
Comparison of 16PF Results To National Sample

Figure A displays the scaled score profiles of 265 ARTCC controllers in the present ATC Health Change Study (ATC HCS) and of 6231 ARTCC controllers in the national study of Karson and O'Dell (1974). Figure B displays the profiles of the 42 ATC HCS tower controllers and the 4816 tower controllers from the Karson and O'Dell (1974) study. In both cases the profiles appear quite similar in spite of several differences.

The degree of similarity in profiles can be expressed statistically by using the weighted occupational group-to-group coefficient of similarity for the 16PF (Cattell, Eber, and Tatsuoka, 1970, p. 311-312). The profile of the ARTCC controllers was significantly related to the national sample profile as expressed by a coefficient of similarity of .65 ($p < .01$). The tower controller profile also was significantly related to the national tower controller profile with a similarity coefficient of .76 ($p < .01$). These statistical results indicated that

FIGURE A

COMPARISON OF 16 PF PROFILES OF CENTER CONTROLLERS: ATC HEALTH CHANGE STUDY VS NATIONAL SAMPLE

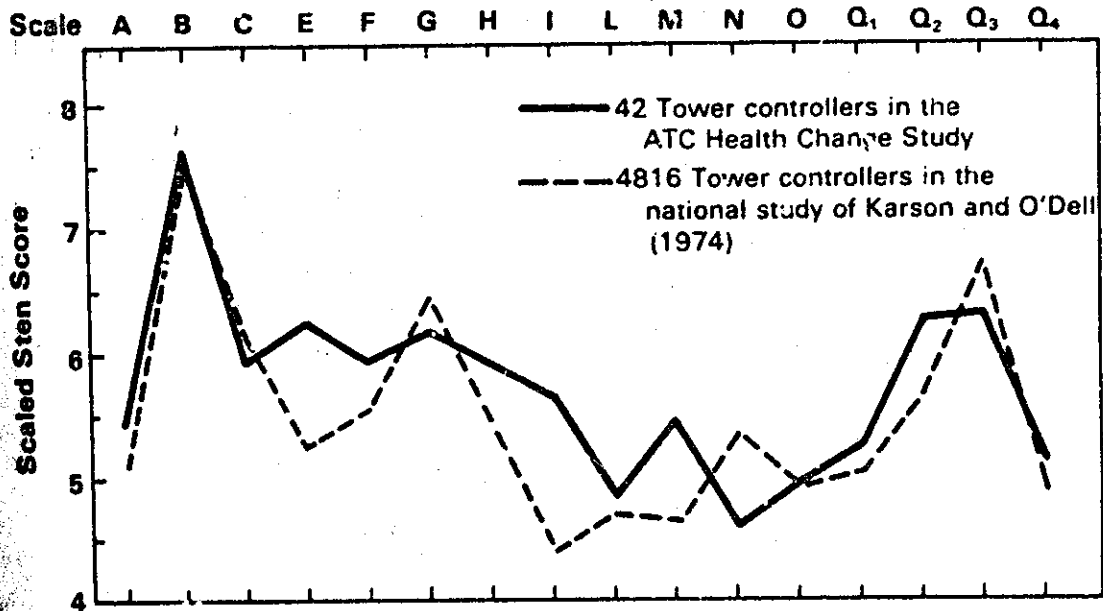


A = WARMTH
 B = INTELLIGENCE
 C = EGO STRENGTH
 E = DOMINANCE
 F = ELATION
 G = GROUP CONFORMITY
 H = BOLDNESS
 I = EMOTIONAL SENSIBILITY

L = ANXIOUS INSECURITY
 M = BOHEMIANISM
 N = SOPHISTICATED
 O = GUILT PRONENESS
 Q₁ = CRITICALNESS
 Q₂ = SELF-SUFFICIENCY
 Q₃ = COMPULSIVITY
 Q₄ = FREE FLOATING ANXIETY

FIGURE B

**COMPARISON OF 16 PF PROFILES OF TOWER
CONTROLLERS: ATC HEALTH CHANGE STUDY
VS NATIONAL SAMPLE**



A = WARMTH
B = INTELLIGENCE
C = EGO STRENGTH
E = DOMINANCE
F = ELATION
G = GROUP CONFORMITY
H = BOLDNESS
I = EMOTIONAL SENSIBILITY

L = ANXIOUS INSECURITY
M = BOHEMIANISM
N = SOPHISTICATION
O = GUILT PRONENESS
Q₁ = CRITICALNESS
Q₂ = SELF-SUFFICIENCY
Q₃ = COMPULSIVITY
Q₄ = FREE FLOATING ANXIETY

the 16PF profiles of the ATC HCS controllers matched the national sample profiles quite well. Overall, the results meant that one would be right somewhat more than 99% of the time in saying that the ATC HCS controllers were reasonably representative of controllers nationwide, in terms of the 16PF profile of personality characteristics.

On individual scales of the 16PF, there were differences between the ATC HCS controllers and the national sample. Controllers in this study had more warmth (A), intellectual orientation (B), dominance (E), elation (F), boldness (H), emotional sensibility (I), anxious insecurity (L), bohemianism (M), guilt proneness (O), self-sufficiency (Q2) and free-floating anxiety (Q4). They also had less ego strength (C), group conformity (G), sophistication (N), and compulsivity (Q3).

Although there were statistically significant differences between the ATC HCS controllers and the national sample on individual scales, the high similarity of profile coefficients with respect to personality characteristics suggests that data and findings of this study may have application to the broader group of air traffic controllers.

Comparison to Caplan, et al. Regional Sample

During the fifth and final examination, a number of scales used in the Caplan et al. study (1975) were administered to the ATC HCS controllers: Boredom; Job Future Ambiguity; Supervisor Support, Social Support-Co-Workers, Social Support-Friends, Relatives, and Family; and Role Conflict Scales. One man refused to complete these scales, therefore, data was available on 387 of 388 men seen at the last examination.

After grouping our controllers into ARTCC (Center), tower, and TRACON (Traffic Radar Control) facility options, we compared their scores with the 82 controllers from large facilities and the 43 controllers from small facilities reported by the Caplan group. Table 6 displays the results.

The results indicated that the ATC HCS controllers had significantly higher ($p < .001$) Boredom scores than the Caplan study controllers. However, the ATC HCS controllers were not dramatically different on the remaining possible comparisons for Job Ambiguity, Social Supports or Role Conflict.

These results were important because they showed the basic similarity of the ATC HCS controllers from the Northeastern facilities in this study to those from the Midwest in the Caplan study.

TABLE 6

Comparison of Caplan, et al. (1975)
Regional Controllers with ATC Health Change Study Controllers

Comparison Variable	Caplan, et al. ATCs-Large Airports (N=82)	Caplan, et al. ATCs-Small Airports (N=43)	ATC Health Change Study Center Controllers (N=265)	ATC Health Change Study Tower Controllers (N=46)	ATC Health Change Study Tracon Controllers (N=76)
	Mean S.D.	Mean S.D.	Mean S.D.	Mean S.D.	Mean S.D.
Job Dissatisfaction	3.09 .66	2.85 .69	1.43 .44	1.51 .54	1.46 .56
Boredom	1.49 .68	1.40 .65	2.32 .67	1.81 .85	1.88 .79
Job Future Ambiguity	2.21 .66	2.02 .72	2.48 .97	2.64 .88	2.45 .87
Supervisor Support	2.69 .72	2.87 .64	2.77 .85	2.59 .86	2.65 .91
Social Support-Coworkers	3.12 .54	3.37 .46	2.84 .57	2.92 .60	2.95 .68
Social Support-Friends, Relatives and Family	3.43 .60	3.58 .51	3.30 .70	3.16 .95	3.19 .76
Role Conflict	1.56 .56	1.36 .50	1.48 .51	1.59 .55	1.61 .47

We made one other comparison to the other samples by grouping the various characteristics into those which might be socially desirable or undesirable for controllers in this study, from the motivational standpoint and tested to see if the ATC HCS subjects had a propensity to present themselves in any better or worse light than the other samples. We found that the ATC HCS subjects were reasonably representative of the other controller population.

SUMMARY

Comparability of ATC HCS Subjects to Non-Participating
ATCs in The Same Regions

To assure that the sampling procedures and definition used in this study did not select a group of subjects very different in illness proneness from those who either were not selected or did not volunteer, a comparison was made of medical disqualifications among participants and those among non-participants.

It was found that participants had been medically disqualified at a rate approximately half that of non-participants. Differences between participants and non-participants in disqualification for psychiatric reasons were not as great as differences between the two groups in disqualifications for somatic reasons.

Not only was the rate of medical disqualification (including both participants and non-participants) for the New England facilities higher than that for the New York facilities, but there was also a marked difference between participants and non-participants in medical disqualification rate.

These findings indicated that the rates of health change reported in this study were probably conservative estimates of health change among the larger population of air traffic controllers.

Among 95 men (both participants and non-participants) medically disqualified from New England facilities and the New York Common IFR room, 78% were granted Second Career and/or OWEC options.

Participant ATCs were promoted at a rate approximately 1.7 times that of non-participant controllers.

3. Comparability Of ATC HCS Subjects To Non-Participating ATCs In The Same Regions

The preceding section reported that the air traffic controllers in the Health Change Study were reasonably comparable to controllers around the country in terms of their personality profiles. Furthermore, they were reasonably comparable to samples of midwestern controllers in terms of several psychological and job-related variables. The participating controllers in the Health Change Study were also compared to non-participating controllers from the same facilities, in terms of their medical disqualifications for somatic or psychiatric reasons. This comparison was important to assure that the sampling procedures and sample definition that we used did not result in a group of men who had medical disqualification rates or problems very different from men who were not participants. To obtain the necessary data we asked the Eastern Regional Flight Surgeon, John P. Skelly, M.D. and the New England Regional Flight Surgeon, U.A. Garred Sexton, M.D., to provide us with certain data.

We asked for the total number of fully rated journeyman controllers on every facility roster, the attrition frequencies for reasons other than medical, the number of medical disqualifications, the disqualified man's initials, date of birth, entrance-on-duty date, the date qualified as a controller, and the diagnosis if it were a medical disqualification. These data were requested for each month beginning January, 1974 through October, 1977. The men's initials, birth-dates, and entrance-on-duty dates allowed us to identify those disqualified controllers who had been participants in the study. However, that same data did not allow us to obtain the actual identity of the disqualified non-participants, but allowed us to identify how many non-participants in each facility had the characteristics described. We were deeply appreciative of the efforts put forth by Drs. Sexton and Skelly and their staff to provide us with this data in a relatively short period of time.

Although these data also represented occupationally related outcomes which are discussed in Section III E, the purpose of the analysis in this section was to ascertain the extent to which the subjects in this study appeared to match their non-participating colleagues in illness proneness, as measured by number of medical disqualifications in each group.

Table 7 displays the comparison of somatic and psychiatric disqualifications of non-participants and participants in the health change study according to age groupings. The figures at the top of the table are simple counts of the number of men disqualified for the listed reasons in the various categories. To make comparisons between the disqualification rates for participants and non-participants, we calculated the number of man-months at risk.

Overall Age-Grouped Comparison of
Medical Disqualification Rates
For ATCs Participants And Non-Participants

MEDICAL DISQUALIFICATIONS AT ALL FACILITIES IN STUDY

<u>Age as of 9/73</u>	<u>NON-PARTICIPANTS</u>		<u>PARTICIPANTS</u>		<u>Total</u>
	<u>somatic</u>	<u>psychiatric</u>	<u>somatic</u>	<u>psychiatric</u>	
25-37	20	15	5	5	45
38-49	20	12	7	6	45
50+	30	11	0	0	41
subtotals	70	38	12	11	131

Total Non-participant/participant 108

23

i. Overall man-months at risk = 43674

A. Participant man-months at risk = 12780

B. Non-participant man-months at risk = 30894

ii. Overall medical disqualification rate - 3.00 per 1000 man-months

A. Participant medical disqualification rate = $23/12780 = 1.80$ per 1000 man-months.

B. Non-participant medical disqualification rate = $108/30894 = 3.50$ per 1000 man-months.

Total somatic disqualification rates

A. Participants = $12/12780 = .94$ per 1000 man-months.

B. Non-participants = $70/30894 = 2.27$ per 1000 man-months.

Total psychiatric disqualification rates

A. Participants = $11/12780 = .86$ per 1000 man-months.

B. Non-participants = $38/30894 = 1.23$ per 1000 man-months.

For participants, the number of man-months at risk was calculated from the date of entry into the study until the date of exit from the study. The date of exit from the study was the date on which a man became ineligible for participation for any one of several reasons, or the date of his fifth and final examination at Boston University.

Since we did not have the same depth of data regarding the men who were non-participants in the study, the man-months at risk for non-participants were calculated by first summing the number of fully rated journeyman controllers in each facility during each month from January, 1974 through October, 1977, and then subtracting from this number the man-months at risk for the participants in this study. In all of the facilities in the study, the monthly roster of individuals changed due to medical disqualifications and other reasons, such as transfers and retirements. The overall man-months at risk for fully rated journeymen controllers in all of the facilities in the study was equal to the sum of all men on the facility roster each month from January, 1974 to October, 1977, made up of participants and non-participants.

With these calculations it was possible to compare the disqualification rates across all facilities as well as for regions. Table 7 shows that the overall medical disqualification rate for any reason was 3.00 per thousand man-months. The participant medical disqualification rate was 1.80 per thousand man-months, whereas the non-participants were medically disqualified at a rate of 3.50 per thousand man-months, almost twice the participant rate.

Part III of Table 7 shows that the participants had somatic disqualification rates of .94 per thousand man-months, while the non-participants were disqualified for somatic reasons at more than double that rate, 2.27 per thousand man-months. Disqualifications for psychiatric reasons at a rate of .86 per thousand man-months among participants, and 1.23 per thousand man-months among non-participants, were not so greatly different.

We decided to examine these data in more detail by region. Table 8 displays a distribution of all of the medical disqualifications by primary somatic and psychiatric diagnoses, in the Eastern (New York) region facilities in this study (New York Common IFR Room, New York Air Route Traffic Control Center). The same diagnoses are listed so that the reader may compare them with the diagnoses made in the study reported in Section III C 2. The diagnoses for psychiatric disqualifications are listed for comparison with those reported in Section III D 3. For the latter comparison it is important to note that the primary psychiatric diagnoses were neurotic and not psychotic disorders.

Table 8 also shows the comparative rates of medical disqualifications in the New York region for somatic diagnoses and for psychiatric

Distribution of Medical Disqualifications
From January 1974 Through October 1977
New York Region Facilities
Journeyman ATCs Only

I. Number of ATCs who were medically disqualified = 48

A. Primary somatic diagnoses

	<u>Non-Participants</u>	<u>Participants</u>
Gross obesity and hypertension	1	0
Bronchitis and hypertension	1	0
Hypertension	3	0
Myocardial infarction	1	1
Cardiovascular disease	3	0
Epilepsy	1	0
Paraesthesia	0	1
Spinal disc injury	1	0
Back injury	0	1
Hearing deficit	1	1
Nephritis	1	0
Ulcer and hiatus hernia	1	0
Diverticulitis and colitis	1	0
Ulcer and colitis	2	0
Post-concussion syndrome	1	0
Multiple phorias	2	0
Deceased (1-cancer, 1-accidental)	1	1

Subtotals by participation status 21 5
 Subtotal of primary somatic diagnoses = 26

¹ Includes those subjects who were ineligible, randomly excluded and randomly selected but non-volunteers.

B. Primary psychiatric diagnoses

	<u>Non-Participants</u>	<u>Participants</u>
Anxiety and/or depression ²	12	6
General psychiatric	2	0
Psychophysiological disorder of G.I. Tract	1	0
Alcoholism	0	1

Subtotals by participation status 15 7
 Subtotal of primary psychiatric diagnoses = 22

² Includes two cases with secondary diagnosis of hypertension

II. Comparative rates of medical disqualifications

A. Total man-months at risk = 20730

1. Non-participants man-months at risk = 13279
2. Participant man-months at risk = 7451

B. Overall medical disqualification rate = 2.32 per 1000 man-months

1. Non-participants = $36/13279 = 2.71$ per 1000 man-months
2. Participants = $12/7451 = 1.61$ per 1000 man-months

C. Total somatic disqualification rates

1. Non-participants = $21/13279 = 1.58$ per 1000 man-months
2. Participants = $5/7451 = .67$ per 1000 man-months

D. Total psychiatric disqualification rates

1. Non-participants = $15/13279 = 1.13$ per 1000 man-months
2. Participants = $7/7451 = .94$ per 1000 man-months

III. Frequencies of Medical Disqualifications by type of Disqualifications and Age Group: New York Facilities

as of 9/73	<u>Non-Participants</u>		<u>Participants</u>	
	<u>Somatic</u>	<u>Psychiatric</u>	<u>Somatic</u>	<u>Psychiatric</u>
25-37	11	7	4	2
38-49	6	5	1	5
50+	4	3	0	0
	<hr/>	<hr/>	<hr/>	<hr/>
	21	15	5	7

diagnoses. The comparative rates indicated that the New York facilities' participants in the study experienced somatic health change at a rate equal to only 42% that of non-participants, but were disqualified for psychiatric reasons at a rate equal to 83% of that for non-participants.

Similar comparisons were made between participants and non-participants for the New England regional facilities in the study. Table 9 displays the results of these comparisons as well as the primary diagnoses listed in FAA records. Again, psychiatric diagnoses were all neurotic in level and type rather than psychotic.

The overall rate of medical disqualifications in the New England facilities was 3.62 per thousand man-months, a figure substantially higher than the New York rate of 2.32 per thousand man-months. The total somatic disqualification rate of non-participants was 2.78 per thousand man-months compared to 1.31 per thousand man-months for participants. Participants were disqualified at a rate of .75 per thousand man-months for psychiatric reasons whereas non-participants were disqualified at a rate of 1.31 per thousand man-months.

While the participants from the New York region were medically disqualified at a rate that was 59% of their non-participating colleagues' rate, the New England participants were medically disqualified only half as much as their non-participating colleagues. Therefore, not only was the rate of disqualification greater in the New England facilities, but the difference between participants and non-participants was greater.

The comparisons between participants and non-participants were particularly important because they indicated that the rates of health change reported in this study were probably conservative estimates of health change among the larger population of air traffic controllers.

Data regarding the disposition of medical disqualification were available for a limited number of facilities. Table 10 displays the distribution of Second Career Program and Office of Workmen's Employment Compensation (OWEC) actions granted to 95 men who were disqualified medically from New England facilities and the New York Common IFR room. A total of 78% were granted Second Career and/or OWEC options after their medical disqualification from the FAA. Five percent were pending at the time we received this data in late 1977, and 17% had a disposition with no compensation other than their possible retirement benefits. These men were both participants and non-participants, but it was not possible to separate the groups and compare their dispositions.

Finally, Table 11 displays a comparison of promotion and transfer rates between non-participants and participants in the Health Change Study from January, 1974, through October, 1977, in the par-

Distribution of Medical Disqualifications
From January 1974 Through October 1977
New England Region Facilities
Journeyman ATCs Only

1. Number of ATCs who were medically disqualified = 83

A. Primary somatic diagnoses

	<u>Non-Participants</u>	<u>Participants</u>
Hypertension	5	1
Hypertension and psychoneuroses	2	0
Hypertension and diabetes	1	1
Cardiovascular disease	9	0
Cardiovascular disease and other	3	1
Diabetes	3	0
Hearing loss	11	2
Hearing loss and blindness	1	0
Ulcer	3	0
Hyperplasia	0	1
Multiple Sclerosis	1	0
Vertigo and medications	1	0
Musculo-skeletal disorder	1	0
Eye disease	2	0
General medical	5	1
Dermatitis and medications	1	0
Subtotals	<u>49</u>	<u>7</u>

B. Primary psychiatric diagnoses

	<u>Non-Participants</u>	<u>Participants</u>
Psychoneurosis plus other	1	0
Psychoneurosis	2	1
Personality disorder	4	0
Disturbance of consciousness	1	0
General psychiatric	13	3
Anxiety and depression	1	0
General psychiatric plus other	1	0
Subtotals	<u>23</u>	<u>4</u>

2. Comparative rates of medical disqualifications

A. Total man-months at risk = 22944

1. Non-participant man-months at risk = 17615
2. Participant man-months at risk = 5329

B. Overall medical disqualification rate = 3.62 per 1000 man-months

1. Non-participants = $72/17615=4.09$ per 1000 man-months
2. Participants = $11/5329=2.06$ per 1000 man-months

C. Total somatic disqualification rates

1. Non-participants = $49/17615=2.78$ per 1000 man-months
2. Participants = $7/5329=1.31$ per 1000 man-months

D. Total psychiatric disqualification rates

1. Non-participants = $23/17615=1.31$ per 1000 man-months
2. Participants = $4/5329=.75$ per 1000 man-months

III. Frequencies of Medical Disqualification by type of Disqualifications and Age Group: New England Facilities

<u>Age as of 9/73</u>	<u>Non-Participants</u>		<u>Participants</u>	
	<u>Medical</u>	<u>Psychiatric</u>	<u>Medical</u>	<u>Psychiatric</u>
25-37	9	8	1	3
38-49	14	7	6	1
50+	26	8	0	0
	<hr/>	<hr/>	<hr/>	<hr/>
	49	23	7	4

TABLE 10

Disposition Of Medical Disqualifications
From Selected Facilities For 95 Men

	<u>Number of Men</u>	<u>% of Total</u>
Second Career Program only	45	47%
OWEC only	3	3%
Both Second Career and OWEC	15	16%
Second Career - pending	3	3%
OWEC - pending	2	2%
Second Career granted with OWEC pending	11	12%
Neither Second Career or OWEC	16	17%
	<hr/>	<hr/>
	95	100%
Total granted Second Career and/or OWEC	=74 (78%)	
Total with Second Career and/or OWEC pending	=5 (5%)	
Total with no compensatory disposition	=16 (17%)	

Complete data for this presentation was available only for Boston ARTCC, Quonset TRACON, Bradley Tower, Providence Tower, Otis TRACON, and the New York Common IFR Room.

Comparison Of Promotion And Transfer Rates
Between Non-Participant And Participant ATCs From
January 1974 Through October 1977 In Participating Facilities

	<u>Rate per 1000 man-months</u>	
	<u>Non-participants ATCs</u>	<u>Participant ATCs</u>
Promotions ¹	2.33	3.94
Transfers ²	4.63	1.94

¹ Promotion data was available from the Boston ARTCC, Logan Tower, Otis TRACON, Quonset TRACON, and Bradley Tower

² Transfer data was available from New York ARTCC, Boston ARTCC, Logan Tower, Quonset TRACON, and Bradley Tower.

ticipating facilities. Full data was not available from all facilities, but the comparisons should still be valid since the largest part of the data were available for examination.

First, one can note that participant ATCs were promoted at a rate approximately 1.7 times that of non-participant controllers. Secondly, non-participant controllers were transferred to other facilities more than twice as often as participant controllers. Since a number of contributory factors possibly accounted for these differences, we were hesitant to interpret this data. A conservative interpretation might be that men who volunteered to participate in the study were not expecting to be transferred and furthermore may have had higher aspirations for themselves.

In summary, the most important conclusion from these comparisons of participating vs. non-participating controllers was that the controllers participating in the health change study were somewhat less likely to be medically disqualified than non-participants. Thus, the health change rates reported in the later sections may be somewhat conservative in that all journeymen controllers probably experience health changes at a rate slightly higher than those who were selected and who volunteered for this study.

B. Predictor Variables

Several criteria were applied to determine the selection of health change predictor variables. First, relevance to air traffic controllers and to the air traffic environment was required. Second, the variable had to be measurable. If a measurement technique was not available, we considered the feasibility of devising an assessment technique. On the other hand, if techniques were available, we considered them from the standpoint of practicality in usage. Third, we evaluated the reliability and validity of assessment techniques. And finally, we searched for and required evidence that a given variable would have either a direct or moderating influence on health change.

Using these criteria, ten predictor variables were chosen: Socio-demographic characteristics, history of health and health-related behavior, personality characteristics, marital, family and social supports, job-related characteristics, life changes, workload, psychological and behavioral measures at work, cardiovascular measures at work and endocrine measures at work.

A description of each predictor variable follows, along with the rationale for its use in the study, explanations of the method of measurement, and descriptive findings.

The ability of these variables to predict any of the health or job outcomes is discussed in Section V, Predictive Findings.

SUMMARY

SOCIO-DEMOGRAPHIC CHARACTERISTICS

Data were collected on the ATCs' parents; social, educational, economic, military and religious backgrounds; and adolescent experiences for analyses of their relationship to health change. Some descriptive data is reported in Section IIIA1. In addition, the data showed that:

- 1) The ATCs' parents were generally compatible;
- 2) 62% of the ATCs recalled a growth rate about the same as their adolescent peers;
- 3) 91% of the ATCs were equally or more athletic and fit than their high school classmates;
- 4) 91% had as many, or more, friends in high school as others;
- 5) 35% had considered quitting high school;
- 6) 77% socialized with girls at least weekly in high school;
- 7) The relationships of 86% of the ATCs with their parents were average or better than those of most others; and
- 8) 62% had alcoholic beverages outside their home by age 16.

1. Socio-demographic Characteristics

As we were interested in determining the extent to which certain background or current biographical data might predict future health or job outcomes, we used the information obtained from the Air Traffic Controller Biographical Questionnaire (ATC BQ) not only to describe the study participants (see Section III A 1) but also to ascertain whether or not there were any significant relationships between specific socio-demographic characteristics and health or job outcomes. Although general information descriptive of the participants has already been reported in the previous section, the rationale for attempting to relate socio-demographic characteristics with health changes, and additional information pertaining to aspects of the personal lives of the participants, is reported below.

Rationale

It is well accepted that the circumstances and life style into which a person is born and raised has an effect, often indeterminate, on his or her future well-being. Some attempts have been made to predict future outcomes by use of biographical inventories that elicit information on personal background. Early uses were in the prediction of success of salesmen (Goldsmith, 1922; Kornhauser, 1965; Kurtz, 1939), prediction of college success (Bittner, 1945) and vocational success (Ghiselli, 1955; Super, 1957), success in an officer training program (Guilford and Lacey, 1947), and detection and treatment of accident-prone drivers (Johnson, 1946).

Biographical data has been extensively used in industrial studies (Owens and Champagne, 1965), in psychological research to predict amenability to psychotherapy and severity of anxiety reaction (Lawrence, 1947) and in health research to establish a relationship between status incongruity and level of illness symptoms (Jackson, 1962), as well as between coronary disease and both status incongruity and social mobility (Cohen, 1974; Wardwell and Bahnson, 1973), and between health change and a variety of personal life history and current life variables (Jenkins, 1976). Finally, such background factors as religious affiliation (Kaplan, 1975; Wardwell and Bahnson, 1973) and church attendance (Kaplan, 1975; Comstock and Partridge, 1972) have also been related to a variety of health problems.

The study of health change in air traffic controllers presented a good opportunity to determine under carefully controlled conditions whether or not social background or current life circumstances were related to future health changes among this population.

Findings

Characteristics already summarized in Section III B 1 to describe the sample included their social setting while growing up, the economic situation and family size and membership of their parental families, education and occupations of fathers and mothers as compared with the ATCs themselves, and their religious affiliations. Other social background characteristics of interest for predictive purposes included the extent of compatibility between parents in background, personality and goals for their families, and the adolescent experiences of the ATCs themselves, summarized below.

The ATCs perceived their parents as having very similar goals for the ATC, but perceived the parents' personalities as being dissimilar. More than 50% of the participants judged their parents to be very similar in social background, education and religious emphasis. To obtain an overall measure of parental compatibility on these issues, the scores of the five items inquiring about parental compatibility were summed, yielding a range from 5 (very similar on all items) to 15 (sharply different on all items). Using the total scores 5-7 as "very similar," 8-12 as "a little different," and 13-15 as "sharply different," the following results emerged: (1) very similar, 48%, (2) a little different, 47%, and (3) sharply different, 5%. The results indicated considerable compatibility between the parents of the study population.

Because of the importance of the teen-age years to later development, we included seven items in the ATC BQ to assess the ATCs' experiences at that time, as they were recalled.

When asked to compare their physical growth with that of their peers in adolescence, 62% of the study group believed they were about the same, 15% perceived their own growth rate as faster, and 23% as slower.

Asked how athletic and fit they were in comparison with their adolescent classmates, 44% recalled that they were about average, 47% above average, and 9% less fit.

For 75% of the controllers, the number of friends they had in high school seemed to be about the same as others, while 16% recalled that they had more friends than others, and 9% recalled having fewer friends than others.

Twenty-six percent of the study group reported that they had seriously considered quitting high school once or twice, 9% had considered it more frequently than once or twice, and 58% had never considered quitting.

Seventy-seven percent of the ATCs reported that during their last year in high school, they went out socially with girls one or more times a week, with 11% reporting that they went out four or more times a week. Twenty-three percent recalled going out with girls less than once a week.

The relationship between the ATCs and their parents during the ATCs' teen years was described as about average by 56% of the participants, as better than that of most others by 30%, and as worse than that of others by 14%.

The majority of the study group (62%) had their first alcoholic beverage outside of their home by the time they were 16 years of age. Another 35% had their first drink outside of their home by the age of 20; 1% never drank, and 2% were over 21 years of age before they drank outside of their home.

The extent to which the social characteristics described both in Section III A 1 and above are predictive of future health change is reported in Section V, Predictive Findings.

SUMMARY

Health History and Health-Related Behavior

Family health histories, elicited during visits to Boston University Medical Center, revealed the following:

- 1) 73% of the ATCs had one or more relatives who had had a heart attack or who suffered from angina;
- 2) 25% of the ATCs had fathers who had suffered either a heart attack or angina;
- 3) 50% of the controllers had some family members with hypertension, 20% of the controllers having fathers with hypertension and 20% having mothers with hypertension;
- 4) 40% of the men reported cancer among their relatives;
- 5) 43% of the men reported allergy in their families.

2. Health History and Health-Related Behavior

Rationale

Any attempt to explain health change in a population is incomplete without knowledge of the health histories of its members. Large studies of the health of industrial populations have shown that a significant, though weak, predictor of future health change is the frequency of illness in the past. In addition, a complete medical examination has traditionally included data both on family history of disease and personal disease history.

The impact upon health of a variety of daily life habits has been well established. Adequacy of sleep and regularity of meals have been associated with five-year survival rates in free-living communities as studied by Belloc and Breslow*. The use of cigarettes and other tobacco products has been associated with ill health and increased mortality in a variety of studies. One's choice of beverages has been related to future incidence of gastric ulcer. Hence, it was deemed important to obtain a family history of disease and a history of personal health and health-related behaviors at each of the five examinations of the ATCs at Boston University Medical Center.

There were two specific reasons, in addition to medical tradition, for including these factors. First, it was important to determine whether the rate of health change in air traffic controllers as a group followed from a particularly high or particularly low frequency of such health problems in the family background or earlier life history of the ATCs. The health histories and habits were necessary to test the hypothesis that a high rate of a particular disease might be observed in this sample of ATCs because some inadvertent selection factors had brought a high risk group into the study population. Secondly, to determine the independent contribution of current life stresses in illness causation, one would need to know the extent to which the illness was predictable on the basis of family or personal health history or habits alone.

Findings

At the intake examination, ATCs were asked to indicate which, if any, blood relatives had ever had any of the following conditions: heart attack or angina, stroke, high blood pressure, asthma/

* Belloc, N.B., RELATIONSHIP OF HEALTH PRACTICES AND MORTALITY. Prepublication report. Human Population Laboratory, California State Department of Public Health, Berkeley, California.

hay fever/hives or eczema, diabetes (sugar disease), nervous disorder, liver disease (jaundice), anemia or bleeding disease, kidney disease, cancer or leukemia, suicide, peptic ulcer, emphysema or other chronic lung disease. At each subsequent examination, ATCs were asked for any additional report of relatives who had developed any of these diseases and also for an update of the record if they had, in the interim, learned of the presence of any of the diseases in relatives with whom they may not have had regular contact. A medical history was elicited for the father, mother, grandparents, uncles or aunts (if blood relative), siblings and offspring of the ATC. The Medical History Questionnaire is appended in the Exhibits section of this report.

The most commonly reported familial health condition was heart attack or angina. In all, 73% of the men reported one or more of the relatives with such a history, including 25% who reported this for their fathers. High blood pressure was reported in the family by 50% of the controllers, with fathers and mothers each mentioned by about 20% of the men. The next most frequently reported health condition was cancer, mentioned by 40% of the men. In this case, grandparents and other blood relatives older than the subject were reported more than three times as frequently as either parent. The allergy category was mentioned by 43% of the men. Interestingly, the relatives most commonly affected were sons and daughters, reported by 17% of the men.

At each of the subsequent examinations, 2% to 3% of the ATCs reported an additional relative to have been affected by one or more of the more common of diseases from among a comprehensive list. Coronary disease, stroke, high blood pressure, and cancers were the most commonly reported subsequent family illnesses, as might be expected by their frequency in the general population.

The personal health history of the ATCs is reflected in the discussion on past and present illnesses at intake into the study (Section IIIC3), and health-related behavior is discussed in the context of its relationship to later health change (Section VA).

SUMMARY

Personality Characteristics

Although personality characteristics have frequently been related in research studies to illness experience, few studies have been able to separate personality characteristics resulting from, and those antecedent to, any illness outcome, nor have these studies shown the biological mechanisms transmitting the influence of personality.

Our prospective study of air traffic controllers provided an opportunity to attempt to clarify these and other issues raised regarding personality influence on health outcome.

Six different instruments or scales were selected to measure or assess these personality characteristics, each described in turn in the sections following.

3. Personality Characteristics

One of the long-standing controversies in medicine relates to the question of whether or not personality characteristics predispose either to specific diseases or to disease in general. An extensive literature (Weiner, 1977) has explored the relationships particularly to certain diseases considered to have more probable connection with personality and hence labeled "psychosomatic" in nature.

The crux of the controversy over the influence of personality on disease lies in two main uncertainties: First, most of the studies reported to date were unable to prove that the personality characteristics often found to be concomitant with certain diseases were in fact antecedent to the onset of the disease. As the studies were typically retrospective in nature, it was usually not possible to separate personality characteristics resulting from, and those antecedent to, any disease outcome. Second, studies in which personality characteristics were correlated with disease initiation or maintenance did not pursue how the personality attributes might have been linked to the biological mechanisms of the disease. As physiological and endocrine measurements were rarely made together with personality assessments, little evidence of the process of personality influence on illness could be offered.

Another provocative question was whether personality characteristics could in themselves predict certain diseases, whether a personality pattern (e.g., a pattern of dependency) was only activated under certain circumstances; or whether personality attributes played only a partial role in combination with other predisposing factors (e.g., life change, genetic predisposition, or other body factors) to initiate illness. Complicating these many questions has been the additional possibility that specific personality characteristics may relate to certain sub-types of disease and that better understanding of the influence of personality on disease initiation or maintenance may await greater clarity in specifying disease sub-types.

As our prospective study of air traffic controllers provided a good opportunity for possible clarification of some of these questions as well as an opportunity to answer, for this particular population, whether or not their illnesses could be predicted in any way by personality characteristics, we were eager to utilize measurements of personality characteristics that would allow comparison with other research findings, and would provide us with scores having generally accepted reliability and validity.

After considerable thought, we selected six different instruments or scales, each of which will be described in turn, along with the rationale for selection of that particular measure. The predictive value of personality characteristics as measured will be discussed in Section V, Predictive Findings.

SUMMARY

The California Psychological Inventory (CPI)

The CPI, a commonly used inventory of everyday personality traits arranged to measure 18 different dimensions, was administered to the ATCs at their second Boston University Medical Center examination.

Relative to 5000 U.S. males in the original standardization sample, the controllers as a group scored within a normal range, and showed group tendencies toward strong, dominant, aggressive, independent, sociable, conscientious and self-confident personalities who dislike and feel uncomfortable with outside regulation and authority and who are somewhat intolerant of people different from themselves.

a. The California Psychological Inventory

Rationale

Our first requirement was for an instrument that would provide an acceptably valid and reliable general assessment of personality traits. We considered a number of multitrait personality inventories, including the Minnesota Multiphasic Personality Inventory (MMPI), the Sixteen Personality Factor Questionnaire (16PF) and the California Psychological Inventory (CPI).

As the MMPI concentrated primarily on psychopathology, which we had other means of assessing, and the 16PF was initially rejected by the air traffic controllers because of their bad experience with this measurement by other investigators at a previous time,* we decided against use of these measures.

On the other hand, the CPI seemed to be an ideal choice for several reasons, and therefore was selected to be administered during the second examination at Boston University Medical Center as an instrument for assessing general personality traits.

The CPI assesses eighteen personality characteristics (Gough, 1960). It had been used in at least one previous study of air traffic controllers (Trites, Kurek and Cobb, 1967), providing us with data for possible comparison and interpretative assistance.

The CPI focuses on more positive, everyday personality traits, such as dominance and responsibility. Its content consists of questions about typical behaviors, feelings, opinions and attitudes of a respondent about social, ethical and family matters. It is notable for its lack of psychopathologically or symptom-oriented material. Finally, the CPI has been used in literally hundreds of research studies, and therefore a large literature was available regarding its use and interpretation. These considerations were bolstered by high praise from a leading psychometrist (Anastasi, 1968) and by the detailed review of validity, reliability and psychometric research on the CPI by Megargee (1972).

Findings

Table 12 lists the names of the eighteen CPI scales and descriptive characteristics of persons who score high on each of

* Although the air traffic controllers initially rejected the 16PF, by the time of the fifth round of examinations at Boston University Medical Center, they had changed their view and demonstrated their confidence in us by allowing us to administer the 16PF to them.

TABLE 12

California Psychological Inventory
Scale Names and Descriptive Characteristics Scale

<u>Scale Name</u>	<u>Descriptive Characteristics of High Scores</u>
Dominance	Ambitious, dominant, forceful, aggressive, persistent
Capacity for Status	Discreet, forgiving, imaginative, independent
Sociability	Clever, confident, wide interests, outgoing, sociable
Social presence	Adventurous, pleasure-seeking, self-confident, relaxed
Self-acceptance	Confident, enterprising, independent thinking, sophisticated
Sense of well-being	Dependable, good-natured, free from worries
Responsibility	Capable, conscientious, serious, useful, responsible
Socialization	Adaptable, efficient, honest, sincere, high social maturity
Self-control	Dependable, logical, self-controlled, freedom from impulsivity
Tolerance	Forgiving, generous, good-natured, soft-hearted
Good impression	Adaptable, changeable, considerate, kind
Communality	Cautious, conscientious, deliberate, non-randomness
Achievement-conformity	Ambitious, capable, intelligent, logical
Achievement-independence	Foresighted, independent, intelligent, versatile
Intellectual efficiency	Capable, confident, efficient
Psychological mindedness	Foresighted, independent, responsive to inner needs of others
Flexibility	Easy going, highly adaptable, optimistic, spontaneous

these scales. Figure C displays the CPI profile for the 391 controllers completing the questionnaire during their second examination at Boston University Medical Center (1 of the 392 who came to the second examination was not included because his scores indicated that he was randomly answering the questionnaire). The controllers' mean scale scores are plotted relative to 5,000 males in the original standardization study (Gough, 1960), where 50 was the average male score and 10 was the average standard deviation.

Relative to the standardization sample of middle class American males between the ages of 18 and 50, controllers scored quite high on the Social Presence, Dominance and Self-Acceptance scales, indicating dominant, independent, outgoing, adventurous and confident personalities in general.

The controllers scored quite low on the Responsibility and Socialization scale of the CPI. These two scales assess what one might call "respect for authority" in that very low scores are typical of juvenile delinquents, parolees, prisoners and other social misfits (Megargee, 1972). High scorers on these two scales tend to be in positions of leadership in their schools, communities and organizations. The low score for the controllers indicates not a lack of responsibility nor a lack of socialization as the scale names would suggest, but rather a low regard for rules and regulations and a tendency to do things as one wishes in order to get them done.

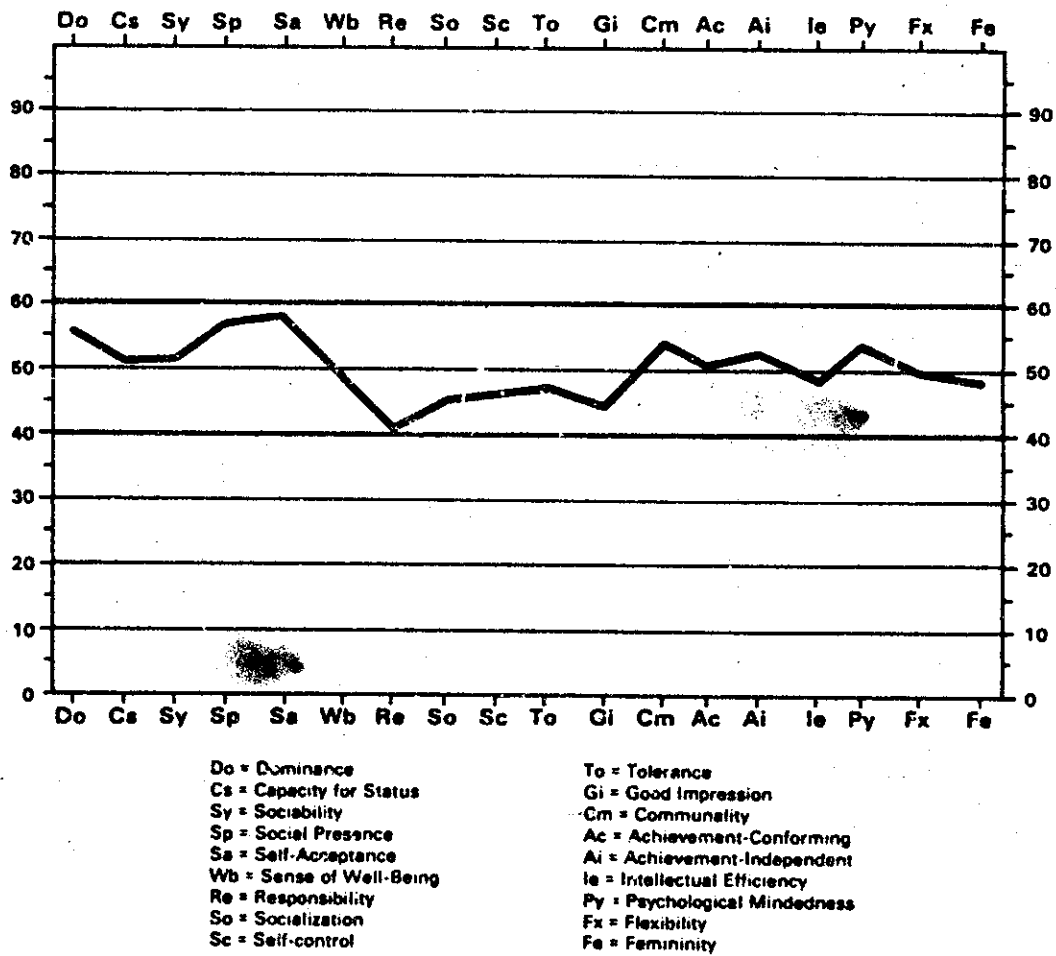
The controllers scored in the low average range on the Self-Control scale reinforcing the previous profile of dominant, forceful, aggressive and self-confident persons who dislike rules and regulations, and do not mind breaking laws or other external restrictions.

In all of the remaining scales the controllers scored in the average range, with slight elevations for being cautious and conscientious (Communality), for achieving in more independently oriented ways rather than conforming ways, and for being psychologically minded. Their Intellectual Efficiency scores were average as were their Flexibility and Femininity scores.

The CPI also provided three of the validity scales used in this study. The Sense of Well Being scale is an inverse "faking-bad" scale; that is, a person scoring extremely low (below a scaled score of 30) is likely to be describing himself in an excessively negative fashion. Studies have shown that people who are very upset will score in a more moderate range (30 to 40) than persons who are attempting to make themselves look very bad (Megargee, 1972). As a group the controllers had a slight tendency to describe themselves in less than optimum fashion, but an analysis of indivi-

FIGURE C

CALIFORNIA PSYCHOLOGICAL INVENTORY PROFILE OF 391 AIR TRAFFIC CONTROLLERS



Note:
The standardization of over 5000 males scored at an average of 50 for all scales. The darker lines at 40 and 60 on the profile would include about 68% of the standardization sample scores.

dual records indicated that only a very few scored in the "faking-bad" direction. These individual records were examined and other data were used to confirm whether these men were in fact feeling as bad as their scores indicated. In all cases the additional data (medical, psychiatric and biological) confirmed the men's self description.

The second validity scale provided by the CPI was the Good Impression scale. The Good Impression scale assesses "faking-good," an extremely high score indicating an attempt to make oneself look better than is probably true. Again only a very few controllers scored very high on the Good Impression scale. For these few men, other data indicated a strong need to be seen in a good light, but on the other hand, they did not deny instances where they were not performing or feeling up to their ideal.

Finally the Communality scale indicates the degree to which a respondent's answers are consistent and systematic. Very low scores on this scale indicate random answering, concealing feelings and beliefs. One of 392 men tested scored below 30, which suggested random answering. Examination of his individual profile and the remainder of his data showed that the CPI results were confused and inconsistent but that his other data were not disordered. It may have been that this one man did not align his answer sheet with the proper questions and therefore systematically misanswered all of the remaining items. Since his score was so deviant and his answers were so inconsistent on the CPI, we discarded his results from all analyses using CPI scores.

In summary, the CPI indicated that controllers scored in essentially a normal fashion with group tendencies indicating strong, dominant, aggressive, independent, sociable, conscientious and self-confident personalities who dislike and feel uncomfortable with externally imposed regulations and authority, and who are somewhat intolerant of people different from themselves. The validity scales indicated that very few men (a maximum of 30 over all three faking scales) had strong tendencies to describe themselves either very favorably or very unfavorably. In all but one case the results were considered valid because there was confirming data from other sources as to their different status.

The value of the 18 CPI personality variables in predicting health changes occurring after the second examination at Boston University are reported in Section V, Predictive Findings. Use of the "faking-good" and "faking-bad" scales to check the validity of other self-reported data is discussed in Section IV, Evidence for the Validity of Self-Reported Data.

SUMMARY

The Jenkins Activity Survey (JAS)

The JAS, measuring "Type A behavior pattern," was administered to the ATCs as a potential predictor of health change. Type A persons are hard-driving, competitive, impatient, aggressive, hurried, job-involved, achievement oriented, conscientious and responsible. Type A behavior has been associated in other studies with increased risk of coronary heart disease and atherosclerosis.

Four JAS scores were provided:

- 1) Extent of Type A behavior pattern;
- 2) Speed and Impatience;
- 3) Job Involvement, and;
- 4) Hard-driving competitive.

b. The Jenkins Activity Survey

The Jenkins Activity Survey (JAS*) was designed to measure the Type A behavior pattern which has been associated in recent studies with increased risk of coronary heart disease and atherosclerosis. As this self-administered, computer-scored multiple choice questionnaire has been administered to many thousands of American and European men over 13 years of development and standardization, it was quite natural that the questionnaire was selected to be administered to the ATC population of the present study as an additional test of its value in predicting health changes. The ATCs were given this questionnaire during their second visit to Boston University Medical Center.

The JAS provides four scores:

The first score represents a clinical judgment as to the extent of Type A behavior pattern defined by the cardiologists Rosenman, Straus, Friedman et al. (1964). Scores in the positive direction indicate increasing intensity of the Type A pattern, whereas scores in the negative direction signify the converse Type B pattern. Type A persons are hard-driving, competitive, impatient, always in a hurry, aggressive, committed to their profession, achievement oriented, conscientious and responsible. In contrast, Type B individuals are more calm and relaxed, more interested in the quality of life than quantity; for the most part they are also interested in good performance and good success, but they seek their goals in a less pressured, less intense manner. Scores on the Type A scale have been found in several independent studies to be higher in patients with coronary disease than in controls, and high scores were also associated with higher risks of development of new clinical coronary disease and recurrent myocardial infarction. The Type A behavior pattern is a complex syndrome which is composed of three major independent dimensions. These dimensions are measured by the remaining three scores generated by the JAS.

Speed and Impatience. This scale, derived by factor analysis, measures the tendency to do things quickly, to be always in a hurry, to be impatient with others when they speak or work slowly, to have a strong temper and to be willing to express feelings forthrightly.

Job Involvement. This scale is composed of items depicting one's work situation as containing many pressures, important deadlines, demands for overtime work, many challenges and unexpected problems needing attention and correction. In addition, this scale

* Available from the Psychological Corporation.

includes items which indicate that high scorers will also receive promotions and pay increases in response to their job dedication.

Hard-driving, Competitive. High scorers on this scale describe themselves as being hard-driving, competitive, conscientious, and more serious than other people in the same line of work. They will also state that they put forth more effort, need to hurry more often, and have been told by family members and others that they are too active and need to slow down. High scorers can be characterized by the motto, "We try harder."

The relationship between these scores and health changes is discussed in Section V.

SUMMARY

Sixteen Personality Factor Questionnaire (16 PF)

Because the 16 PF had been used in previous studies of air traffic controllers, it was selected to be administered to this study population for purposes of comparisons across ATC groups. However, as previous experiences of the ATCs with this instrument in other studies caused reluctance to cooperate in administration of the questionnaire until the last examination period, the results could not be used for predictive purposes, but could be used in retrospective comparisons of men with different health change history over the three-year study.

In comparison with 1,147 males in the U.S. comprising the original normative sample used in devising the 16 PF, the present ATC group scored significantly higher on dimensions of intelligence, ego strength, dominance, elation, group conformity, boldness, self-sufficiency, compulsivity and free floating anxiety. The ATCs scored lower than the U.S. males on dimensions of emotional sensitivity, anxious insecurity, sophistication, guilt proneness, and criticalness.

The results were consistent with those found for a national sample of air traffic controllers.

c. Sixteen Personality Factor Questionnaire

In an earlier section we described how our subjects, located at Air Route Traffic Control Centers and Towers, compared with respect to age and experience with national samples of controllers at these same types of facilities. The earlier results were used to help establish the comparability of our subjects with other controllers around the country. This section describes and interprets certain comparisons between our air traffic controllers and the original normative sample used in devising the Sixteen Personality Factor Questionnaire (16PF). In addition, the rationale and procedure for use of the 16PF in this study is explained.

Rationale

The 16PF exists in four forms (A,B,C,D) and two revisions (1962, 1967). Because a number of studies were available in which the 1962 Form A version of the 16PF was used on air traffic controllers, we selected this same version for our study even though it was not the most recent version. However, use of the 16PF presented several problems. First, the controllers were very sensitive about taking the 16PF because, according to them, there had been repercussions on individuals as a consequence of its previous use by other investigators. Hence, although the 16PF would have been most useful at the intake examination, we were unable to obtain cooperation at that time for its administration. Rather, we had to wait until the fifth and last examination before the men were sufficiently comfortable and confident in their interactions with us to allow us to administer the 16PF.

Of the 388 men present for the last examination, 387 completed the questionnaire, with one man still refusing to cooperate. For descriptive purposes, the results based on 387 are adequately representative of the results we might have obtained with the original 416.

Findings

Table 13 lists the 16PF scales and provides a raw score description, the general characteristics being assessed and the high score description for each scale. Figure D plots the 16PF profile of controllers in this study with the distribution of scores among 1,147 males in the general U.S. population. The comparison indicates that controllers score significantly higher on the personality dimensions of intelligence (B), ego strength (C), dominance (E), elation (F), group conformity (G), boldness (H), self-sufficiency (Q2), compulsivity (Q3), and free floating anxiety (Q4). On the other hand, the controllers scored lower than the normative population on the personality dimensions of emotional sensitivity

Sixteen Personality Factor Questionnaire
Scale Names and Descriptive Characteristics

<u>Scale Name</u>	<u>Low Score Description</u>	<u>General Characteristic</u>	<u>High Score Description</u>
A	Reserved, detached, critical, aloof, stiff	warmth	Outgoing, warmhearted, easygoing, participating
B	Dull Low intelligence	Intelligence	Bright High intelligence
C	Affected by feelings, emotionally less stable, easily upset, changeable	Ego strength	Emotionally stable, mature, faces reality, calm
E	Humble, mild, easily led, docile, accommodating	Dominance	Assertive, aggressive, competitive, stubborn
F	Sober, taciturn, serious	Elation	Happy-go-lucky, enthusiastic
G	Expedient, disregards rules	Group Conformity	Conscientious, persistent, moralistic, staid
H	Shy, timid, threat-sensitive	Boldness	Venturesome, uninhibited, socially bold
I	Tough-minded, self-reliant, realistic	Emotional Sensitivity	Tender-minded, sensitive, clinging, overprotected
L	Trusting, accepting conditions	Anxious Insecurity	Suspicious, hard to fool
M	Practical, "down-to-earth" concerns	Bohemianism	Imaginative, bohemian, absent-minded
N	Forthright, unpretentious, genuine but socially clumsy	Sophistication	Astute, polished, socially aware
O	Self-assured, placid, secure, complacent, serene	Guilt Proneness	Apprehensive, self-reproaching, insecure, worrying, troubled
Q1	Conservative, respecting traditional ideas	Criticalness	Experimenting, liberal, free-thinking
Q2	Group dependent, a "Joiner" and sound follower	Self-Sufficient	Self-sufficient, resourceful, prefers own decisions
Q3	Undisciplined self-conflict, lax, follows own urges, careless of social rules	Compulsivity	Controlled, exacting will power, socially precise, compulsive, following self-image
Q4	Relaxed, tranquil, torpid, unfrustrated, composed	Free-floating Anxiety	Tense, frustrated, driven, overwrought.

FIGURE D

SIXTEEN PERSONALITY FACTOR QUESTIONNAIRE PROFILE OF 387 AIR TRAFFIC CONTROLLERS

LOW SCORE DESCRIPTION	FACTOR	STANDARD SCORE (IN STENS)										HIGH SCORE DESCRIPTION	
		1	2	3	4	AVERAGE RANGE		7	8	9	10		
RESERVED	A	•	•	•	•	•	•	•	•	•	•	•	OUTGOING
LESS INTELLIGENT	B	•	•	•	•	•	•	•	•	•	•	•	MORE INTELLIGENT
EMOTIONAL	C	•	•	•	•	•	•	•	•	•	•	•	STABLE
HUMBLE	E	•	•	•	•	•	•	•	•	•	•	•	ASSERTIVE
SOBER	F	•	•	•	•	•	•	•	•	•	•	•	HAPPY-GO-LUCKY
EXPEDIENT	G	•	•	•	•	•	•	•	•	•	•	•	PROPER
SHY	H	•	•	•	•	•	•	•	•	•	•	•	VENTURESOME
TOUGH-MINDED	I	•	•	•	•	•	•	•	•	•	•	•	TENDER-MINDED
TRUSTING	L	•	•	•	•	•	•	•	•	•	•	•	SUSPICIOUS
PRACTICAL	M	•	•	•	•	•	•	•	•	•	•	•	IMAGINATIVE
FORTHRIGHT	N	•	•	•	•	•	•	•	•	•	•	•	SHREWJ
PLACID	O	•	•	•	•	•	•	•	•	•	•	•	APPREHENSIVE
CONSERVATIVE	Q ₁	•	•	•	•	•	•	•	•	•	•	•	EXPERIMENTING
GROUP-TIED	Q ₂	•	•	•	•	•	•	•	•	•	•	•	SELF-SUFFICIENT
CASUAL	U	•	•	•	•	•	•	•	•	•	•	•	CONTROLLED
RELAXED	Q ₄	•	•	•	•	•	•	•	•	•	•	•	TENSE
A sten of		1	2	3	4	5	6	7	8	9	10	is obtained	
by about		2.3%	4.4%	9.2%	15.0%	19.1%	19.1%	15.0%	9.2%	4.4%	2.3%	of adults	

(I), anxious insecurity (L), sophistication (N), guilt proneness (O) and criticalness (Q1). These results were entirely consistent with those reported by Karson and O'Dell (1974) regarding the general personality characteristics of their national sample of air traffic controllers.

In general, the 16PF Questionnaire results indicated that the controllers were more like the general population of males than not. But, on the other hand, they had several predominant personality characteristics including intellectual orientation, compulsivity, and self-sufficiency. Along with the California Psychological Inventory results (see Section III B 3), these results indicated that the air traffic controllers were intelligent persons whose anxieties were controlled by meticulous compulsive behavior, who tended to be dominant and group conforming but who also held beliefs that authority and regulations were obnoxious. They tended to be bold and to be somewhat lacking in emotional sensitivity. Anxiety and conflict, rather than causing guilt, tended to result in conformance to group expectations. This type of conformance included verbal manifestations, but not necessarily conformance in actual behavior or physical symptoms of illness. This result has been suggested before (Karson and O'Dell, 1971; Karson and O'Dell, 1974), but in this study we had the first opportunity to validate this suggestion.

Since the 16PF was administered at the last examination, we could not use it for predictive purposes. Rather, it was included primarily for descriptive purposes and to provide retrospective comparisons of men who had different health change histories over the course of the study. Since our subject population of controllers scored so similarly to the national samples of Karson and O'Dell (1974), we could expect that our retrospective comparisons would have utility for screening purposes in later studies.

SUMMARY

PSY 130

A series of true-false scales were administered to measure the following dimensions: Hypochondriasis, Depression, Hysteria and Anxiety.

The Hypochondriasis and Hysteria measures were used as validating checks on self-reports of illness to ascertain whether or not these psychological tendencies were responsible for increased reporting of symptoms. The Depression and Anxiety scales were used as potential predictors of health change.

d. PSY 130

At the third examination a series of true-false psychological scales were administered as a single instrument which was labeled "PSY 130." This same set of 108 true-false items had been used in previous studies at Boston University School of Medicine under the name, "The Boston Health Study." The scales of this study were derived from the Minnesota Multiphasic Personality Inventory (MMPI) (see Dahlstrom, Welch, and Dahlstrom, 1973, for development and validation information; also Zyzanski, et al. 1976), and consisted of the following dimensions:

Hypochondriasis. This scale is a measure of the tendency to complain about symptoms of physical ill-health, particularly under the circumstance that no organic basis can be found. Although MMPI research has found that persons diagnosed as hypochondriacs by psychiatrists score very high on this scale, it has also been established that persons with documented organic disease also score somewhat above the population average in most instances. The hypochondriasis scale was included in the ATC HCS on a single occasion as a validity check to see to what degree symptom complaints by participants might be correlated with this personality tendency rather than with demonstrable physical disease.

Depression. The standard MMPI depression scale containing 60 items was judged to be too long for most research purposes. The short form of this scale developed by Dempsey (1964), and found to have greater reliability than the original scale, was included in the PSY 130.

Hysteria. The full hysteria scale of the MMPI was included for use along with the hypochondriasis scale to determine whether hysterical hypochondriacal features were possibly making a major contribution to reports of ill health. For many kinds of health problems, the diagnosis depended far more heavily on self-report of signs and symptoms than it did on laboratory findings, and hence a check for the presence of bias and particularly for individuals who might be prone to such bias in the reporting of symptoms was a methodological precaution.

Anxiety. A short form of the Taylor Manifest Anxiety Scale developed by Bendig (1956) was the fourth and final scale included in PSY 130. The Taylor Manifest Anxiety Scale has been frequently used in research and has become established as an acceptable measure of clinical anxiety. The Bendig scale, containing the 20 strongest of Taylor's 50 items, served as an independent measure of anxiety at the third examination. Both the Bendig anxiety scale and the Dempsey depression scale were found, in a study by Zyzanski and colleagues at Boston University Medical Center (Zyzanski et al.,

1976), to be associated with increased amounts of atherosclerosis as determined by coronary angiography. The PSY 130 thus contained two scales which had demonstrated association with organically determined cardiovascular illness (a general category of disease to which the ATCs were considered to be particularly vulnerable). The other two scales (HS and HY) had been shown in other studies to be associated more with complaints of disease and symptoms of psychological origin as contrasted with organically demonstrable disease. The PSY 130 was used, therefore, both as a validating check on other data and as a potential predictor of health change.

SUMMARY

Anomie

To test the hypothesis that individuals who feel alienated from society and powerless would be at greater risk for illness, five statements representing feelings of alienation (Srole role anomie scale) were embedded in the ATC Biographical Questionnaire administered at intake. The ATCs were asked to indicate their relative agreement or disagreement with the anomic indicators.

The total score distribution for the anomie scale allowed identification of three categories: 16% of the ATCs were classified as anomic, 12% as eunomic and the remaining 72% as "neither." Anomie correlated significantly (and inversely) with five measures of job satisfaction, as would be expected.

E. Anomie

Rationale

The degree to which an individual feels integrated in his interpersonal relationships and reference groups can be described on a eunomia-anomia continuum. The former refers to a person who is well integrated while the latter describes a person who feels separated from society and reference groups. The term anomie has been used generally to describe this entire continuum in which a person low in anomie would have a generalized, pervasive sense of "belongingness," whereas a person high in anomie would feel a sense of "alienation" (Srole, 1956). At the high end, anomie represents the following five components:

the individual's sense that community leaders are detached from and indifferent to his needs;

the individual's perception of the social order as essentially fickle and unpredictable such that he can accomplish little toward realizing future life goals;

the individual's view that he and people like him are retreating from the goals they have already reached;

the individual's perception that his frameworks of immediate personal relationships are no longer predictive or supportive.

Not surprisingly, anomie has been related empirically to a variety of negative factors, such as elimination of creativity, feelings of estrangement from the products of one's work, self-alienation, feelings of meaninglessness, isolation, and powerlessness (Israel, 1968; Mills, 1951, 1962; Seeman, 1959). It has also been related to mental health problems (Reinhardt, 1972; Reimanis, 1974). The study team hypothesized that ATCs who were anomic would be at a greater risk for negative health change; thus, a measure of anomie (Srole, 1956) was included.

Findings

Since anomie was seen as an enduring trait, it was measured only at intake, and embedded in the ATC HQ using the following statements:

These days a person doesn't really know whom he can count on.

Nowadays a person has to live pretty much for today and let tomorrow take care of itself.

Most public officials (people in government offices) are not really interested in the problems of the average man.

In spite of what some people say, the condition of the average man is getting worse, not better.

It is hardly fair to bring children into the world with the way things look for the future.

Each of these statements was followed by four response categories from "strongly agree" to "strongly disagree," thus permitting a range of scores from 5 to 20 with low scores representing the more anomic responses. On the basis of the men who completed the scale at intake (n=409), it was determined from the total score distribution that three categories of individuals could be identified -- anomic, eunomic, and neither of these. Sixteen percent of the ATCs were classified as anomic, 12% as eunomic, and the remaining 72% were classified as "neither." This rather lopsided categorization occurred because of the large number of scores in the center of the total possible score distribution and the smaller frequencies of extreme scores. Since anomie was being measured by only five, strongly-worded attitudinal questions, this conservative approach to categorization seemed appropriate.

One way to determine the validity of the measure of anomie was to examine its relationship with other variables. From the empirical literature, it was expected that anomie should be related to job dissatisfaction. Since the work role is an important part of the person's life, feelings of anomie should be associated with apathy and dissatisfaction with one's job. Table 14 contains the correlations between anomie and the five job satisfaction variables. Since higher scores on the anomie variables are indicative of less anomic feelings, the relationships in the table are as expected. As can be seen from the table, anomie is significantly related to all five satisfaction variables. Furthermore, the higher values for coworker satisfaction, individual satisfaction, and group morale are consistent with our conception of the anomie variable, that is, one would expect more general feelings of job satisfaction to be more closely related to anomie than attitudes toward specific job factors. The higher value for coworker satisfaction is logical in that anomie feelings are critically dependent on one's social support system.

The relationship of anomie to health changes is discussed in Section V, Predictive Findings.

TABLE 14

Correlations Between Anomie and Job Satisfaction

<u>Satisfaction Variable</u>	<u>Correlation With Anomie Score</u> (Higher Score = less anomie)
Overall Satisfaction	.15*
Work Satisfaction	.32**
Life Satisfaction	.16*
Individual Satisfaction	.29**
Group Morale	.27**

.05

.01

SUMMARY

Marital, Family and Social Supports

It was hypothesized, on the basis of available information, that a strong support system would modify or reduce an ATC's risk for illness and injury. Three methods of determining support resources were:

- 1) 4 questions in the ATCQ on marital support;
- 2) 4 questions in the ATCQ on the availability of help from relatives, friends and co-workers; and,
- 3) several items from the ATC BQ, including household composition, relationships with wife and children, family decision-making and agreement between ATC and wife on family goals.

Psychometric analysis showed the scales used to be acceptably reliable and to be measuring an independent variable.

Social coping resources were found to be negatively related to depression and anxiety and positively related to sociability, social presence and tolerance.

The ATCs generally perceived themselves as more dominant in family decision-making.

A large proportion of the ATCs were satisfied with their marital situation and felt in close agreement with their wives on family goals.

4. Marital, Family, and Social Supports

Rationale

One would intuitively surmise, even without reading the scientific literature, that a person's marital, family and social well-being would have a substantial impact on his physical and/or mental health. This hypothesis was reinforced by evidence from the scientific literature that work satisfaction had been related to life satisfaction in general (Kavanagh and Halpern, 1977), and to specific family characteristics such as the presence of preschool children in the household (Quinn, Staines and McCullough, 1974) and marital satisfaction (Ridley, 1973). Investigators have also found a relationship between angina pectoris and family problems (Floderus, 1974; Medalie, Snyder and Groen, 1973) as well as satisfaction with co-workers (Medalie et al., 1973); and Jenkins (1976), in a review of the literature, concluded that a number of psycho-social factors, many of them directly intertwined with an individual's social support system, affect the risk of coronary disease.

Health statistics for all developed societies, moreover, have shown that marital status is related to physical or mental well-being. It has been consistently reported that married people have lower rates of both mental and physical illness, as well as life expectancies that are different from those of single, widowed or divorced people. Recent analyses have indicated in addition that married men have an advantage over married women in lowered risk of death from those diseases that are linked to social interactions, e.g., suicide, homicide, accidental death, or cirrhosis of the liver.

Altogether, it was clear that the marital, family and social supports of the air traffic controllers in our study merited investigation and that an attempt should be made to determine whether or not these factors altered their risk for illness. The methods used to measure this aspect of the controllers' lives, and the descriptive results follow, while a discussion of the importance of these factors in the controllers' health changes is included in Section V, Predictive Findings.

a. Marital Coping Resources: The Air Traffic Controller Questionnaire

Because we hypothesized that a controller who perceived his wife to be interested and supportive would have less illness than one who perceived his wife to be uninterested and rejecting, we embedded in the Air Traffic Controller Questionnaire (ATCQ), described in detail in Section IIIB5, a measurement of the marital resources available to the ATC to cope with any felt strain or stress in his job.

The following four items were used to measure this variable:

"How often do you talk with your wife about your feelings that are a consequence of your work?"

How do you feel about your wife sharing her trials and tribulations of the day when you arrive home?

How understanding is your wife of your need to unwind at the end of a day's work?

How often do you feel embarrassed by many things your wife says and does?"

Based on the results of a pilot study and other psychometric evidence described in Section IIIB5, a scale was developed, using responses to these four questions as a measure of the ATC's perception of his marital coping resources. The purpose of the remainder of this section will be to discuss the psychometric properties of this scale to determine the quality of the measurement of this variable.

Measurement Qualities of the Marital Coping Resources Scale

Based on the responses of the 410 men who completed the ATCQ during the intake examination, the internal consistency reliability of the marital coping resources scale was .71, an acceptable reliability under established measurement standards. The other major form of reliability of considerable importance to effective measurement is test-retest reliability, which reveals the stability of the measurement of the variable over time. Based on the responses of 383 men who completed the ATCQ on Rounds 1 and 2, the test-retest reliability of the marital coping resources scale was .69, an acceptable value, particularly since test-retest values are usually lower than internal consistency reliabilities. It was concluded, there-

fore, that the scale measuring marital coping resources was adequate in internal consistency and in stability over time.

Along with determination of the scale's reliability, we needed to determine its validity. Although it was not possible to determine whether or not our four items in fact defined and measured what was intended, i.e., marital coping resources, it was possible to determine whether or not the scale at least was a measure of an independent dimension. This test was made by examining the relationships between various scales. A demonstration that no relationship exists between measurement of one variable and others, where no relationship is expected conceptually or empirically may be considered positive evidence for the independence of the measures. There was no reason to expect the marital coping resources scale to be correlated with any of the other ten scales in the ATCQ or with the industrial psychological variables described in IIIB5, and none of the correlations with these variables did, in fact, exceed .20. On the basis of these results it was concluded that the measurement of marital coping resources as defined by our questions was sufficiently independent of these other self-report measures.

As discussed in Section IIIA2, a variety of measures from the research project of Caplan et al. (1975) were included in Round 5 so that our results could be compared with the results from their ATC samples. Among the variables included were measures of social support provided by "your wife, friends, and relatives," "your immediate supervisor," and "other people at work," in the following four situations: (1) making the ATC's work life easier; (2) ease of talking to these people; (3) being able to rely on these people when things get tough at work; and (4) how willing these people were to listen to the ATC's personal problems. The correlations between responses concerning these three social support groups and those on the marital coping resource scale are presented in Table 15.

TABLE 15

Correlations Between Marital Coping
Resources and Social Support Variables
(N = 343)

	Marital Coping Resources
Social Support - Supervisor	.07
Social Support - Coworker	.07
Social Support - Wife, Friends, Relatives	.65

Marital coping resources were not expected to correlate with the first two social support variables, and as expected, the correlations were statistically non-significant. However, the rather close relationship with the third social support variable involving the wife provided further validity evidence for the marital coping resources scale.

b. Social Coping Resources:
The Air Traffic Controller Questionnaire

Along with the marital coping scale, the ATCQ also contained a measure of the social resources available to the ATC to cope with any felt strain or stress on his job. Again the hypothesis was that a strong social support system consisting of friends, coworkers, or relatives would be associated with less health change than a weaker support system.

Four items were used to assess the ATC's perception of his social coping resources. The first three asked: "If you or your family were struck by a crisis or tragedy, how many persons of the following categories could you really count on to help you?" This question was followed by "relatives," "friends," and "people at work" to complete the items. The ATC was to use a scale from "none" to "8 or more" to answer these items. The last item asked: "How many people do you consider close friends who live within an hour's drive of your home?" The ATCs responded on the same scale as for the first three items. Based on the results of a pilot study and on psychometric evidence presented in Section IIIB5, these four items were combined into a scale to measure the ATC's perception of his social coping resources.

Measurement Qualities of the Social Coping Resources Scale

Using the responses of 410 men who completed the ATCQ during the intake examination, the internal consistency reliability of the social coping resources scale was determined to be .70, which is acceptable under measurement standards. Based on the responses of 383 men who completed the ATCQ on both Rounds 1 and 2, the test-retest reliability was .63, which is also acceptable. It was thus concluded that this scale had a good degree of internal consistency and test-retest stability.

This scale was not expected, conceptually or empirically, to be related to the other scales on the ATCQ or to the industrial psychological variables described in Section IIIB5. The results of the correlational analysis verified this expectation in that none of the correlations exceeded .20. It was thus concluded that this scale was measuring this variable independently of the other self-report measures.

In accordance with the work of Kasl and Cobb (1970), social coping resources were expected to be related to certain personality characteristics. Since both the CPI and certain scales from the MMPI (see Section IIIA3) were administered during the intake

visit, we were able to correlate these scales with the social coping resources scale. Social coping resources were associated with low MMPI measurements of depression, anxiety, and the tendency to admit symptoms, and with a positive tendency to deny symptoms. These findings are in agreement with those of Kasl and Cobb. High social coping resources were also related to high sociability, social presence, and tolerance dimensions on the CPI. Considering the meanings of the CPI scales, these results are also supportive of the validity of our measurement of social coping resources. It should be noted that all of these correlations were in the .20's, indicating moderately low relationships.

As described above, three social support variables were measured in Round 5. Table 16 contains the correlations between the social coping resources scale and the three social support measures.

TABLE 16

Correlations Between Social Coping
Resources and Social Support Variables

(N = 387)

	Social Coping Resources
Social Support - Supervisor	.20
Social Support - Coworkers	.36
Social Support - Wife, Friends, Relatives	.24

Although all three values are statistically significant, the higher value for the social support by coworkers is in agreement with the emphasis in the social coping resources scale. The other lower, but statistically significant, values are also understandable since the social coping resources scale included friends, relatives, and people at work. These results provide further evidence for the validity of the measurement of social coping resources in the ATCQ.

c. Biographical Items As Possible Supports

Household Composition

Eight-seven percent of the ATCs had children living with them (2.3 average). In addition, as many as 14% had other persons (not including spouse) living with them, such as relatives, in-laws, or friends. We combined marital status and other persons in the home to measure household composition for the sample. Not unexpectedly, the largest percentage of ATCs (66%) lived with a wife and children, and no other persons in the home. Seven percent lived alone, 4% lived with a wife only, while 2% lived in a broken home with their children. Interestingly, 17% lived in what we called a complex home environment, which meant that the ATC was living with friends or "others," regardless of marital status. Finally, 3% were living in "extended" home environments, which meant the presence of relatives or in-laws regardless of the ATC's marital status.

Relationship With Children

Seventy percent of the ATCs in this study reported they had taken their children somewhere during the week preceding administration of the ATC BQ. When asked if they had taken their children somewhere during the past month, only 6% responded that they had not taken their children to an eating place, the movies, some entertainment or recreation, or to visit a friend.

Family Decision-Making

Two important areas measured in the ATC BQ were the manner in which family decisions were made and the agreement in family goals between the ATC and his wife. Note that these variables were measured in terms of the ATC's perceptions; thus, they may not accurately assess the wife's perceptions and/or the objective situation. Since the ATC is the unit of study, his perceptions were considered to be the important ones for their possible impact on his health.

The ATC's perception of family decision-making was measured on the basis of nine major types of family decisions: the husband's job choice, family car, life insurance purchase, vacation plans, house choice, wife going to work, choice of doctor, food budget, and discipline of the children.

The ATC was asked whether the decision was made (1) by the husband always, (2) by husband more than wife, (3) by husband and wife exactly the same, (4) by wife more than hus-

band, or (5) by wife always. Not surprisingly, there were considerable differences in the way the ATCs described the different decision situations. The husband was more dominant in making the decision on his job choice, the choice of a car, and the purchase of life insurance. Husband and wife shared, in a large percentage of households, decision-making on where to go for a vacation, house or apartment choice, and discipline of children. Finally, decisions on whether the wife should work, choice of doctor, and family food budget were made often by the wife; however, the percentage endorsement by the ATCs on these items was not nearly as strong as for the first two sets of decisions. In fact, by summing across all nine items, an overall index of family decision-making was derived. The distribution of the ATCs' scores is clearly skewed such that husband dominance in family decision-making is more prevalent, a finding in agreement with anecdotal and interview data from the study.

Family Goals

The ATCs were asked to rank on a scale from one to ten the importance they attached to ten different family goals, and also to rank the same goals a second time as they thought their wives would rank them. Measuring the differences in rankings provided an index of value consensus on family goals between the ATCs and their wives. The distribution of these scores indicated that 67% of the ATCs saw themselves and their wives in fairly close agreement on family goals, 23% perceived moderate agreement, and 10% saw disagreement on family goals.

Husband-Wife Relationships

The final two items on the ATC BQ dealing with husband-wife relationships inquired into the frequency with which the ATC took his wife out, and his overall marital satisfaction. Seventy-nine percent of the ATCs reported that they had taken their wife outside the home socially at least once or more during the week preceding their completion of the ATC BQ, and the percentage jumped to 96% when the reporting period was increased to a month. Eight-four percent reported they were currently satisfied with their marriage, 7% had mixed feelings, and 9% expressed dissatisfaction.

In general, these descriptive results indicate that a large proportion of the ATC group was satisfied with their marital situation at the time of entry into the study; however, a proportion of the men indicated on all of the indices a less than satisfactory state of marriage.

100

The extent to which these various coping resources among the study group relate to their health change is discussed in Section V, Predictive Findings.

5. Job-Related Characteristics

Among the possible predictors of health change that we wished to test were a number of job-related characteristics, some associated specifically with the air traffic controller occupation, and others relevant to jobs generally.

We wanted to explore whether or not health changes or specific illnesses were in any way related to differences among the ATCs in such specific variables as:

- i. attitudes towards their skills, and their psychological "investment" in their work;
- ii. the affective discomfort produced by their work;
- iii. styles or ways of coping;
- iv. attitudes toward the FAA;
- v. competence on the job.

We also wanted to assess general and specific satisfactions of the ATCs with their work, and we wanted to know how they perceived the behavior of their leaders.

Our efforts to define characteristics and to find or devise methods of measuring them are related below, together with the results of the measurements taken. The extent to which differences in these characteristics among the ATCs were related to health outcomes is discussed in Section V, Predictive Findings.

SUMMARY

Specific ATC Variables

The ATC Questionnaire, administered at all 5 rounds measured psychological and attitudinal dimensions specific to the occupation, including 11 factors: Psychophysiological anxiety reaction, good controller, coping-by-drinking, social coping resources, work avoidance on bad days, subjective cost, bounceback-burnout, investment in work, tension discharge rate, coping by physical activity, marital-coping-resource. Correlations with several standard personality inventories showed the following:

- 1) There was little overlap between the job-specific psychological characteristics and general personality traits assessed by the CPI;
- 2) There were few, and very low, correlations with the coronary-prone behavior pattern;
- 3) High social coping resources were associated with low depression, low anxiety, high tendency to deny symptoms;
- 4) Psychophysiological anxiety was positively correlated with MPI hypochondriasis, depression, anxiety, and tendency to admit symptoms.

Items in the ATCQ intended to measure satisfaction with management, with training and with promotion policy revealed that the ATCs were considerably dissatisfied with all three.

Nominations for competence by peers were not associated with any unique psychological characteristics. Nominations for amicability were related negatively to dominance and self-acceptance.

a. Specific ATC Variables

During the first year of the ATC HCS, we realized that there were several psychological dimensions of being an air traffic controller that could not be measured with standard, available psychological tests. For example, although the phenomenon of "burnout" among ATCs had been reported to us many times by controllers and FAA management, there was no existing method for its measurement, and it had never been directly assessed. Similarly the capacity for "bounceback" had been described to us as a controller's ability to adapt quickly and easily between heavy and light workload. The bounceback had been described and discussed informally and clinically, but no published assessment procedure was available. Consequently, we undertook the major task of defining a number of constructs that seemed particular to the air traffic controller and his job, and then devising questionnaire scales that would assess these constructs reliably and validly. The resulting instrument was called the ATC Questionnaire.

Investigators and psychological consultants for this study spent many hours in air traffic facilities familiarizing themselves with the ATC work environment. Many group and individual conversations were held with ATCs, supervisors, and IAA officials. A few ATCs became particularly interested in this work, and their advice and suggestions were extremely valuable; particularly George Kerr and Ted Paolotti of the New York Air Route Traffic Control Center were instrumental in this preliminary work.

Development of A Priori Scales

After eight months of observations, discussion, and immersion in the ATC environment, the investigators held formal meetings to define the variables of salient interest. With the definitions and constructs in mind, the investigators then wrote more than 1,000 questions. Further refinements and the elimination of redundant items led to the preliminary selection of 206 items defining 18 different constructs.

This original list of 206 items was compiled into a questionnaire and pilot tested in the Oakland, California, Air Route Traffic Control Center with 55 air traffic controllers.

The results in the pilot test were carefully analyzed in accordance with several criteria (see Appendix 1), and 147 items were retained. These 147 items were administered to all 416 men in this study population during the entrance examination at Boston University Medical Center. Another item analysis was performed. The second analysis resulted in shortening the questionnaire to 95 items.

The 95-item questionnaire was administered at the remaining four examinations. Two additional scales were devised and administered beginning with the second examination. These scales were concerned with symptoms of anxiety caused by incidents and conflicts, and anxiety symptoms related to giving on-the-job, live-traffic training. In all, we developed scales to assess 20 ATC-specific job characteristics. The definitions of these characteristics are displayed in Table 17, along with data on the internal consistency and stability of each of these scales.

Internal consistency reliability was important as an indicator of how well the scale's items converged on a common construct. Internal consistency is high when items overlap and are somewhat redundant. On the other hand, when items are independent of one another, there is low internal consistency. Coefficient alpha (Nunnally, 1967, p. 193) was used to measure internal consistency. The results shown in Table 17 indicate that the internal consistency was reasonable for most of the longer scales, but it was very poor for a number of the short scales, particularly the coping scales. We did not consider all of these scales entirely adequate and therefore performed another series of analyses and refinements. However, in spite of some of the poor internal consistencies, a number of these a priori scales were considered sufficiently important from the conceptual and explanatory standpoint to be used for predictive purposes.

Another important characteristic was the test-retest reliability of the scales, referring to the stability of the measurement of the constructs and the stability of the constructs themselves. With perfect measurement, low to moderate stability would indicate that the construct was a "state variable" with wide individual variation over time. On the other hand, high stability over repeated testing would indicate that the construct was a trait of enduring substance. The test-retest reliability was derived from scores on the first and second administrations of these job-specific scales. The results are presented in Table 17.

As shown in the Table, 15 of the 20 scales had a test-retest stability of .54 or greater, indicating reasonable long-term (9-month) stability. Several of the scales with the lowest internal consistency had higher retest stability. Since internal consistency sets the upper limit for the true reliability of assessment (Nunnally, 1967, p. 210), the scales with higher test-retest stability than internal consistency were influenced by stable response modes rather than by stable measurement of the target construct.

Development of Job-Specific Psychological Factor Scales

Consequently, our dissatisfaction with the psychometric characteristics of all 20 a priori scales led us to conduct a number of

TABLE 17

ATC Job-Specific Scales And Definitions

Bounceback - four items. Internal consistency = .69 Stability = .49.

The four items composing this scale were devised to assess an ATC's self-perceived ability to cycle between heavy traffic and light traffic conditions at work. This construct represents a flexibility in coping and adaptation to fluctuating workload. The hypothesis was that low bounceback abilities were related to the development of psychological and physical illness, whereas a high level of bounceback was protective and adaptive.

Burnout - five items. Internal consistency = .68 Stability = .63.

This construct was conceptualized as the premature exhaustion of a man's physical, cognitive, and psychological resources leading to early retirement for medical and/or psychological reasons. It is characterized by a loss of ability to control aircraft in any but the easiest circumstances and a heightened sense of anxiety and fear when called upon to do so. Due to the sensitivity of this issue, the items were phrased projectively and impersonally rather than with first person self-evaluations.

Toughmindedness - six items. Internal consistency = .35 Stability = .60.

This construct referred to a man's emotional style while working. That is, did the man feel he let situations get to him, or could he pass them off and get on with the job of separating aircraft. We expected an inverse relationship with burnout.

Investment - eight items. Internal consistency = .68 Stability = .65.

Investment was conceptualized as a man's involvement with his job and particularly, the strength of his identification with being an air traffic controller. In a sense the items were devised to assess how important it was for the ATC to be an idealized controller of exceptional character and ability. This intensity of involvement was expected to be a moderator variable in that those men with a high degree of investment but low coping and controlling abilities would be more susceptible to health change than ATCs of similar abilities but with low investment.

ension Discharge Rate - eight items. Internal consistency = .82
ability = .67.

This construct referred to an ATC's felt ability to relax and unwind.

Questions were phrased in terms of rate of tension release. It was hypothesized that those who could release tensions quickly would be less susceptible to health change than those who had difficulty discharging tensions.

6. Tension Discharge Mechanisms on Bad Days - six items. Internal Consistency = .70 Stability = .57.

The items assessing this construct were a list of possible means of releasing tension during difficult days at work. Theoretically we were considering this construct as an indication of tension release effectiveness. This conception of tension release effectiveness assumed that a person who reports that no mechanism is utilized on bad days must (a) not be affected by bad days, or (b) discharge the tensions so rapidly and effectively that the mechanism is not recalled. On the other hand a person who uses more mechanisms might (a) use less effective mechanisms, and/or (b) have poor utilization of the available mechanisms. We hypothesized that this variable would be inversely related to health change.

- Before Work Anxiety - six items. Internal consistency = .88 Stability = .59.

Six psychophysiological symptoms were listed after an introduction which asked how often the ATC experienced each of the symptoms before going to work when the weather or air traffic conditions were bad. This construct was meant to assess anticipatory anxiety. It was expected to have a positive relationship with health change.

- During Work Anxiety - seven items. Internal consistency = .84 Stability = .65.

Seven more psychophysiological symptoms were listed. The ATCs were asked how often they experienced each of them during difficult air traffic situations. Again, a positive relationship with health change was hypothesized.

- After Work Anxiety - six items. Internal consistency = .81 Stability = .65.

Yet another six psychophysiological symptoms were listed. The controllers were asked how often they experienced the symptoms after being relieved from a long period of heavy traffic. We hypothesized that all three temporal types of anxiety would be related to each other as well as to health change. In addition, we hypothesized that individuals who did not consistently report the symptoms across the three time periods may differ in health change and/or on-the-job physiological responsiveness.

- Subjective Costs - eight items. Internal consistency = .74 Stability = .60.

This scale was concerned with an ATC's subjective evaluation of how much his job took away from eight areas in his life (such as family time, social life, and so forth). In other words, how much did it "cost" him

TABLE 17 cont'd.

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to be an ATC? It was expected that those who felt higher levels of "cost" would be more susceptible to health change than those who felt lower levels.

Shift Change Cost - three items. Internal consistency = .47 Stability = .36.

This short scale assessed the felt "cost" due to changing shift schedules. Many men had complained that the rapid rotation of shifts interfered with many aspects of their lives, including their sense of well-being and social membership. Again, we expected a positive correlation between shift change "costs" and health change.

Coping by Drinking - six items. Internal consistency = .87 Stability = .76.

We devised several coping scales. The coping-by-drinking scale assessed how often the ATC consumed alcoholic beverages in order to unwind, relax, or get rid of problems. The questions were phrased in terms of frequency and purpose but not quantity. We hypothesized a positive relationship with health change.

Coping by Physical Activities - four items. Internal consistency = .53 Stability = .54.

This coping scale was concerned with the usage of physical activities (sports and active hobbies) for the purpose of relaxation, tension release and the like. A negative relationship with health change was expected.

Coping by Outside Activities - four items. Internal consistency = .28 Stability = .58.

Hobbies, another job, and handyman tasks were the focus of this scale. Once again, items were phrased in terms of frequency and purpose. A negative relationship with health change was expected.

Coping by Socializing - three items. Internal consistency = .38 Stability = .59.

These three items assessed the frequency of using social situations (group conversations, parties, and so on) for unwinding and relaxation. A negative relationship with health change was hypothesized.

Coping Mechanism Effectiveness - three items. Internal consistency = .15. Stability = .42.

This short scale was composed of three overall summary items inquiring about the effectiveness of the behaviors reported in the coping scales. A negative relationship with health change was expected.

TABLE 17 cont'd.

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17. Marital Coping Resources - four items. Internal consistency = .71
Stability = .69.

Four items were devised which specifically queried the ATC's perception of marital support. It was hypothesized that the perception of an interested, supportive spouse would be associated with less health change than the perception of an uninterested, rejecting spouse.

18. Social Coping Resources - four items. Internal consistency = .70
Stability = .63.

The number of friends, coworkers and relatives on whom the ATC could rely for help or support were three items on this scale. The last item assessed the number of close friends living within an hour's drive of the ATC's home. It was theorized that this scale would reflect the extent and depth of the ATC's social support system. The hypothesis was that a stronger social support system would be associated with less health change than a weaker social support system.

19. Anxiety Due to Incidents - six items. Internal consistency = .60
Stability = .44.

These six items listed symptoms of anxiety that might be elicited by having involuntary incidents and conflicts (violation of separation standards). It was hypothesized that men who were upset greatly and who took longer to recover from their upset would be at higher risk for health change.

- Anxiety Due to Training - six items. Internal consistency = .74
Stability = .41.

It was reported that giving on-the-job, live-traffic training was particularly stressful. These six items inquired about how anxiety-provoking certain aspects of this experience were for the respondent. A positive relationship to health change was expected.

* * * * *

factor analyses to arrive at the most reliable and valid scales from the standpoint of psychometric characteristics. The factor analyses all used a common factors approach in which the shared variance between items was factored rather than the total variance, thus excluding chance correlations between error variances (Harmon, 1960). The squared multiple correlation between a given item and all others was used as the initial communality estimate. After factoring, a rotational method was applied to clarify the factor structure. Presented in Table 18 are the results from a common factors solution with an orthogonal (Varimax) rotation since this was the most understandable methodology. Other factoring methods and other rotational solutions yielded the same results and therefore are not reported.

Description of Job-Specific Psychological Factors Content and Reliability

As seen in Table 18, eleven factors were found to subsume significantly most of the items originally devised for the twenty a priori scales. These eleven factors were significant by Kaiser's (1960) and Cattell's (1966) criteria. They accounted for 89.4% of the common variance among the items.

The item loadings and the item content for each of these factors is presented in Appendix I, Section III B 5. A brief discussion below of each scale includes its primary content in meaning and its composition with respect to the a priori scales.

The psychophysiological anxiety reaction factor was composed of 23 items with a high degree of both internal consistency and nine-month stability (see Table 18.) Basically, it was composed of the items describing psychophysiological anxiety symptoms before, during and after work. These symptoms were all phrased in the context of various ATC work situations, resulting in a factor that is completely job-specific.

The good controller factor was composed of 12 items, all of which were phrased as positive self-evaluative statements with high agreement indicating a higher level of their positive quality. Consequently this factor may have represented a social desirability factor for air traffic controllers, i.e., the extent to which they respond in a manner that wins approval. This factor was the only new combination of items resulting from the factor analysis. The a priori scales were not highly related to it.

The coping-by-drinking factor was very similar to the a priori "drinking-to-cope" scale, with which it correlated .97. The factor analysis merely shortened the scale and slightly improved the reliability.

TABLE 18

ATC Specific Job-related Characteristics

<u>FOR "NAME"</u>	<u>NUMBER OF ITEMS</u>	<u>INTERNAL CONSISTENCY</u>	<u>9-MONTH TEST-RETEST STABILITY</u>
Physiological Safety Reactions	23	.92	.74
Controller	12	.51	.46
ing by Drinking	8	.81	.80
al Coping Resources	4	.70	.63
Avoidance on Bad Days	5	.71	.55
ective Costs	6	.73	.58
edback - Burnout	4	.80	.65
atment	6	.66	.64
ion Discharge Rate	6	.82	.65
ing by Physical Activity	4	.50	.60
al Coping Resources	4	.71	.69

Social coping resources emerged from the factor analysis identical to the a priori social coping scale. The same four items were involved; therefore the reliabilities remained as before. The a priori scale definition remained unchanged.

A new scale created by the factor analysis was named "work avoidance on bad days." The five items in this scale had much in common with the a priori scale called "tension discharge mechanisms on bad days." The content was slightly tightened by the factor analysis yielding good internal consistency and nine-month stability. The definition for this factor is essentially the same as it was for the a priori "tension discharge mechanisms on bad days."

Subjective cost also came out as a factor nearly identical to an a priori scale. Again the factor analysis merely tightened the item structure. The definition for the subjective cost factor is the same as for the a priori scale.

A bounceback-burnout factor was identified which was equally split between the a priori bounceback and the a priori burnout scales. The new combined factor scale was composed of two burnout items and two bounceback items which together had very good internal consistency and quite reasonable stability over time. High scores on this scale were equivalent to having a high level of bounceback and a minimal level of self-reported burnout, whereas a low score corresponded to a high level of self-reported burnout and low bounceback abilities.

An investment factor, identified by the factor analysis, was also almost identical to the a priori factor of the same name. The meaning and reliability of this factor were the same as for the a priori scale.

Tension discharge rate was a construct identified by both the a priori analysis and factor analysis. The meaning and reliability stayed essentially the same for the factor-analyzed scale.

The coping-by-physical activity factor also was very similar to the a priori scale of the same name. One item was dropped and a new one added as a result of the factor analysis. The reliability figures were improved, but the meaning was the same. Men scoring high on this factor would tend to participate in physical activities to cope with tension and anxiety.

Finally, Table 18 showed that the marital-coping-resource a priori scale also was identified by the factor analysis. The same four items were involved, and therefore the meaning and reliabilities remained the same.

In summary, the scales resulting from the factor analysis were equal or superior in psychometric characteristics to the a priori scales. In addition, the factor scales were highly interpretable since their content was so carefully described and highly related to the a priori scales. Consequently, for most analyses presented in this health change study, the factor-analyzed job-specific psychological scales were used as predictors and correlates of other variables. On occasion, however, where a particular variable was of extreme interest to the contracting agency (for example, the effects of shift changes), we have used the corresponding a priori scale. However, the remaining descriptive results are applicable only to the factor scales and by inference to their most closely related a priori scales.

Relationship of Job-Specific Psychological Factors to General Job-Related Variables

Since the 11 job-specific factor scales formed a core set of the predictor variables for health change, we considered it important to ascertain their validity to whatever extent was possible. We used the device of assessing concurrent validity, i.e., correlational relationships at a given point in time between two or more measures of related constructs. If the measures are intended to assess aspects of a common construct and if they have significant correlations with one another, there is evidence of convergent validity. If measures are intended to assess different constructs and have very low correlations with one another, there is evidence of discriminant validity. Our purpose in developing these factor scales was to assess job-specific psychological characteristics rather than general psychological traits. Consequently, we expected low magnitude correlations with other scales that were more general in nature. The following series of results documents a number of these correlational validities. Another validity of great importance is predictive validity, which is discussed with other predictive findings in Section V.

Table 19 presents the significant correlations between the job-specific psychological factors and certain standard industrial psychology scales. A description of the standard industrial psychology scales is provided in Section III B. The main point of the results presented in Table 19 is that all of the correlations between the job-specific factors and the standard industrial scales were low. These low correlations indicated that the 11 job-specific psychological factors were relatively independent of the standard published scales of more general characteristics.

Specifically, satisfaction with work was positively related to the good controller factor and the bounceback factor, indicating that a controller felt more satisfied with his work if he himself was a good controller and had good abilities to bounce back.

TABLE 19

Significant Correlations Between Job-specific
Factors and Standard Industrial Psychology Scales*
(N = 392)

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Job Description IndexSatisfaction with Work

- | | |
|------------------------------|-------|
| 1. Good Controller | 0.27 |
| 2. Subjective Costs Factor | -0.20 |
| 3. Bounceback-burnout Factor | 0.29 |

Satisfaction with Coworkers

- | | |
|---------------------------------------|-------|
| 1. Psychophysiological Anxiety Factor | -0.25 |
| 2. Subjective Costs Factor | -0.20 |
| 3. Bounceback-burnout Factor | 0.20 |
| 4. Tension Discharge Rate Factor | 0.21 |

Satisfaction with Pay

No Significant Correlations equal to or over 0.20

Managh Life Attitude ProfileIndividual Morale

- | | |
|---------------------------------------|-------|
| 1. Psychophysiological Anxiety Factor | -0.42 |
| 2. Subjective Costs Factor | -0.31 |
| 3. Bounceback-burnout Factor | 0.29 |
| 4. Tension Discharge Rate Factor | 0.31 |

Group Referenced Morale

- | | |
|---------------------------------------|-------|
| 1. Psychophysiological Anxiety Factor | -0.29 |
| 2. Subjective Costs Factor | -0.27 |
| 3. Tension Discharge Rate Factor | 0.26 |

Organizational Behavior Description Questionnaire1. Initiation of Structure

No significant correlations equal to or over 0.20

2. Consideration of Others

Psychophysiological Anxiety Factor -0.22

3. Tolerance of Freedom

Psychophysiological Anxiety Factor -0.26

*Correlations $\geq .20$, $p < .001$, are reported

between high and low workload conditions. On the other hand, if he felt that he was paying a large subjective cost in many areas of his life for being an air traffic controller, he tended to be less satisfied with his work. These correlation results were evidence for convergent validity of the good controller, subjective costs, and bounceback-burnout job-specific psychological factors.

The Kavanagh Life Attitude Profile provided two scales of interest, individual (self-referenced) morale and group morale (one's morale considering one's peer group issues). Several job-specific psychological characteristics had significant relationships to these two general characteristics. Men with high individual morale tended to report fewer psychophysiological anxiety symptoms and fewer subjective costs as a consequence of being an air traffic controller. In addition, men with high individual morale also tended to report higher bounceback and higher rate of tension discharge.

Similar results were found with respect to group-referenced morale. This type of morale taps a man's sense of satisfaction with his job in more group-oriented terms such as quality of supervision. High group-referenced morale was negatively related to psychophysiological anxiety and subjective costs, and positively related to tension discharge rates. Both of these findings with respect to the Kavanagh Life Attitude Profile scales provided additional evidence regarding the meaning of the job-specific scales and their convergent validity.

The Leader Behavior Description Questionnaire required air traffic controllers to describe their immediate supervisors' behavior. Since they were describing someone else, one would expect low correlations with reports about themselves. In fact, Table 19 shows that there were only two very low correlations between the job-specific psychological scales and the Leader Behavior Description Questionnaire scales. The only significant correlations were between anxiety and a supervisor's consideration of other people and a supervisor's tolerance of freedom. In both of these cases, high anxiety was associated with descriptions of supervisors as having little consideration of other people and having low tolerance for workers' freedom. These results from the Leader Behavior Description Questionnaire provided evidence of discriminant validity as previously discussed.

Relationship of Job-Specific Psychological Factors to General Personality Traits

Originally, we believed that there were ATC psychological characteristics which were not appropriately assessed by widely-used personality tests. As we demonstrated, this was certainly true for job-related attitudes such as work satisfaction, co-worker satisfaction, and so forth. The next series of results presents data on the rela-

relationship between the California Psychological Inventory (CPI) scales, several Minnesota Multiphasic Personality Inventory (MMPI) scales, and the job-specific psychological factors.

The CPI (see Section III B 3) assesses 18 personality traits which are listed and described in Table 12. As this inventory was administered at the second examination at Boston University Medical Center, the following results are based on the testing of 391 of the 392 controllers who answered the CPI validly.

Table 20 displays correlations between the CPI personality traits and the job-specific psychological factors. Only these correlations of .20 or greater, $p < .001$, are reported. The two additional anxiety scales (anxiety caused by training or by incidents) are included since they were not part of the factor analysis. As can be seen in Table 20, most of the correlations were in the expected direction.

The CPI traits are scaled such that more of a "desirable" trait is reflected by a higher score (Megargee, 1972). The job-specific psychological factors are scaled such that a higher score represents more of the ATC characteristic. Some ATC psychological characteristics were considered to be negative or undesirable from a theoretical standpoint inasmuch as they would be risk factors for illness (e.g., the anxiety factor). Other ATC psychological factors represented characteristics that we felt were protective from illness (e.g., bounceback). Thus, for example, the positive correlations of the CPI Well-Being scale with marital coping resources, bounceback and ten-on-discharge rate were in the expected direction (all low, but positive). Similarly, the negative correlations of the CPI Well-Being scale with the anxiety, coping by work avoidance, subjective costs, anxiety caused by incidents, and anxiety caused by training also were in the expected direction (negative and low).

Although they were in the expected direction, the correlations between the job-specific psychological factors and CPI personality traits were all very moderate in magnitude. Our decision to devise ATC job-specific psychological scales was supported by the results shown in Table 20 which indicated very little overlap between the job-specific psychological characteristics and the general personality traits assessed by the CPI.

Table 20 shows that subjects in this health change study were neither attempting to make themselves look worse nor better than they really were when answering the job-specific psychological items. The low correlations between the CPI Well-Being scale and the 11 factors and 2 additional anxiety scales, and the very low correlation between the CPI Good Impression scale and the job-specific factors and anxiety scales provide some evidence that they were not "faking." Finally, there was no evidence whatsoever of any tendencies for random answer-

TABLE 20

Job Specific Factor Scale
Correlations with CPI
Personality Traits *
 (N=391)

CPI Personality Trait	Marital Coping Resources (N=350)	Social Coping Resources	Psychophysiological Anxiety	Good Controller	Coping by Drinking	Coping by Work Avoidance	Coping by Physical Activities	Subjective Costs	Bounceback	Investment	Tension Discharge Rate	Anxiety due to Training	Anxiety due to Incidents
...ice	20												
...ity for status													
...ility		23	-23	25				-20	24				
... Presence		20	-26					-24	26				-20
...ceptance													
...ing	20		-38			-20		-26	31		27	-20	-22
...ibility													
...ization	22				-24								
...ontrol			-23		-28				21		20		
...se	23	20	-22					-23	23				-20
...pression	22		-25		-22			-21	23		20		
...ility													
...ent-													
...ity	21		-26		-25			-24	28		21		
...ent-													
...ence									22				
...tual													
...ity								-26	27				
...logical-													
...as			-22										-22
...ity													
...ity													-22

*Correlations $\geq .20$, $p < .001$, are reported; decimal points omitted.

ing on the job-specific factors and anxiety scales. Thus we could be reasonably sure that the scores on the job-specific psychological factors were not unduly distorted by possible "faking good," "faking bad," or random answering.

The subjects in this study also completed the Jenkins Activity Survey (JAS) on their second visit to BUMC (see Section III B 3) and several short MMPI scales on their third visit (see Section III B 3). The results from the JAS and the MMPI scales are presented in Table 21. There were few and very low significant correlations between the JAS personality dimensions and the ATC job-specific psychological characteristics. The results indicated that the job-specific psychological characteristics were not particularly associated with the four main dimensions of the coronary-prone behavior pattern (Jenkins, 1972). However, there were a number of correlations between the job-specific psychological characteristics and those assessed by the short MMPI scales.

High social coping resources were associated with low depression, low anxiety, low tendency to admit symptoms, and high tendency to deny symptoms. These findings were reasonable and expected since they confirmed the data and findings of Kasl and Cobb et al. (1970).

The psychophysiological anxiety factor was positively correlated with the MMPI hypochondriasis, depression, anxiety, and tendency to admit symptom scales, but it was negatively associated with the denial of symptoms index. Thus although the psychophysiological anxiety symptoms were specifically related to ATC work situations, these data suggested that these symptoms also were related to more generic and psychological traits.

Other job-specific psychological scales with a number of moderate MMPI correlates were subjective costs, bounceback, tension discharge rate, and anxiety due to incidents. High scores on the subjective cost and anxiety caused by incidents scales seem to be more related to general psychological traits since they had moderate, positive correlations with the psychopathological characteristics in the MMPI scales. On the other hand, high scores on bounceback and tension discharge rates were more indicative of healthy psychological functioning, since they had negative, though moderate, correlations with the MMPI scales.

Attitudes Toward the FAA

After we had completed the intake examinations, we received considerable feedback from the study participants that there were gaps in the coverage of ATC job attitudes by the Job Description Index (JDI) scales (see Section III B 5). This is a fairly common phenomenon in attitude research and measurement in organizations since general scales

TABLE 21
Job Specific Factor Scale
Correlations with MMPT(N=351) and
Jenkins Activity Survey(JAS-N=390)
Traits^a

	Marital Coping Resources**	Social Coping Resources	Psychophysiological Anxiety	Good Controller	Coping by Drinking	Coping by Work Avoidance	Coping by Physical Activities	Subjective Costs	Bounceback	Investment	Tension Discharge Rate	Anxiety due to Training	Anxiety due to Incidents
A Person-													
(JAS)											-24		
and In-			31					20	-21		-32		
ance (JAS)													
Involve-													
(JAS) ⁴													
Driving				25									
Headaches			36					25	-35		-22		
Depression(MMPI)	-26	41	-26					26	-37		-28		26
Worry (MMPI)	-20	43						30	-30		-37	20	26
Symptoms	-20	38			21			29	-34		-24		27
Symptoms	24	-40			-22			-30	30		30	-21	-27

Correlations $\geq .20$, $p < .001$, are reported; decimal points omitted
 Marital coping resources - N=310

from previous research studies can never capture all of the specific elements of the job of the respondents in any given study. Specific areas indicated as missing were attitudes toward management, training, and promotions. Based on interviews and informal discussions with the ATCs, the ATC HCS team developed items to measure satisfaction with management (7 items), satisfaction with promotion policy (5 items) and satisfaction with training (3 items). These scales were administered at the second through fifth examinations. Internal consistency reliability and test-retest reliability of these three scales proved to be adequate and are displayed in Table 22.

Descriptive Results

Since norm groups for comparison samples do not exist for these attitude variables, a threshold criterion of 20%-25% dissatisfaction was used to identify a problem area. This "rule-of-thumb" is well accepted in the industrial psychological literature; the complete rationale is discussed in Section III B 5. The threshold criterion of 20%-25% dissatisfaction can be used to interpret the three job-specific attitude dimensions: Satisfaction with Management, Satisfaction with Training, and Satisfaction with Promotion Policy. However, since these scales were not based on previous literature, examination of item response distributions is appropriate. Tables 23-25 contain the percentage of agreement with the items which represent dissatisfaction in the three scales.

The consistent, negative results on the items concerned with management and management policy in Table 23 would indicate that this is a significant area of dissatisfaction for controllers. This finding is consistent with the results found on the Group Morale scale in Section III B 5 below. This dissatisfaction is perhaps revealed most succinctly in responses to the following single item: "The greatest problems I face in doing my job well are due to FAA policies and not the work itself." Responses to this item indicated that 61% of the ATCs agreed.

As the final two scales, Satisfaction with Training and Satisfaction with Promotion Policy, also represented aspects of management policy, the negative attitudes indicated by the large percentages in Tables 24 and 25 were consistent. It was most interesting to note that the one item showing a relatively lower negative percentage (28%), "One loses the respect of peers when promoted," did not involve management policy, and, in fact, was closer to what has been defined below in Section III 5 as Individual Satisfaction.

However, it was clear from the results that a substantial number of ATCs were quite dissatisfied with management, training and promotion policies. These results were criticized by the FAA after an

TABLE 22

Internal Consistency And Test-Retest Reliabilities of
Satisfaction With FAA Policies Scales

<u>Scale</u>	<u>Internal Consistency</u> <u>Reliability Coefficient*</u>	<u>Test-Retest</u> <u>Reliability Coefficient**</u>
Satisfaction with Management	.65	.70
Satisfaction with Training	.53	.64
Satisfaction with Promotion	.72	.67

*Based on Round 2 data, N = 392

**Based on Round 2 - Round 3 data, N = 352, with an average
test-retest period of nine months.

TABLE 23

Responses to Satisfaction with Management Scale7 Items, Round 2
(N = 392)

<u>ITEM</u>	<u>CUMULATIVE FREQUENCY OF AGREE (COMPLETELY, MODERATELY OR SOMEWHAT)</u>
FAA does not reward consistently good performance.	85%
Facility reluctance to use OT results in dangerous understaffing.	68%
Biggest problems are FAA policies, not the job itself.	61%
FAA more concerned with hardware than helping people do their job.	60%
Controllers' welfare is too low on the facility chief's priorities.	48%
Washington, DC policies hinder facility chief's ability to help ATCs.	44%
Facility reluctance to use OT seriously disrupts personal life.	29%

TABLE 24

Responses to Satisfaction with Training Policy Scale3 Items, Round 2
(N = 392)

	<u>CUMULATIVE FREQUENCY OF AGREE (COMPLETELY, MODERATELY OR SOMEWHAT</u>
too easy now to become fully qualified.	75%
quality of trainees is too low.	74%
ning should not be done with live traffic.	56%

TABLE 25

Responses to Satisfaction with Promotion Policy Scale5 Items, Round 2
(N = 392)

	<u>CUMULATIVE FREQUENCY OF AGREE (COMPLETELY, MODERATELY OR SOMEWHAT)</u>
Performance counts very little for promotions.	91%
ward for controlling well is recognition from other ATCs.	73%
ment only responds to the quality of work when something goes wrong.	70%
ion to supervisor means becoming a "yes-man".	52%
les the respect of peers when promoted.	28%

interim report because of potential response bias. Most of the items, it was argued, were phrased negatively, inducing a high negative response.

As a result of this criticism, it was decided to check this potential bias during Round 5 data collection. All items from Round 2 were retained verbatim within the same questionnaire. A new questionnaire was created primarily to include measures identified in the Caplan et al. (1975) study for comparison with their results (see a discussion of this questionnaire in Section III A). Our previous questions on attitudes toward management, training and promotion were reworded so that agreement would indicate satisfaction with management policies, and the reworded questions were embedded in this questionnaire. For example, the original item, "The FAA is more concerned with improving hardware than with helping people do their job," was reworded, "The FAA is more concerned with helping people do their job than improving hardware." Finally, in order to minimize memory effects, the two questionnaires were administered at separate sittings, one in the morning and one in the afternoon, and the order of presentation was counterbalanced.

The results from Round 5, in terms of percent dissatisfied for each item by attitude area, are presented in Tables 26-28. These results did not support the contention that negatively-stated items biased the responses toward a high degree of dissatisfaction. There were no significant decreases in dissatisfaction with management (Table 26) when the items were stated positively. In fact, as indicated in the table, two items showed significant increases in dissatisfaction when the meaning was reversed.

The situation is the same when Satisfaction with Training results are examined (Table 27). Although two of the three items showed slight decreases, the percent of dissatisfaction was still so high as to make the small changes negligible for practical purposes.

The Satisfaction with Promotion Policy results were somewhat different in that four of the five showed changes in the direction of greater satisfaction. However, the levels of dissatisfaction on the items reversed in wording were still seriously high, and should be of concern to management. The original and reversed wording for the three items showing significant changes were:

- (1) Job performance counts very little for promotion (original).

I believe excellent performance as a controller is an important consideration when promotions are made (reversal).

- (2) One of the problems of being promoted to supervisor is that you become a "yes-man" for management (original).

TABLE 26

Responses to Satisfaction with Management Scales
(Round 5, N = 387)

	<u>PERCENT DISSATISFIED</u>	
	<u>ORIGINAL WORDING</u>	<u>REVERSE WORDING</u>
more concerned with hardware than helping people do their job.	49%	62%*
most problems are FAA policies, not the job itself	58%	59%
facility reluctance to use OT seriously disrupts personal life	24%	59%
facility reluctance to use OT results in dangerous understaffing.	69%	65%
facility does not reward consistently good performance.	81%	83%
Washington, DC policies hinder facility chief's ability to help ATCs	36%	62%*
controllers' welfare is too low on the facility chief's priorities.	43%	48%

significant increase in dissatisfaction.

TABLE 27

Responses to Satisfaction with Training Policy Scale

(Round 5, N = 387)

	<u>PERCENT DISSATISFIED</u>	
	<u>ORIGINAL WORDING</u>	<u>REVERSE WORDING</u>
should not be done with live traffic.	52%	57%
ity of trainees is too low.	86%	77%
o easy now to become fully qualified.	71%	65%

TABLE 28

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Responses to Satisfaction with Promotion Scales

(Round 5, N = 387)

	Percent	
	Original Wording	Dissatisfied Reverse Wording
performance counts very little promotion	79%	40% ^{1,2}
promotion to supervisor means becoming "yes-man"	56%	38% ²
loses the respect of peers promoted	39%	34%
reward for controlling well is promotion from other ATCs	76%	62% ²
management only responds to the quality of work when something goes wrong	67%	71%

content inadvertently changed - see discussion in text.

significant change

An ATC's attitude toward controllers becomes much worse when he is promoted to supervisor (reversal).

- (3) About the only reward for controlling well is the recognition other controllers give you (original).

Exceptional controller performance results in recognition from supervisors that helps in getting promoted (reversal).

Examination of these items revealed that the reversed items were not exactly the opposite of the original items. In accordance with the belief that respondents do not care to answer questions that are very similarly worded and that appear to be repetitive, we attempted to change the wording so the questions would not be recognized from the previous sitting. Although the other job-specific items were easy to change and reverse, it was particularly difficult to change and reverse these three items. Thus, increase in satisfaction may well have been more due to semantic subtleties in the items than to the reversal itself. However, even though the 79% of the ATCs who believed that "job performance counts very little for promotion" decreased to 40% who disagreed with the statement that "excellent performance as a controller is an important consideration when promotions are made," that proportion of dissatisfied ATCs was considerably greater than the 20%-25% criterion, indicating a problem in the area of promotions policy.

A comparison of Round 2 data with Round 5 data in terms of percent dissatisfaction revealed a high degree of stability over time. Of course, different men may have been dissatisfied at Round 2 than at Round 5, but of the 15 items, only 4 showed shifts greater than 10%. These results may indicate that the ATC's attitudes in these job dimensions are not easily changed. It might also indicate that many ATCs accept these negative feelings about management, training and promotion much as other workers accept high noise levels or poor illumination as "part of the job." If this is true, one would expect these attitude responses to have little ability to predict health change. Results of analyses of their predictability are noted in Section V.

In conclusion, reversing the item wording had little impact on the extent of satisfaction revealed. The only significant changes appeared to be more a consequence of changed item meanings than response bias. The responses of our study group at Round 5 indicated that ATCs were considerably dissatisfied with management policy, training and promotion policy, the same conclusion reached from Round 2 data.

Peer Nominations for Competence

In our discussions with the FAA administrators and air traffic controllers, we often were presented with statements that competent controllers might be affected less by the pressures of their job. Other less competent men, it was suggested, struggled more and were strained more by their job. These suggestions were based on many years of involvement with the air traffic system and therefore were considered with great care.

Our visits to air traffic facilities and continued observation suggested that these ideas had considerable merit. It was not difficult to find anecdotal evidence that supported the idea that competence could moderate the effects of workload and possibly influence the effects of air traffic control work on health. Other observational evidence also suggested that competence had a more direct effect on health. Thus, we considered it relevant to find the best method of assessing the competence of the individual ATCs.

Alternative Techniques for Assessing ATC Competence

A number of techniques were available for assessing competence. These included (1) supervisor ratings from annual performance evaluations, (2) semi-annual task performance profile ratings, (3) expert-observer ratings of all ATCs, (4) peer ratings of all ATCs, (5) self-ratings, (6) peer group nominations of the most competent. All of the techniques were feasible, but each had drawbacks as well.

Supervisor ratings are a means of evaluating job performance and merit in the FAA. Although this established use of supervisor ratings would have given them a special relevance, their use also presented problems: neither the ATCs nor the supervisors felt the annual performance evaluations were an appropriate measure of competence. Their comments indicated that these evaluations had changed from a performance to a compensation orientation as is common in most companies. Consequently they felt that these evaluations would yield skewed distributions with nearly everyone being rated at the competent end in order to insure annual step-in-grade raises. Thus, supervisor ratings were eliminated as useful measures of competence because of inadequate discrimination between individuals.

Semi-annual task performance profile ratings also are conducted within the air traffic control system. These ratings are made by supervisors using a rating and task definition system that is quite comprehensive (System Development Corporation, 1972). However, the developers of this system noted that it was not applicable for studies across different air traffic facility environments. Further, this system is an "official" system, and consequently, there were poten-

tially serious political problems associated with its use for research. Therefore, we eliminated this method of competence rating from consideration.

Global expert-observer ratings could have been used. We could have trained ex-ATCs or supervisors, for example, to rate the ATCs in the study using scales such as those of Milne and Colmen (1972). However, a major problem with this method was that a standard series of work situations was not available and such a series would be necessary since the depth of observation would necessarily be limited for our particular study. For that reason, this method was not used.

Global peer ratings would have avoided the problem of lengthy, in-depth observations because men would know each other's performance based on years of observation in many different situations. On the other hand, we were informed that we could expect virtually no negative evaluations and a preponderance of very favorable evaluations if we used global peer ratings. Many controllers felt this kind of procedure would be a psychological popularity study. The method was dropped from further consideration.

Self-ratings were ruled out by the study team for a multitude of reasons. One overriding reason for exclusion was the lack of accuracy and validity typical of self-ratings (Lawler, 1967). A probable reason for this inaccuracy of self-ratings is that they are influenced by self-esteem. Other reasons included the lack of comparable standards between individuals, the extremely skewed distribution that could be expected, and the general lack of acceptability of such ratings by either the sponsors or participants in the research.

Peer group nominations (sociometric nominations), the remaining alternative, are a form of peer group rating. Individuals nominate or rank their peers in terms of varying characteristics, such as competence. A given person's "score" in this type of system is the average rank order or the number of nominations received from one's peers. Our subjects informed us that they thought that such a system would be fair, practical, and valid as long as every individual did not have to be rated. That is, our subjects thought it would be all right to say who was "good" but not who was "bad." They did not want to rank-order all relevant individuals (e.g., end up placing someone at the bottom of a list) nor did they want to assign a rating to all individuals (because then someone would end up with the lowest average).

To alleviate these feasibility problems, we arrived at a compromise solution. The Sociometric Peer Rating Questionnaire (SPRQ) was devised so that each subject nominated only three other subjects for each of three questions. A given person could be nominated for

more than one question but only once for each question. A subject was provided with a list of all of the subjects with whom he worked. For men from small facilities, all volunteers from the facility would be on each person's list. For men from larger facilities, each person's list included only men from his own work team and "sister" teams (sister teams work the same shifts). Every man had more than three other persons' names on his list, and therefore, no one was put in the position of ranking or rating everyone. This procedure was acceptable to our subjects.

Since the SPRQ seemed to be the most feasible instrument and method for assessing ATC competence, we investigated previous research on sociometric ratings. Evidence in the scientific literature for the general validity, reliability, and relevance to health of peer ratings is discussed in Appendix 1, under Section III B 5: Background. Available literature, in summary, confirmed that peer nominations could be expected to have a strong relationship to actual job performance.

Application of the Peer Rating Method

A total of 416 men were processed through the first series of examinations for the ATC Health Change Study. Prior to the first man's visit in February 1974, lists of potential participants in the study were drawn up for use with the sociometric questionnaire. Originally these lists contained the 547 names of those eligible for the study on the basis of a stratified random sampling. By January, 1974, 458 men had either volunteered to participate or were undecided.

The lists used for the sociometric nominations were designed to include only active journeyman controllers who had indicated that they were going to participate. Of the 458 men, 11 were undecided, and hence were excluded from the lists (these 11 eventually did volunteer). Another three were on specialized non-controlling assignments, and since our lists included only men working on functioning controller teams, these three were excluded from the lists. Consequently, the list for the first series of examinations included 444 men.

By the end of the first series of examinations in September, 1974, 435 men had signed informed consent forms certifying their decision to participate in the study. Twenty-three of the 458 had changed their decision to participate and/or finally decided not to participate. In addition, 19 men became ineligible to participate because they had been promoted, transferred or medically disqualified within the FAA. Consequently we saw only 416 men in the first series. Of the 416 men, two refused to complete the sociometric questionnaire. Hence, 414 men made the nomina-

tions on the first round. During subsequent administrations of the SPRQ, there were fewer subjects because additional individuals became ineligible for the study.

On the SPRQ questionnaire a man was presented with three questions. First, if all assignments were changed to correspond to his preferences, what three ATCs would he most like to work with (ideal team nominations). Second, without considering technical ability, with what three ATCs would he find it easiest to work (amicability nominations)? Third, without considering how easy it was for him to work with someone, who did he believe were the best controllers from a technical standpoint (competence nominations)?

We provided each respondent with a list of names of men in the study. Each man's list included his own team members and those of the two sister crews with which his team regularly worked. In this way we limited the choices to persons with whom they would be familiar and who were in the study.

Each question was presented separately by the computer along with the appropriate list of names. The ATC typed in the identification numbers of the three persons he chose to meet the criteria of the questions, and further, the subject indicated if each of his selections was on his own team. After receiving the answers to one question, the computer displayed the next question. Checking routines were built into questionnaire programs to preclude invalid answers (such as trying to list the same person three times for one question).

The nomination lists were updated at the beginning of each series of examinations (rounds) but were not modified once a series started. This procedure was followed to ensure that all names were presented to the same (and appropriate) people for the same amount of time. If a subject changed teams during a series, the list on which his name appeared was not modified. Rather, that subject would be given a new list of names from which to make his choices, but his own name would stay on the old list until the next series of examinations. The names of subjects who had dropped from the study between rounds were retained on the list until the next round, so that they could be nominated after leaving the study, but could not participate in nominating others.

Interrelationship of Choices

Before accepting the Sociometric Peer Rating Scale and the procedures we had devised as reliable and valid indicators of the variable we wished to measure, i.e., competence of the indi-

vidual ATC, we carried out a number of tests to determine whether or not the probability of being chosen randomly might affect the frequency of any man being chosen and whether or not the values or choices that were measured by the questionnaire were stable over time. Details of these tests and their results are included in Appendix I, Section IIIB5: Background. The tests that we made persuaded us that no adjustment of the raw scores was necessary. Further, we were reassured by the test-retest reliability coefficients generated over two successive intervals that the peer ratings were reasonably stable. We were primarily interested in obtaining a measure of competence. We placed the question of competence after two questions of a more innocuous nature (who would you put on your ideal team, and who is easy to work with?). The intent of this procedure was to reduce popularity or halo effects on the nominations for competence.

The interrelationships between the three types of choices are presented in Table 29. All of the correlations in the table are highly significant ($p < .001$). A most important finding, however, was that amicability was distinguished from competence (sharing 36% of its variance) and was most highly related to whom an ATC would put on his ideal team. Thus the competence ratings were not simply "nice guys" ratings; however, clearly a number of the ATCs nominated as competent were also "nice guys."

Relationship to Other Psychological Characteristics

Pearson product moment correlations between the three main scores of the SPRQ and other psychological scales were generally very small in magnitude (the highest was .15). This result was not unusual for sociometric ratings (Korman, 1968), but it could have been due to several factors such as non-normal distributions or curvilinear relationships. Consequently we conducted one-way analyses of variance using ordinal categories of SPRQ scores as the independent variables and other psychological scales as the dependent variables.

Table 30 shows the significant analysis of variance results for ideal team nomination categories; Table 31 shows the significant results across the amicability nomination categories; and Table 32 gives the same results for the competence nomination categories. Although more than 40 psychological characteristics were examined for each type of nomination, few unique characteristics were associated with how often one was chosen by one's peers.

The results shown in Table 30 indicate that those men who reported fewer anxiety symptoms and tension discharge mechanisms were nominated to the ideal team significantly more often than

TABLE 29

Correlations Between
Types of Sociometric Nominations
(N = 401)

<u>Nomination</u>	<u>Ideal</u>	<u>Amicability</u>	<u>Competence</u>
al Team	1.00		
amicability	.86	1.00	
petence	.80	.62	1.00

Analysis of Variance Results
for Ideal Team Nominations

Psychological Variable	Number of Times Nominated for the Ideal Team						
	0	1	2-3	4-6	7+		
Anxiety before work	Mean	50.5	51.3	48.7	51.9	46.9	F = 2.70 p < .03
	S.D.	9.9	10.9	9.5	11.1	6.5	
	N.	64	72	127	88	42	
During work anxiety	Mean	51.5	51.8	48.4	51.0	47.6	F = 2.64 p < .04
	S.D.	10.8	10.3	9.4	10.1	8.4	
	N.	64	72	127	88	42	
After work anxiety	Mean	53.0	50.9	48.9	49.5	48.3	F = 2.28 p < .06
	S.D.	10.8	10.0	10.0	9.5	9.4	
	N.	64	72	127	88	42	
Tension Discharge Mechanisms on Bad Days	Mean	53.2	51.3	49.4	48.9	48.4	F = 2.60 p < .04
	S.D.	10.9	10.9	10.4	9.0	7.2	
	N.	64	72	127	88	42	

Analysis of Variance Results for
Amicability (Ease of Working With) Nominations

Psychological Variable	Number of Times Nominated as Easy to Work With						
	0	1	2-3	4-6	7+		
Subjective Costs (Visit 1)	Mean	52.1	52.6	49.7	47.9	51.0	F = 2.94 p < .02
	S.D.	10.5	8.6	10.4	10.6	7.9	
	N	56	77	132	87	41	
Social Coping Resources (Visit 1)	Mean	47.7	49.7	49.3	52.5	49.3	F = 2.22 p < .06
	S.D.	10.0	10.9	9.7	9.6	9.4	
	N	56	77	132	87	41	
CPI Dominance (Visit 2)	Mean	58.5	56.0	57.6	55.9	53.6	F = 2.39 p < .05
	S.D.	12.2	12.3	11.1	12.0	12.4	
	N	80	79	95	92	44	
CPI Self-Acceptance (Visit 2)	Mean	61.6	58.8	58.7	57.2	57.0	F = 2.86 p < .03
	S.D.	9.2	9.7	9.7	8.8	9.0	
	N	80	79	95	92	44	

TABLE 32

Analysis of Variance Results
for Competence Nominations

Psychological Variable		Number of Times Nominated as Most Competent					
		0	1	2-3	4-6	7+	
During Work Anxiety	Mean	51.8	50.8	49.7	50.1	46.6	F = 2.47 p < .04
	S.D.	10.9	9.5	10.5	9.8	7.4	
	N	84	75	100	80	54	
Tension Discharge Mechanisms on Bad Days	Mean	53.7	50.0	48.4	50.3	47.9	F = 4.11 p < .003
	S.D.	10.5	10.0	10.0	10.1	8.0	
	N	84	75	100	80	54	
Outside Activities to Cope	Mean	52.4	49.2	50.5	49.6	47.3	F = 2.46 p < .05
	S.D.	10.7	10.3	8.5	10.1	9.9	
	N	84	75	100	80	54	
Toughmindedness	Mean	47.6	50.2	51.9	48.8	51.8	F = 2.85 p < .02
	S.D.	10.3	11.2	10.1	9.7	7.6	
	N	84	75	100	80	54	
Investment	Mean	47.0	49.2	51.6	50.6	51.0	F = 2.84 p < .02
	S.D.	9.7	10.3	9.9	9.6	10.4	
	N	84	75	100	80	54	

those men who reported a higher number of anxiety symptoms. Although there was a high correlation (.86) between nominations for an ideal team and for being easy to work with (amicability), a different set of self-reported psychological characteristics differentiated the men chosen as most amicable (see Table 31). As shown in Table 31, those who were nominated as "easy to work with" experienced fewer subjective costs and tended to have more social resources than those who were never nominated for this attribute.

Perhaps the most interesting result was the finding that the amicability nominations were related to the traits of dominance and self-acceptance as measured by the California Psychological Inventory. The people who were never nominated as being easy to work with scored the highest on dominance and self-acceptance while those who were nominated most often for this characteristic scored significantly lower on these two traits. It appears that more dominant, self-accepting controllers are not particularly easy to work with.

Finally, the results for competence nominations are presented in Table 32. Those men who were nominated most often as competent reported themselves to be significantly less anxious at work, using fewer tension discharge mechanisms, engaging in fewer community and union activities, and having greater toughmindedness and more job investment than those who were nominated only once or never.

SUMMARY

General Job-Related Variables

Three sets of scales were used to assess the ATCs' general attitudes toward their jobs and work: the Job Description Inventory (JDI), the Kavanagh Life Attitude Profile (KLAP) and the Leader Behavior Description Questionnaire - Form XII (LBDQ).

Of five scales of the JDI, the three used were: Satisfaction with Pay, Satisfaction with Co-workers and Satisfaction with Work itself. The KLPA's two scales, Group Morale and Individual Satisfaction, were used as measures of overall satisfaction. Certain supervisory behaviors, as seen by the ATCs, were reported and measured in terms of frequency on the LBDQ. The supervisory dimensions measured were: Initiation of Structure (IS), Tolerance of Freedom (TF) and Consideration (C). Psychometric properties of internal consistency, test-retest reliability and independence of the scales were tested and found to be adequate.

Attitudes of the ATCs toward the work itself were found to be average when compared to a normative sample of other workers stratified by socio-economic characteristics; ATC attitudes toward co-workers were low and toward pay, above average when compared with the same normative sample. In comparison with workers at comparable salaries, ATC attitudes towards work, co-workers and pay were quite low.

The three supervisory behavior qualities were noted less frequently among ATC supervisors than among comparison supervisors.

The KLAP revealed that 42% of the ATCs felt "so-so" in general about their jobs. Differences in responses between the Group Morale and Individual Satisfaction scales supported a conclusion that the major sources of dissatisfaction were note in the ATCs' work itself, but rather in the work environment.

b. General Job-Related Variables

In addition to our decision to explore psychological and attitudinal dimensions particular to the air traffic controlling occupation because of their potential impact on health outcomes of the men, a reading of the industrial psychology literature persuaded us that we should also investigate more general work and job satisfactions as possible modifiers, if not generators, of health change.

A number of studies suggested that satisfaction or dissatisfaction with work were related to health (Antonovsky, 1968; Caplan, 1971; Kasl and Coff, 1970; French and Caplan, 1970; Friedman, Rosenman and Carroll, 1957; Groen and Drory, 1967; House, 1972; Jenkins, 1971; Kornhauser, 1965; Maaora and Taustein, 1969; Quinn, Staines and McCullough, 1974; Russek, 1959; Sales, 1969; Sales and House 1971; Wolf, 1971; Weintraub, 1974; Palmore, 1969; Beret, 1972). However, as none of the previous studies were longitudinal in nature, it was not possible to determine what associative, modifying or possibly causal role was played by the work attitude factor, nor were the findings consistent in relating work satisfaction to types of illness.

The current study provided an opportunity to determine whether or not general job satisfactions were related to changes in health, and whether deterioration in attitudes toward work anteceded or were concurrent with health changes.

While it was necessary to devise an instrument to assess dimensions particular to the air traffic control occupation (preceding section), the more general attitudes toward work and jobs (regardless of the specific nature of the work) could be assessed by existing industrial psychological scales which provided, at the same time, normative scores from other populations so that we could compare job attitudes of ATCs with those of males in a diverse group of other industries.

We selected three sets of scales to assess general job attitudes or perceptions. The Job Description Inventory (Smith, Kendall and Hulin, 1969), the Kavanagh Life Attitude Profile (Kavanagh, MacKinney and Wolins, 1971), and the Leader Behavior Description Questionnaire - Form XII (Stogdill, 1963).

The Job Description Inventory (JDI)

Because of its extensive use, and availability of norm data, the JDI was a useful instrument for comparisons of job satisfactions between the ATC group and other populations. In addition, it had strong psychometric properties to recommend

it (Smith et al., 1969).

Of the five scales contained in the JDI - satisfaction with supervision, with promotions, with pay, with co-workers and with work itself - we used only the last three named. The satisfaction with supervisors scale was omitted because another more comprehensive measure of supervisory behavior was used. The satisfaction with promotions scale was omitted because this dimension was included in the ATC Questionnaire and was directed specifically to FAA promotion policy. The scale relating to pay was shortened from nine to five items to reduce overlap with another scale and to eliminate items inappropriate to the ATCs.

The Kavanagh Life Attitude Profile (KLAP)

In addition to the measurement of satisfaction with specific aspects of the job, such as pay and co-workers, we wanted to have a measure of the ATCs' overall satisfaction with the job. Such a global measure of satisfaction, it was thought, might well relate differently to health change than would the measures of satisfaction with specific aspects of the job.

The KLAP scale (Kavanagh, et al., 1971) was chosen as the global measure of job satisfaction. The instrument contains two overall satisfaction scales -- group morale and individual satisfaction with 10 and 8 items, respectively. These scales differ from other job satisfaction scales in that the items, individually, measure various aspects of the job, but are summed to derive indices of overall individual satisfaction and group morale.

The KLAP scales differ from other job satisfaction scales also with respect to reference. Most scale development is based on factor analysis of responses to job attitude items, with the resulting scales, or factors, comprised of items similar in their reference to a given aspect of the job. For example, the JDI Work scale contains items whose common reference is the work the person is doing. The two KLAP scales were based on a different developmental analysis, one that clustered agreement among people (not items) to job satisfaction items.

Items showing the highest agreement between employees of the same work group were identified to comprise one scale, while those items showing the lowest (from a larger set of items) agreement were combined into another scale. Examination of the reference of these two sets of items revealed that those with high agreement referred to job factors that employees held in common, while those for which there was low agreement were distinctly individualistic in reference. The latter was named Individual Satisfaction, while the former was named Group Morale.

One advantage of these scales versus single items is that the respondent is not asked to sum the various job aspects "in his head," and respond with a summary answer. In addition, this scale distinguishes between two aspects of overall satisfaction, individual feelings and feelings shared with other employees (group morale). Group morale is the overall attitude a person shares with others in his work group or organization, and it typically involves factors external to the person such as the company administration, or the supervision he receives. Group morale is expected to be fairly stable over time. On the other hand, individual satisfaction as an overall measure is more personal and typically deals with factors internal to the person, such as whether or not he finds his work boring. Individual satisfaction is expected to be more variable over time.

Strong psychometric properties reported by Kavanagh, et al. (1971) added to this instrument's utility as a measure of overall job satisfaction.

Leader Behavior Description Questionnaire (LBDQ)

A measure of the behavior of the supervisor as seen by the employee is included in the ATC HCS for several reasons. The effect particularly of the immediate supervisor's style or behavior on employee's performance, job satisfaction and role conflicts seem to be important (e.g., see Campbell, Dunette, Lawler, and Gilley, 1970; Korman, 1966; Stogdill, 1974; Kahn et al., 1964; and Filley, 1968; Vroom, 1964). In addition to the importance of supervisory behavior generally, it has been shown to be particularly important specifically in the ATC occupation (Singer and Smith, 1971; Smith, 1973). An unpublished report by CAMI on the attitudes of ATCs, for example, states that "the dominant issue for all three ATC specialties (ARTCC, TRACON, and Tower) is that of management. In this they share attitudes in common with European controllers and with employees in most other ATC specialties." Finally, we hypothesized that there would be a relationship between supervisory behavior and job stress, and we intended to investigate possible relationships between supervisory behavior and health changes, we determined to include a measure that would allow us to assess supervisory influence in the work environment of the ATC.

Rather than measure attitudes (satisfaction) toward supervisors, we decided to measure supervisory behavior because this would be more useful. It could tell us what supervisors were in need of improvement, so that recommendations for intervention might be made as appropriate; and since behavior is more easily changed than attitudes, it would pro-

de a more efficient focus for intervention.

Although a variety of scales were available to measure supervisory behavior (see Stogdill, 1974), three major ones demanded consideration, the Supervisory Behavior Description Questionnaire (SBDQ), (Fleishman, 1972), The Leader Opinion Questionnaire (LOQ) (Fleishman, 1972) and the Leader Behavior Description Questionnaire (LBDQ) (Stogdill, 1963).

The LBDQ was chosen because the other scales had limited use in the ATC HCS. The LOQ is a self-description by the supervisor as to how he should behave. This seemed inappropriate for this study as we were interested in the ATCs' perceptions of their existing work environment. The SBDQ and the LBDQ both elicit employees' descriptions of their supervisors' behavior. However, the SBDQ measures only two dimensions of leader behavior, is considerably longer than the LBDQ, and the construct validity of one of its scales has been under sharp criticism (Schriesheim and Stogdill, 1964; Schriesheim, House, and Kerr, 1976; Szilagyi and Keller, 1976; Eisenberg and Kavanagh, 1972). On the other hand, the psychometric evidence for the development and use of the LBDQ is reasonably good (Stogdill, 1963).

The LBDQ was developed from earlier work describing behavioral dimensions of the supervisor's role (Stogdill and Bowers, 1957). However, these early efforts resulted in the identification of only two dimensions of supervisory behavior. It seemed unreasonable to assume that two dimensions would be sufficient to describe completely the complexity of supervisory behavior. Thus, the LBDQ-Form XII (referred to as the LBDQ in this report) was developed to include additional dimensions of leader behavior, and the LBDQ-Form XII contains 100 items to measure 12 dimensions. In order to keep the questionnaire to a manageable size for use in the study, the ATC HCS team limited the number of dimensions in the study. Based on observations of the ATCs in job interaction with their supervisors as well as on interviews with various ATCs, the following supervisor behavior dimensions were chosen: 1) Initiation of Structure (IS - clearly defines own role, and lets followers know what is expected; 2) Tolerance of Freedom (TF) - allows followers scope for initiative, decision, and action; and 3) Consideration (C) - attends to the comfort, well-being, status, and contribution of followers.

It is important to recognize that the LBDQ measures the frequency of supervisory behaviors, not satisfaction with supervisory behavior. The instructions for the LBDQ items

clearly indicate that the ATCs were to report their perceptions of the frequency of their supervisors' behavior on the items.

Technical Considerations

Certain measurement aspects of the scales described in this section should be set forth, including specific modifications made to improve the quality of the scales, and psychometric evidence supporting the use of the various measures. As the psychometric evidence regarding the development of the scales has been referenced, this section deals with the following topics: 1) number of scale points, 2) reduction in the length of the scales, 3) reliability of the scales, and 4) independence of the variables.

Number of Scale Points

All scales were converted to 7 point response formats. This was done for several reasons. First, numerous studies have found that reliability of scales is a monotonically increasing function of the number of scale points (Guilford, 1954). As Nunnally (1967) has pointed out, the increase in reliability, starting with two scale points, is very rapid at first, and then tends to level off at about seven. Secondly, from a practical standpoint, seven-point scales were used to allow the ATCs more latitude in responding to individual items. Finally, seven-point scales, contrasted with shorter scales, could lead to increased item scale variance, thus potentially increasing the value of a given variable for predicting health change.

The original JDI scales were formulated as three-point scales, LBDQ as five-point scales, and the KLAP as 99-point scales. It is important to determine if the seven-point format for the LBDQ and LBDQ were equivalent to the original response format, since the scales have norms which were based on their particular response format. Since the KLAP had no norms, this was not necessary. Item response transformations were developed so that the LBDQ and the LBDQ could be scored using both the seven-point system and the original response format. The re-scored scales were related with the standard seven-point scales, with the following results: Work Satisfaction: .77; Coworker Satisfaction: .74; Satisfaction: .87; Initiation of Structure: .90; Tolerance of Freedom: .93; and Consideration: .90. For practical purposes, the magnitude of these values indicates that the scores may be considered virtually equivalent. Much of the difference between the observed correlation and the theoretical may be a function of the reduced range of the original measurement rather than a failure of the new format to have the same meaning as the original.

Scale Reduction

Since the number of items contained in the first data collection phase was large, we thought that reducing the number of items within each scale would be desirable. However, the basic meaning of each scale had to be maintained. In order to accomplish this, item-total scale score correlations were calculated to determine which items were most highly related to the total scale score. The items in each scale were also regressed on the scale score using a step-wise procedure. This procedure adds items one by one, in descending order of correlation with total scale score, until the total variance accounted for in the scale score by the present equation (larger by one predictor item) is not significantly different from the variance accounted for by the previous equation of predictor items. This procedure maintains the meaning of the scale while decreasing the number of items to be used in later data collection phases.

The regression analysis was computed on the first 173 participants' responses in Round 1. For the JDI - Work Satisfaction, the regression solution indicated 10 items (original number of items was 18) could be used ($F = 212.9$, $p < .001$). These ten items accounted for 93% of total scale score variance. For the JDI - Coworker Satisfaction, the stepwise solution indicated 10 items (original number was 18) could be used ($F = 275.6$, $p < .001$). These items accounted for 94.4% of the total score variance. The Pay scale of the JDI was not analyzed because it only contained four items. Likewise, the two subscales of the KLAP were not analyzed because they contained eight and ten items respectively. In addition, the original development of these scales was empirically different from the typical scale development procedure, making item-total regression analysis inappropriate for reducing scale length. The original scale development (see Kavanagh et al., 1971) involved correlating people, not items, to identify group morale and individual satisfaction. Item-item or item-total score correlations to reduce scale length would thus violate the conceptual foundation of these scales. Therefore, these scales were retained in full for subsequent data collection rounds.

Regression analysis of the LBDQ revealed that the subscales could be reduced in length. The Initiation of Structure scale, originally 10 items, could be reduced to 5 items, which accounted for 91% of the total score variance ($F = 354.9$, $p < .001$). The Tolerance of Freedom scale, originally 10 items, could be reduced to 5 items that accounted for 96% of the total scale score variance ($F = 247.3$, $p < .001$). Finally, the regression solution indicated that the Consideration scale, originally 10 items, could be reduced to 5 items that accounted

for 95% of the total scale score variance ($F = 596.77$, $p = .001$).

However, the exclusive use of items from the regression analyses could have lowered the internal consistency of the scales since the regression technique tends to choose items relatively independent of each other so as to maximize the total explained variance. To insure that the internal consistency would not be seriously affected, the highly correlated items identified in the first analysis but not included by the regression were included in the revised, shortened scales.

The result of this dual procedure was to reduce the total number of items in the combined scales from 89 to 54. The table below shows the item reduction by scale.

<u>SCALE</u>	<u>ORIGINAL NUMBER OF ITEMS</u>	<u>REVISED NUMBER OF ITEMS</u>
<u>JDI</u>		
Work Satisfaction	19	8
Coworker Satisfaction	18	7
Pay Satisfaction	4	4
<u>KLAP</u>		
Individual Satisfaction	8	8
Group Morale	10	10
<u>LBDQ</u>		
Initiation of Structure	10	6
Consideration	10	6
Tolerance of Freedom	10	5

These are the scales that were used in subsequent data collection phases. The modified form of these scales is included in the Exhibits appended.

Reliability of the Scales

Internal Consistency. Internal consistency reliabilities were calculated using coefficient alpha (Nunnally, 1967, p. 193-196) for the eight shortened scales. As can be seen from Table 33, all scales met acceptable standards of reliability (Nunnally, 1967, p. 226). The reliabilities also compared favorably with previous research. Smith et al. (1969) found internal consistency reliabilities of .73, .78, and .67 for the Work, Coworker and Pay scales, using a sample of 80 males from two electronic plants. Stogdill (1963) reported the following ranges of reliabilities for the LBDQ scales: 1) Initiation of Structure - .72 to .80; 2) Tolerance of Freedom - .58 to .86; and 3) Consideration

.76 to .87. As can be seen in Table 33, the reliabilities for the ATC HCS compared quite favorably with these values and supported the use of the scales. No previous internal consistency reliabilities were reported for the Individual Satisfaction and Group Morale scales since this was not appropriate in their development (Kavanagh et al., 1971). However, the values in Table 33 were quite acceptable. The lower value for the individual satisfaction scale as contrasted with the group morale scale was consistent with their conceptual basis. One would expect items with reference shared by team (or group) members to be more internally consistent than satisfaction items individualistic in nature.

Test-Retest Reliability. Not only was it important for scales to be internally consistent, but it was also important that the scores for the ATC study group were relatively consistent over time as the variables measured by the scales were thought to be relatively enduring attitudes. Table 34 presents the test-retest reliabilities for the scales for three rounds. The test-retest reliabilities met generally accepted standards for reliability of measurement over time (Nunnally, 1967). The relatively lower values for the LBDQ were most likely a result of changes in supervisors between data collection points, rather than weakness of the measurement. The rather remarkable result in Table 34 was that the reliability over eighteen months did not show substantial deterioration from the nine-months test-retest reliabilities.

Independence of Variables

The independence of the industrial psychological variables was tested by inter-scale correlations. If two variables were highly correlated, it would make little sense to include both in a study as a score on one would allow prediction of the score on the other. Table 35 presents the results of the inter-scale correlation for the Round 1 data. Most of the values in Table 35 were low enough to support the conclusion that the variables were indeed independent measures. However, the correlations above .60 indicated some overlap between the measures. No values were high enough to warrant dropping variables from the study.

Inter-scale correlations for Round 2 between the job-specific attitude scales discussed in the previous section and the general job-related scales discussed in this section are presented in Table 36. Again, these values did not warrant the dropping of any scales. The significant correlations between the five general satisfaction scales and the job-specific scales provided evidence that the latter scales were indeed measuring the ATCs' affective (attitudinal) responses to their

TABLE 33

Internal Consistency Reliabilities
For Industrial Psychological Scales

INSTRUMENT	SCALE CONSTRUCT	RELIABILITY COEFFICIENTS
DI*	Work Satisfaction	.81
	Coworker Satisfaction	.73
	Pay Satisfaction	.69
LA?*	Individual Satisfaction	.62
	Group Morale	.82
DDQ*	Initiation of Structure	.72
	Consideration	.75
	Tolerance of Freedom	.89

Based on Round 1, N = 410

Test-Retest Reliabilities For Industrial Psychological Scales

SCALE CONSTRUCT	ROUND 1- ROUND 2 RELIABILITY* (N = 386)	ROUND 2- ROUND 3 RELIABILITY* (N = 352)	ROUND 1- ROUND 3 RELIABILITY** (N = 347)
JDI			
Work Satisfaction	.71	.67	.60
Coworker Satisfaction	.62	.67	.51
Pay Satisfaction	.65	.69	.63
KLAP			
Individual Satisfaction	.63	.66	.63
Group Morale	.66	.65	.59
LBDQ			
Initiation of Structure	.58	.54	.43
Consideration	.58	.58	.48
Tolerance of Freedom	.56	.50	.42

* An average test-retest period of nine months.

**An average test-retest period of eighteen months.

TABLE 35

Correlation Matrix For The Industrial Psychology Scales - Round 1

Work Satisfaction	1.00							
Coworker Satisfaction	0.34	1.00						
Pay Satisfaction	0.01	0.19	1.00					
Individual Satisfaction	0.19	0.33	0.66	1.00				
Group Morale	0.16	0.31	0.30	0.53	1.00			
Initiation of Structure	0.11	0.13	0.03	0.20	0.52	1.00		
Consideration of Others	0.11	0.18	0.09	0.30	0.55	0.63	1.00	
Tolerance of Freedom	0.11	0.18	0.06	0.22	0.39	0.32	0.61	1.00

NOTE: These correlations are based on an N of 375, since only ATCs with scores on all variables were included in this analysis.

TABLE 36

Correlations Between The Job-Specific Attitude Scales
And The General Job-Related Scales

General Job-Related Scales	Job-Specific Attitudes		
	Satisfaction with Management	Satisfaction with Training	Satisfaction with Promotion
Work Satisfaction	.11	-.13	.16
Worker Satisfaction	.25	-.30	.22
Job Satisfaction	.38	-.24	.21
Individual Satisfaction	.57	-.35	.43
Group Morale	.57	-.28	.47
Participation of Structure	.22	-.05	.18
Consideration	.34	-.06	.28
Tolerance of Freedom	.21	-.01	.15

er Round 2, N = 392

obs.

The inter-scale correlations for the JDI scales compared favorably with the original work done by Smith et al. (1969). They reported the following values based on 981 males pooled across 21 plants: (1) Work-coworker .36; (2) Work-Pay, .40; and (3) Coworker-Pay, .28. These values for the ATC HCS were (1) .34; (2) .01; (3) .19. Although the ATC results appear better in terms of being more independent measures in two of the three cases, it must be remembered that the ATC results were based on a single occupational group, whereas the Smith et al. (1969) results were based on many different occupations in different organizations. No comparison interscale correlations were available for the other industrial psychological variables; however, the values were generally low with a few exceptions. Interpretation of other results must take these correlations into consideration.

Normative Comparisons

JDI. We compared the ATC scores to norms in order to determine how satisfied the ATCs were with aspects of their job compared with other workers. Table 37 presents the results of the normative comparisons for the ATC scores on the JDI scales. In order to understand these results, it is necessary to describe the normative sample for the JDI (Smith et al., 1969). The male norms were based on 2,019 males pooled across a total of 21 plants, representing 19 different companies and 16 different Standard Metropolitan Statistical Areas. According to Smith et al. (1969, p. 88), "the basic sample was drawn from individual units (with 50 or more employees) of business and industrial firms in the continental United States (excluding Alaska) as of 1956," and they claimed that "the 21 plants and 16 communities are reasonably representative of the range of conditions found in American industry and business." The sampling of workers in terms of job levels was as follows: 22% unskilled, 30% semiskilled, 18% skilled, 13% white collar, and 17% supervisory (almost entirely at the first-line level). Selected company and community characteristics are displayed in Tables 38 and 39.

The importance of understanding the normative sample characteristics can be seen by examining the percentile rankings in Table 37. Compared against the total array of normative samples, the ATC means converted to percentiles for the work, coworker and pay satisfaction scales were 46 percentile, 24 percentile and 60 percentile, respectively. The attitudes of the ATCs sample toward the work itself were therefore about average com-

TABLE 37

Norm Comparisons for the Job Description Inventory

SCALE	ATCS	MALES IN 21 INDUSTRIES	ATC %ILE OVERALL	ATC %ILE BY INCOME GROUP	ATC %ILE BY EDUCATION GROUP	ATC %ILE BY JOB TENURE GROUP	ATC %ILE BY COMMUNITY PROSPERITY	ATC %ILE BY COMMUNITY DEPRE-ITUDE
Satisfaction with Work	36.20	36.57	46	8	30	46	43	50
	6.56	10.59						
	408	1977						
Satisfaction with Coworkers	39.64	43.49	24	15	31	27	32	34
	6.90	10.02						
	410	1928						
Satisfaction with Pay	33.29	29.90	60	17	52	53	68	64
	12.93	14.53						
	400	1966						

All cells read: Mean
 Standard deviation
 Number of subjects

Highest 13-14 yrs educ 10-15 yrs exp. 37-50 yrs 19-25 yrs

TABLE 38

Characteristics Of Companies In Normative Sample, 1960

STATE	LOCATION	PRODUCT OR SERVICE	NUMBER OF EMPLOYEES	AVERAGE ANNUAL EARNING	
				MALE	FEMALE
Mich.		Brass fittings	475	5220	3810
Md.		Research	75	6380	3220
Mass.		Office files	360	3140	1770
Mass.		Electronics	3100	5310	3250
Mass.		Aero weapons	2500	5670	3050
Conn.		Pumps	745	5890	3800
Wis.		Heavy machinery	630	4830	3500
N.Y.		Iron foundry	105	6400	--
Ind.		Instruments	620	6330	4040
N.Y.		Appliances	4200	6010	3790
Wis.		Iron castings	115	4950	--
Ill.		Retail	2000	5230	2190
Ill.		Phone equipment	900	4560	3130
N.C.		Textiles	505	3080	2230
Mass.		Valves	415	5380	--
Pa.		Glass	490	4730	3310
Wis.		Small machinery	1000	5340	3610
Minn.		Banking	1550	5670	3320
Ill.		Power	720	6300	4000
Tenn.		Chemical production	3000	6680	4850
Tenn.		Chemical research	4000	7305	5270

Characteristics of Communities in Normative Sample, 1960

PLANT	POPULATION (In 1000s)	APPROXIMATE MEDIAN FAMILY INCOME	MEDIAN MONTHLY RENT	% OWNER OCCUPIED HOMES	MEDIAN HOME VALUE (in \$1000s)	MEDIAN AGE
1	3800	6800	79	71	13	29
2	2000	7600	88	49	17	29
3	140	5200	56	44	12	34
4	2600	6700	82	52	16	32
5	2600	6700	82	52	16	32
6	100	8000	91	68	23	32
7	1200	7000	88	58	16	30
8	1300	6500	75	61	15	31
9	110	6500	71	78	10	28
10	560	6400	79	67	13	30
11	1200	7000	88	58	16	30
12	6200	7300	90	51	19	31
13	50	6000	87	64	14	26
14	130	4700	51	61	7	26
15	2600	6700	82	52	16	32
16	40	4800	55	74	7	28
17	1200	7000	88	58	16	30
18	1500	6800	78	68	15	28
19	290	6300	71	70	12	30
20	60	5900	63	69	7	26
21	60	5900	63	69	7	26

ared to Smith's representative sample, low (24th percentile) in comparisons of attitudes toward coworkers, and above average (60th percentile) in comparisons of attitudes concerning pay.

However, Smith et al. (1969) stratified their general norms on income, education, job level, community prosperity, and community decrepitude. This stratification of norms allowed comparisons which took into account the specific characteristics of the sample. The most striking change occurred when the norms for the ATC means were adjusted for income. All three attitude areas dropped sharply, indicating that, compared to persons in the normative sample earning comparable salaries, the ATCs' attitudes toward work (8th percentile), coworkers (15th percentile) and pay (17th percentile) were quite poor. The ATC group was, however, compared with persons in the Smith et al. (1969) sample who were earning a comparable salary of "\$14,000 and over" in 1960. As contrasted with the journeymen ATCs, the Smith sample most likely would be most entirely from the supervisory and professional levels. Thus, this comparison may not have been altogether valid, and the pattern in Table 37 may present a better understanding of the ATC scores.

It seems apparent from the table that ATCs were most satisfied with their pay, and slightly above average compared to other workers. They were least satisfied with their coworkers and clearly below average in comparison with other workers. It also seems apparent from the comparison data given in Table 37 that ATCs, in comparison with other workers, were about average or slightly below average in satisfaction with work. There was no strongly favorable attitude area for ATCs when compared with other workers, although their satisfaction with pay was above average.

LBDQ. Normative comparisons for these scales were not possible, as norms were not developed. However, it was still possible to compare the ATCs' scores with other groups because Stogdill (1963) reported means and variances from a wide range of different samples. Table 40 presents the ATC results against the results reported by Stogdill. In the table, the means represent subordinates' descriptions of how frequently their supervisor/leader engaged in a given behavior. Thus, the headings of the columns refer to the supervisors of the group members who provided the behavioral ratings.

Several interesting facts emerged from Table 40. First, ATC supervisors were significantly lower than other supervisors for all three supervisory behaviors. With respect to Initiation of Structure, the ATCs described their supervisors as not

Leader Behavior Description Questionnaire Results

SCALE	ATC SUPERVISORS	ARMY OFFICERS & NCO'S	AIRCRAFT EXECUTIVES	COMMANDING		COMMUNITY LEADERS	LABOR UNION PRESIDENTS	CORPORATION PRESIDENTS
				POLICE OFFICERS	MINISTERS			
Initiation of Structure (IS)	31.78	38.60	36.60	39.70	38.70	37.20	38.30	38.50
	6.92	5.70	5.40	4.50	4.90	5.70	5.60	5.00
	409	235	165	185	103	57	44	55
Consideration (C)	33.08	37.10	37.10	36.90	42.50	41.10	42.30	41.50
	7.12	5.60	5.80	6.50	5.80	4.70	5.50	4.00
	408	235	165	185	103	57	44	55
Tolerance of Freedom (TF)	35.13	35.90	38.00	36.30	37.50	36.40	38.00	38.90
	4.77	6.50	5.90	5.30	6.00	5.00	4.00	4.90
	408	235	165	185	103	57	44	55

All cells read: Mean
Standard Deviation
Number of Subjects

clearly defining their own roles and not letting the ATC know what was expected. This finding was consistent with the observations of the ATC HCS team when visiting the facilities as well as in interviews with the ATCs. This may stem partly from unique features of ATC work that emphasize a great deal of individual responsibility. ATCs, unlike many other employees, are highly trained when they begin on the job; thus, the amount of directive behaviors by their supervisors to ensure adequate job performance may be low.

The ATCs reported less frequent consideration by their supervisors than that reported for other supervisors. This result probably indicated a low level of interaction between supervisors and ATCs.

However, the last comparison from Table 40 was inconsistent with this low interaction interpretation; that is, ATCs, in comparison with other groups, reported that their supervisors had about the same, or a slightly lower frequency of Tolerance of Freedom behavior. Thus, the ATC supervisor's behavior, in terms of allowing his employees scope for initiative, decision and action, was perceived by the ATCs as slightly lower than other groups. If there were a low level of interaction between the ATCs and their supervisors as previously argued, one would expect the mean for Tolerance of Freedom to be higher. Examination of the pattern of means for the other groups in the table illustrates the rationale for this argument. The means for Tolerance of Freedom, in general, were lower than those for Consideration and Initiation of Structure. Typically, a supervisor with high frequency of the Initiation of Structure and Consideration behavior was conversely reported to have less Tolerance of Freedom. ATCs showed a distinctly different pattern of means.

One explanation for this apparent inconsistency may be that the supervisors did not interact very much with the ATCs in terms of actual work performance; however, the supervisors may have been restrictive in terms of non-work performance activities, e.g., daily assignments, timing of work breaks, etc. Some anecdotal evidence from observations by the ATC HCS team of the ATCs in their work place provided some support for this observation.

KIAP. Since there were no norm groups or comparison samples for these variables, a different perspective was needed to interpret the ATC results on individual satisfaction and group morale. The primary purpose of attitude surveys in industry is to diagnose problem areas in organizations. Most companies prefer to develop locally meaningful surveys than to use standard surveys which have complete norms but are generic and non-specific in nature relative to the unique characteristics of that company. Thus,

there has emerged a generally-accepted guideline or threshold as to when a certain level of dissatisfaction indicates a problem exists and management should take some action. This generally-accepted threshold value varies from 20% to 25% dissatisfied response.

This threshold value is based on several considerations. First, national surveys taken over the past 20 years indicate the level of dissatisfied workers varied from 8% to 19%, with a mean of 14% (Quinn et al., 1974). Second, from a practical viewpoint, many managers believe that having 1 in 5 or 1 in 4 of their workers dissatisfied is a serious problem. Finally, dissatisfaction of workers is costly in terms of turnover, absenteeism, and potentially lowered productivity. A recent empirical study (Mirvis and Lawler, 1977) found that "expected direct-cost savings of \$17,664 in absenteeism, turnover, and performance" could result from a .5 standard deviation increase in job satisfaction.

Using this standard for dissatisfaction, an examination of Table 41. reveals several noteworthy findings. First, the consistent percentage of scores in the neutral category for both individual and group morale indicated that about 42% of the ATCs felt "so-so" in general about their jobs. The distribution for Individual Satisfaction was not severe, although about 21% of ATCs were dissatisfied with their overall personal satisfaction in their jobs, while 36% were personally happy with their jobs. The story changed markedly for Group Morale. The percentages were reversed -- 39% of ATCs were dissatisfied with the general morale in their jobs, while only 19% were satisfied.

Examination of the items in these scales (Table 42) provided one possible explanation for these results. The Group Morale scale was mainly concerned with management, supervision, and working conditions, all factors extrinsic to the ATC's actual work, while the Individual Satisfaction items were more personalistic and dealt with the controller's job. This would lead one to conclude that the major sources of dissatisfaction in the ATC's job were not in the work itself, but rather in the work environment surrounding him.

TABLE 41

Scale Score Distributions For The Kavanagh Life Attitude Profile

<u>VARIABLE</u>	<u>PERCENT DISSATISFIED</u>	<u>PERCENT NEUTRAL</u>	<u>PERCENT SATISFIED</u>
Individual Satisfaction	20.9	42.9	36.2
Group Morale	38.9	42.0	19.1

TABLE 42

KLAP ScalesINDIVIDUAL SATISFACTION

- I am extremely underpaid for the work that I do.
- I can learn a great deal on my present job.
- There is too much pressure on my present job.
- I am satisfied with my salary in relation to my job responsibilities.
- I am satisfied with the extent to which higher management keeps me informed by written communication (about my job).
- I often feel tired and worn out on my job.
- My supervisor has always been fair in his dealings with me.
- For my kind of job, they expect too much work from me around here.

GROUP MORALE

- Management here sees to it there is cooperation between departments.
- This facility operates efficiently and smoothly.
- My supervisor has the job well organized.
- Management really knows its job.
- My supervisor knows very little about his job.
- Poor working conditions keep me from doing my best work.
- My supervisor lives up to his promises.
- Management here does everything it can to see that employees get a fair break on the job.
- For my kind of job, the working conditions are okay.
- My supervisor gets employees to work as a team.

SUMMARY

Impact of Life Changes

To test whether or not life change events were important in the development or exacerbation of disease, an inventory of life events, called Review of Life Experiences (ROLE) was developed and consisted of appropriate items from the two major existing inventories, the Holmes and Rahe Schedule of Recent Experiences (SRE) and the Paykel, Uhlenhuth and Prusoff (PUP) questionnaire, and an additional 20 items representing important life events not included in the other two. A total of 103 items appeared in the ROLE.

The ATCs were asked to make two ratings for each event that had occurred to them, a rating from 1 to 99 for the adjustment the event required of them, and another rating from 1 to 99 of the distress the event caused them. Four different life change assessment scores were derived:

- 1) a score based on the Holmes and Rahe items, using their scoring method, which was based on weights placed on the different items in accordance with the amount of adjustment that a normative population group had indicated that item required;
- 2) a score based on the PUP items, using the Paykel, Uhlenhuth and Prusoff scoring method, which weighted the items by the amount of distress a normative population group had assigned to each item;
- 3) a score on the Holmes and Rahe items based on the adjustment weight each ATC himself assigned to that item; and
- 4) a score on the PUP items based on the distress weighting that the individual ATC assigned to that item. In addition all 103 items could be summed for a total distress score.

It was found that the ATCs assigned greater weight to the adjustment required by their life events than the Holmes and Rahe normative population did, but they were less distressed by their life events than the PUP normative population.

Because further analysis suggested that the normative weights reflected more the number of life events than the distress caused by them, it was decided to use the ATCs' own ratings of distress caused by the life changes in further predictive studies.

6. Impact of Life Changes

We knew from our previous reading of the psychology literature that life events were considered by many researchers to play an important role in the development or exacerbation of disease (Hurst, Jenkins and Rose, 1976, 1978). We were therefore interested from the outset of the study in ascertaining whether or not significant events occurring in the lives of the ATCs were related in time and in emotional effect to the onset of either physical or psychological diseases, or both. However, the method of quantifying life change events and attributing the derived measurements to appropriate conclusions presented certain problems.

Existing Methods of Measurement

Two major approaches had been developed for the systematic recording of life events and their effects on individuals. The Holmes and Rahe approach (Holmes, Rahe, Hawkins, Davies and others, 1957, 1967a, 1967b, 1967c, 1969, 1970, 1976) involved the development and testing of an instrument to assess the frequency of occurrence of 43 life events. This instrument, the Schedule of Recent Experience (SRE) was later revised, with an addition of 12 items, and renamed the Recent Life Change Questionnaire. Another instrument, the Social Readjustment Rating Questionnaire (SRRQ) was devised to be used with the SRE. By administering the SRRQ to research populations, the developers were able to obtain population ratings of the amount of readjustment required after the occurrence of specific SRE life events. These population estimates of readjustment, called life change units or LCU, were applied to the events checked by an individual on the SRE and summed to give an individual a total life change score.

The second approach, that of Paykel, Prusoff and Uhlenhuth (1971, 1972), involved use of a 61-item questionnaire to elicit the life changes that had occurred, and also to attach to these life events varying weights (LCW) that represented population ratings of the amount of distress caused by each specific life change. The Total Life Change score in this approach was the sum of the life changes that had occurred weighted by the distress a general research population had attached to each such life event.

The Holmes and Rahe and the Paykel, Uhlenhuth and Prusoff questionnaires overlapped somewhat in item content, and were similar to the extent that they both applied population estimates of the amount of distress or adjustment to the events reported by an individual to avoid the circularity that might occur in retrospective studies; that is, it was important in retrospective studies that the individual who became ill did not on that account ascribe related importance to the life event occurring previously.

Although both the approaches were based on the number of significant life changes occurring to an individual, the Holmes and Rahe weighted the readjustment required while the Paykel, Prusoff and Uhlenhuth weighted the distress produced by the event.

Our research into the value of using one or the other method of assessing life change raised a number of questions that led eventually to our use of the items from the two available instruments with other items that we added together with a different weighting perspective, in a new questionnaire that we called the Review of Life Experiences (ROLE).

These questions involved the applicability of the population ratings established by the original research to other groups and cultures, the possible differences in ratings of impact when the events were actually experienced as opposed to estimates of impact when they were not actually experienced, the effect on the ratings of the recency of the event, the age and the sex of the rater.

Although the developers of both existing instruments declared that the normative weighting units used for each were applicable to many different groups, and additional research supported this contention in terms of the rank ordering of life changes, little was known about the way in which cultural group differences affected the total life change score, the variable we intended to use for our predictive studies. In addition, results of several studies of differences in ratings for recent events and for the same events when they were more remote, and results of studies of age and sex differences in rating, all caused us to decide that the state of the art of measuring life change events and interpreting the measurements was neither sufficiently advanced nor expedient to merit the use of the existing methods without modification.

One modification that appeared to us to be very important and that was suggested in the literature by Rahe (1976) and others (Goldberg and Comstock, 1976; Paykel, Prusoff and Uhlenhuth, 1971) after some years of research with the original approach was the use of individuals' idiosyncratic ratings for weights instead of the normative ratings. The results of several studies suggested that the individual's own ratings may have better power to predict disease than normative ratings (Lundberg, Theorell and Lind, 1975; Rubin, Gunderson and Arthur, 1969, 1971).

Additional details of the characteristics of the existing instruments, the results of research involving their use, and the questions that have been raised can be found in three papers prepared for publication under auspices of this study which are included in Appendix II (Hurst, Jenkins and Rose, 1975, 1978, and Hurst, forthcoming, 1979).

Review of Life Experience (ROLE)

After studying the questions briefly summarized above and concluding that neither one instrument nor the other sufficiently satisfied our purposes, we devised a composite questionnaire, called the Review of Life Experience (ROLE). The ROLE included 39 of the 43 items of the Holmes and Rahe SRE and 52 of the 61 items of the Paykel et al. questionnaire. We added 20 new items that represented important life crises not included in the two existing scales. In addition some of the standard items in both lists were broken down into their positive and negative aspects. The ROLE as it was constituted allowed us to create Holmes and Rahe equivalent total LCU's, and Paykel, Prusoff and Uhlenhuth equivalent total LCW's. After indicating that any listed event had occurred, the ATC was asked to make an adjustment rating and a distress rating from 1 to 99 for that event.

The instructions for adjustment and distress were carefully written to distinguish between the two, and a linear scale was presented for each to illustrate how to assign a value. The scale had markers every 10 points. Beneath the 1-10 range on the adjustment scale was written "vacation." "Marriage" was written beneath the range of 44-55. "Death of spouse" was written beneath the range of 90-99. The distress ratings, to be made after the adjustment ratings, were accompanied by a scale with "child married with your approval" written under the 1-10 range, "additional person in house" written under the 45-55 range, and "child died" written under the 90-99 range. A copy of the ROLE with instructions is included in the Exhibits appended.

Although we had excluded certain items of each of the schedules because they were not applicable to our group (e.g., questions concerning pregnancy, retirement, etc.), the total scores of our ATC respondents on the Holmes and Rahe items would be the same as if we had used the original schedule because the items excluded would not have occurred to them anyway; and the ATCs' scores on the Paykel et al. items would also correspond to their scores on that original schedule.* Therefore, we were able to compare our ATCs with the normative groups on each set of items, and as the adjustment and distress ratings were made for all 103 ROLE items, we were also able to ascertain whether or not there were significant differences between the amount of adjustment and the amount of distress caused by the specific life change events.

* The original Paykel et al. inventory used a range of 1-20 rather than the 1-infinity scale, later reduced to 1-100, used in the Holmes and Rahe schedule. Therefore, for comparison with the Paykel norms, we simply divided the ATCs' scores by 5 to obtain equivalence.

The ROLE questionnaire provided, therefore, four primary life change assessment scores: 1) the Holmes and Rahe normative total LCU equivalent, 2) the Paykel et al. normative total LCW equivalent, 3) an individual's total life change adjustment rating for the Holmes and Rahe items, and 4) an individual's total life change distress rating for the Paykel et al. items. In addition it was possible to sum across all 103 items for a total distress score.

Procedure

At the intake visit to Boston University Medical Center, the ATCs completed the ROLE at video terminals, responding interactively to the computer displays. Previous instructions on using the terminals had been provided and checking and verification programs were built in to preclude invalid responses.

The entire list of 103 items was presented first, one at a time. A subject indicated if the event never occurred in the prior 2 years, if it occurred in the past 6 months, if it occurred in the previous period of 7-24 months, or if it occurred both in the past 6 months and in the preceding 7-24 months. The computer was programmed to accept only one of the four alternatives. At the end of the presentation and response to all 103 items, the subject had an opportunity to change answers. The computer re-displayed the item, and the new answer could be substituted.

When satisfied with his response concerning occurrence or non-occurrence of events, a subject was presented with the instructions for adjustment ratings. The anchoring scale was continuously displayed in a protected field of the video display. The computer retrieved items that the subject indicated had occurred. It displayed the item and requested an adjustment rating in accordance with the instructions. After receiving adjustment ratings for all of the events that had occurred to the subject, the computer displayed the instructions for distress ratings along with the distress scale. Again the items were displayed and a distress rating was requested. Hence ratings were obtained only for those events that had occurred to a subject.

Descriptive Findings

Table 43 displays a comparison of total life change scores using the individual's ratings with the scores produced when the normative ratings were used. The table shows that the individuals' own ratings of the adjustment required by their life change events produced a significantly higher life change score than that produced by the same life changes weighted by the normative LCU of the Holmes-Rahe items ($t = 2.99, P < .01$). On the other hand, the

TABLE 43

Comparison Of Total Life Change Scores
Using Individuals' Ratings versus Normative Ratings

	<u>N</u>	<u>Mean Total</u>	<u>Standard Deviation</u>	<u>t for correlated means</u>	<u>df</u>
SRE total LCU	356	111.04	75.85	2.99*	355
Total individual adjustment ratings for SRE items	356	124.84	118.38		
PUP total LCW	356	30.68	23.88		
Total individual distress ratings for PUP items	356	15.97	17.92	-16.91*	355

*p < 0.01

ATCs' own ratings of distress resulted in a significantly lower mean total score than that produced by applying the normative LCW to the Paykel et al. items.

The intercorrelations of the life change total scores produced by the four different assessment methods are displayed in Table 44. The highest correlation, .29, was between the SRE total LCU and the PUP total LCW, attributable partially to the overlap of 25 items between the two schedules. The total individual adjustment rating scores correlated .68 with the normative scores and the total individual distress rating scores correlated .73 with the normative weighted scores.

In summary, the life change events of the ATCs appeared to require more adjustment on their part than other groups have indicated, and appeared to cause less distress than other groups have experienced.

The frequency distributions of the number of life events that occurred for each man in the most recent 6-month period are shown for the SRE and the PUP schedules in Table 45. The distributions for both inventories were highly skewed, with that for the SRE events less skewed than the PUP inventory (significance of the difference, Kolmogorov-Smirnov $D = .23$, $P < .01$). The median number of Holmes and Rahe events per individual was 4, or 10.2% of those possible; for the PUP events it was 3, or 5.8% of those possible. Overall, for all 103 items in the ROLE, the average proportion of events per individual was 11.7%. The ROLE event frequency distribution was less skewed than that of the two contributing inventories.

As further analysis suggested that the normative weights may reflect more the number of life change events than the stress generated by them (see Hurst, Jenkins and Rose, 1978), we saw additional justification for proceeding with our predictive studies using the individually rated life change scores.

The extent to which this variable was related to the development of physical or psychiatric illness is discussed in Section V, Predictive Findings.

TABLE 44

Intercorrelation Matrix Of Life Change
Total Scores For Four Assessment Methods
 (N = 356)*

	<u>SRE</u> <u>Total LCU</u>	<u>PUP</u> <u>Total LCW</u>	<u>Total</u> <u>Adjustment</u>	<u>Total</u> <u>Distress</u>
SRE total LCU	1.00	0.79	0.68	0.59
PUP total LCW	0.79	1.00	0.56	0.73
Total adjustment score for SRE items	0.68	0.56	1.00	0.71
Total distress score for PUP items	0.59	0.73	0.71	1.00

All correlations significant at $P < 0.0001$, 2-tailed

Number of events	HR SRE			PUP Inventory		
	Absolute frequency	Relative frequency	Cumulative relative frequency	Absolute frequency	Relative frequency	Cumulative relative frequency
0	12	3.0	3.0	21	5.2	5.2
1	27	6.7	9.7	61	15.1	20.3
2	40	9.9	19.6	78	19.3	39.6
3	61	15.1	34.7	73	18.0	57.6
4	76	18.8	53.5	43	10.6	68.2
5	51	12.6	66.1	47	11.6	79.8
6	30	7.4	73.5	31	7.7	87.5
7	33	8.1	81.6	16	4.0	91.5
8	29	7.2	88.8	13	3.2	94.7
9	21	5.2	94.0	6	1.5	96.2
10	10	2.5	96.5	5	1.2	97.4
11	6	1.5	98.0	9	2.2	99.6
12	4	1.0	99.0	2	0.5	100.1
13	2	0.5	99.5	0	0	100.1
14	2	0.5	100.0	0	0	100.1
15	0	0	100.0	0	0	100.1
16	0	0	100.0	0	0	100.1
17	1	0.2	100.2	0	0	100.1
Totals	405	100.2 ^a	100.2 ^a	405	100.1 ^a	100.1 ^a
Mean (SD)	4.9(2.8)			3.6(2.6)		
Median	4			3		
Mode	4			3		

^a These totals do not add up to 100% due to rounding error.

SUMMARY

Measurement of Air Traffic Controller Workload

In order to determine whether or not the air traffic controllers' differential psychological, behavioral or physiological responsiveness on the job was related to their health changes, their differential workload needed to be evaluated. Components of workload assessed were:

- 1) Peak aircraft, the raw maximum number of planes coming under control within the 2 minutes before physiological measurements were made;
- 2) Transitioning aircraft, a count of the number of planes climbing or descending in the few seconds before the physiological measurements;
- 3) Proposals, the planes expected to come under a controller's legal authority;
- 4) Duty position, one of seven positions: data or clearance delivery, hand-off or ground control, radar or local control, check-ride monitor, training, radar coordinator, or supervisor; or on break;
- 5) Sector Types, one of five types: arrival/departure, enroute low, transition low, enroute high, transition high;
- 6) Percentage of air space not available because of military operations or weather conditions.

Other workload measures were derived as follows:

- 1) Normalized peak traffic, a measure reflecting the difference between peak traffic at any place/time/position and the average peak traffic that could be expected for the facility/sector/position at that time, allowing comparisons of men's responses to change in workload regardless of facility, sector or position worked;
- 2) Maximum peak traffic, the highest raw peak traffic count recorded for a man during a field study day;
- 3) Maximum normalized peak traffic, the highest normalized peak traffic for a man in a day,
- 4) Range in peak traffic, representing the fluctuation in a man's workload for a day;
- 5) Range in normalized peak traffic, representing the fluctuation in normalized work load;
- 6) Maximum consecutive time on position, the maximum number of consecutive observation periods during a day that a man worked a journeyman position without a break;

- 7) Total time on a working position, the number of times, of a possible 15 in a study day, that a man worked on a journeyman position;
- 8) Training time, the amount of time a man spent during the 5-hour study day in training developmental controllers;
- 9) Training work, the peak traffic counts of the trainee while being trained by a subject controller.

These measures were transformed into the following measures, each representing some unique dimensions of workload for the day:

- 1) Paceload, the sum of raw peak traffic recorded for a man during the day, maximum peak traffic and range in peak traffic over the day;
- 2) Normalized workload, the sum of normalized peak traffic, maximum normalized peak traffic and range in peak traffic for a day;
- 3) Timeload, the sum of maximum consecutive time on position and total time on position;
- 4) Area workload, a measure of airspace load estimated by number of transitioning planes plus a weighted index applied to the five types of sectors;
- 5) Time training, the measure defined as a component of workload;
- 6) Work training, the measure defined as a component of workload.

Because the workload of individuals varied from day to day, an average paceload, average normalized workload, average timeload, etc. was calculated to characterize each man's work across 10 field studies. These average measures were used in some analyses, while for other analyses, the specific value of a variable at a particular field visit was used.

The following findings emerged:

- 1) Paceload increased, on average, by 50% over the course of the study;
- 2) Paceload differed significantly among the facilities;
- 3) The oldest group of controllers tended to have a lower mean paceload, but there was no significant difference between three groups clustered by length of experience;
- 4) Facilities did not differ in average normalized workload, as expected by design of the variable;
- 5) Neither age nor experience grouping provided systematic differences in normalized workload;

- 6) Timeload differed at the different facilities;
- 7) Age and experience differences in timeload were not statistically conclusive;
- 8) Facilities differed significantly in amount of time spent training;
- 9) The oldest and most experienced ATCs spent the least amount of time in training others;
- 10) Trainees at the NYARTCC handled more aircraft than trainees at other facilities;
- 11) There was a tendency for the trainees of older and more experienced controllers to handle fewer aircraft.

7. Measurement of Air Traffic Controller Workload

A major emphasis of this study was to examine air traffic controllers on the job to determine if their differential psychological, behavioral or physiological responsivity on the job was related to the development of health changes. Consequently, in May of 1974 we began studying men for five-hour periods during randomly selected work days, measuring blood pressure, collecting blood samples for hormone assay, observing behavior and noting workload. At the conclusion of our field studies in July, 1977, we had completed 1,470 blood pressure studies and 1,156 hormone studies yielding a total of 2,626 man-days of studies at work. As some of these studies represented augmentations of the routine ten visits to the field and included a small number of highly cooperative men, our basic data consisted of 2,570 man-days of observation at work, resulting from the five studies of blood pressure and five studies of endocrine variables. Since each man-day consisted of five hours of observation and three observations were made for each hour, a total of 38,550 concurrent observations of physiology and work formed the basis for our assessment of workload and responsivity on the job. For some studies of workload alone, 2626 man-days of data were used.

Table 46 displays the number of field studies completed for the participants. As can be seen, almost all controllers were subject to at least one field study. Those few who were not had dropped out of the study or were ineligible for field studies by the time that they were approached. On the average, 6.2 days of observation were completed for the original 416 air traffic controllers who volunteered for this study. More than half of the controllers had six or more field studies completed by July, 1977.

Workload was observed and measured concurrently with measurement of blood pressure and collection of blood samples for endocrine studies. Table 47 displays the number of participants for whom blood pressure and endocrine field studies were completed. Blood pressure studies were completed for more men than endocrine studies, a result which we attribute to the less invasive blood pressure measurement equipment.

Each field study included an assessment of eight possible moods at the beginning of the day (see Section IIIB8). After the ATC completed the mood questionnaire, there were either 15 measurements made of blood pressure or 15 collections of blood serum at 20-minute intervals. Each of these physiological events took place two minutes after the evaluation of eight different work variables. At the end of the study day, a controller completed a 17-item "subjective difficulty" questionnaire that inquired about his opinion of the day's work dif-

TABLE 46

175

Number of Field Studies
Completed by Participants

<u>Number of Studies</u>	<u>Number of Men Men Completing</u>	<u>% Of Original 416 ATC Volunteers</u>
0	27	6.5
1	389	93.5
2	367	88.2
3	347	83.4
4	325	78.1
5	289	69.5
6	263	63.2
7	229	55.0
8	180	43.3
9	123	29.6
10	58	13.9

Total Field Studies = 2570

Average Field Studies per Participant = 6.2

TABLE 47

Participants For Whom
Blood Pressure and Endocrine
Field Studies Were Completed

of s	<u>Number of Men Completing Endocrine Studies</u>	<u>% of Original 416 ATC Volunteers</u>	<u>Number of Men Completing Blood Pressure Studies</u>	<u>% of Original 416 ATC Volunteers</u>
	369	88.7	382	91.8
	316	76.0	340	81.7
	243	58.4	288	69.2
	158	38.0	249	59.9
	63	15.1	162	38.9
Studies	1149		1421	

Field Studies = 2570 Man-days
 Hours of Observation = 12,850 Man-hours
 observations = 38,550 Observations

faculties. A description follows of the workload variables that were assessed by direct observation and those that were derived, and our method of determining the most complete and appropriate measures of workload.

Components of Work That Were Assessed

Peak Aircraft. A number of previous studies, including two preliminary studies of this research team, indicated that the raw maximum number of planes coming under control within a unit of time was the best objective index of workload for controllers. These previous studies showed that peak traffic was significantly related to "pace" (ratings of behavioral arousal and activity while controlling aircraft), heart rate and observer-rated stress (Hurst and Rose, 1978a, 1978b; Laurig, Becker-Biskaborn and Reiche, 1971; Philip, Reiche, and Kirchner, 1971).

In these previous studies the unit of time during which the maximum peak traffic was observed varied from 1 minute to 10 minutes. The present research team conducted a pilot study varying the observation time from 2 minutes to 10 minutes at 1-minute intervals. We found that the peak traffic during a 2-minute period of time was highly correlated (above .80) with the peak traffic that would be observed in 10 minutes. Consequently, for the purpose of this study, peak traffic was assessed in ten two minutes prior to a physiological measurement or collection in order to allow the field technicians the opportunity to study more than one man per day.

Transitioning Aircraft. Two published studies also suggested that the number of transitioning planes, i.e., those ascending or descending, might be a relevant objective index of workload (Hurst and Rose, 1978a, 1978b). These studies investigated the theoretical variables of Arad (1963, 1964a, 1964b), called control load variables. Although Arad's work was primarily intended for the optimization of sector design characteristics, we used his formulations in a pilot study. The pilot study included data from the sectors in the New York and New England Air Route Traffic Control Centers and from all of the major IFR airport towers in the continental United States. The results of the pilot study showed that the number of transitioning aircraft was significantly related to Arad's airspace control load variable and was in fact an important component of workload. Consequently, our field studies also included a count of the number of planes climbing or descending (transitioning) in the few seconds before the physiological measurements or collections.

Proposals. "Proposals" were considered to be a third possible component of workload. These are the computerized

flight plan reports received and posted at an air traffic controller duty station, and they represent those planes that can be expected to come under the controller's legal authority. Although no previous research has established the relevance of proposals, our observations in the facilities had indicated that at least some men experienced anticipatory reactions when their proposal board filled up. Consequently, our field technicians also noted the number of proposals on the board in the seconds before the physiological measurement or collection.

Duty Position. The position at which a controller was working also was considered a component of workload. Controllers in air traffic control centers could be working any one of seven positions: data, hand-off, radar, check-ride monitor, training, radar coordinator or supervisor. In towers, controllers could be working data, clearance delivery, ground control, local control, check-ride monitor, training or supervisor positions. Observations in the field and preliminary analyses indicated that the data and clearance delivery positions were essentially equivalent; that the hand-off and ground control positions were essentially equivalent; and that the radar and local control positions were essentially equivalent. Consequently, we combined these positions so that seven position codes were available to be assigned each time a man was observed. Only four of these positions were technically working positions for journeyman controllers with direct legal responsibility for aircraft separation. When a man was on break (either in or out of the control room) or when a man was not assigned a specific job task, a special code was assigned. The positions were as follows:

On break (in or out of the control room) or not assigned. This position code was established to allow separate evaluation of our continuous physiological measures when a man was on a working position and when he was not.

Data or clearance delivery. The data position required a controller to remove proposal strips from the computer and to update these as needed. The strips were placed in plastic holders and then put on the proposal board. The clearance delivery position in a tower required the transmittal of instructions and air field data for takeoff and landing as directed by the local or ground controller. In essence both the data and clearance delivery positions were clerical. These were not journeyman positions since there was no legal responsibility for aircraft.

Hand-off or ground control. The hand-off controller provided the majority of radio communications between sectors when an aircraft was leaving the legal control of one sector and

entering the legal control of another sector. This task relieved the radar controller of these communications. Similarly the ground controller at a tower provided taxiing instructions before and after landing and relieved the local controller of communications with planes that were not yet in a legally defined air space. Hence the hand-off and ground controller positions were primarily communications positions without responsibility for the separation of aircraft in legally defined air space. They were, however, journeyman positions.

Radar or local control. The radar position was the most skilled position of a journeyman air traffic controller. He had the legal responsibility for separating aircraft within his legally defined air space (called a sector) in accordance with FAA standards. In a tower the local controller had this responsibility even though his controlling was primarily visual in nature once an aircraft was handed off from the arrival/departure radar sector of an air route traffic control center or the IFR room in a tower. These were journeyman positions.

Check-ride monitor. The check-ride monitor was a highly responsible position assumed primarily by experienced and highly-rated journeyman controllers. The controller in this position was responsible for a sector but another controller actually provided air traffic separation within that particular sector. The check-ride monitor's responsibility was not only to insure the separation of aircraft within the sector, but also to evaluate the performance of the controller actually providing separation services. A particular kind of stress accompanied this position since the check-ride monitor could not provide instructions or direct traffic without automatically failing the controller attempting to prove his mastery of the sector. This was a journeyman position.

Training. In the training position, a journeyman controller was plugged into a sector along with a non-journeyman controller. The journeyman controller provided on-the-job training for developmental controllers, i.e., those who had yet to prove mastery of all of the sectors within their areas and he had to pass the journeyman air traffic controller examination. The trainer was legally responsible for separation of traffic within the sector at all times. In order to provide appropriate training, however, it was necessary that the trainer allow the trainee some errors in judgment or planning, while making sure that this allowance did not become too general. This was a journeyman position.

Radar coordinator. This position, primarily found in the common IFR Room at Kennedy Airport, entailed coordination of radar controllers at several sectors. The radar coordinator

an active separation responsibility and communicated both with working controllers and aircraft. This was not considered a journeyman position since it was supervisory, and a sector coordinator did not have legal control of aircraft.

Supervisor. Occasionally men in the study were assigned temporary supervision of an area. Although responsible for all of the work within an area, the supervisor typically had direct responsibility for active separation of aircraft; rather a man assigned to the temporary supervisory position was primarily responsible for maintaining adequate staffing, rotations on break, meal schedules, and the coordination of personnel activities. This was not considered a journeyman position since it was supervisory, and a supervisor did not have legal control of aircraft.

Sector Types. Our preliminary work also indicated that this type of sector worked was a relevant component of workload (Hurst and Rose, 1978a; Hurst and Rose, 1978b). Five types of sectors were identified.

Arrival/departure sectors were defined as those in which aircraft were accepted from a local controller at a tower or where traffic was handed off to a tower or IFR room. The airspeed of aircraft in such sectors was relatively low. The number of aircraft could become quite high. The area of airspace covered was relatively small, and these sectors were low altitude.

A second type of sector was an enroute low sector, defined as a sector in which air space extended up to 17,000 ft., and within which less than half the aircraft were transitioning. The enroute low sectors had relatively greater numbers of aircraft flying at relatively slow speeds in areas slightly larger than those of arrival/departure sectors. Very often the majority of traffic in these enroute low sectors was general business aviation rather than commercial airliners since the latter was much higher when they are enroute to their destination.

A third type of sector was the transition low sector. The transition low sector was characterized by altitude responsibility below 17,000 ft., but within which the majority of aircraft were climbing or descending. Typically this was the sector to which an arrival/departure sector would hand off.

A fourth type of sector was the enroute high, defined as having responsibility for aircraft above 17,000 ft., and within which less than half the traffic was climbing or descending. Typically these sectors covered thousands of square miles and

were concerned mainly with commercial aircraft on designated airways enroute to their destination at a defined altitude.

In contrast to the enroute high sector, a transition high sector was one in which a majority of planes were climbing or descending in the altitude strata above 17,000 ft. Transition high sectors also primarily handled commercial airline traffic and were responsible for thousands of square miles.

Percentage of Air Space Not Available. Finally, as suggested by Arad's work, our field technicians assessed the percentage of sector air space not available for controlling because of either military or weather conditions. Unavailable air space was an important consideration for workload assessment, since the amount of airspace within which a controller could maneuver aircraft affected his feeling of pressure and activity. Since most pilots do not like to fly through bad weather, airspace may become quite crowded when bad weather blocks normal air routes and controllers must direct pilots to other air space. In addition, the military occasionally block off certain sections of airspace in order to conduct military maneuvers. This reduces the amount of airspace within which a controller can direct air traffic and increases the density of operations.

These six variables were the main components of workload which we decided to observe directly. A number of other components were derived from our field observations.

Components of Workload That Were Derived

Normalized Peak Traffic. A considerable amount of time in the first year of the study was spent in the facilities. Two important observations were made. First, the air traffic conditions varied widely among the facilities. Second, the controllers adapted to and reacted to their environments in similar ways despite the different air traffic conditions. Consequently, we concluded that we needed a measure of air traffic that would be comparable across facilities and would reflect the observation that men's responses to air traffic conditions were relative to what conditions they usually encountered. The conditions to which they were accustomed included not only their facilities per se, but also the position that they were working and the type of sector that they worked. Table 48 displays a comparison of the peak traffic among the different facilities, positions, and sector types, confirming our observations regarding their differing traffic conditions.

	NYARTCC	BOSARTCC	NYCTR	FOXP	FOXP	FOXP
Number of Observations	13000	5335	2840	1320	508	328
Mean Peak ***	4.38	2.63	3.11	2.45	1.62	2.07
S.D.	2.65	1.84	1.76	1.76	1.23	1.49
		F = 541.23	df = 7,23763	p < .0001		

	POSITIONS		
	Hand Off/ Ground Control	Radar/ Local Control	Check-ride Monitor
Number of Observations	4622	15657	81
Mean Peak	3.51	3.52	3.70
S.D.	2.50	2.43	2.09
	F = 38.89	df = 3,23767	p < .0001

	SECTOR TYPES**			
	Arrival/ Departure	EnRoute Low	Transition Low	EnRoute High
Number of Observations	9291	1283	5765	3445
Mean Peak	3.20	4.45	3.27	4.28
S.D.	2.15	2.72	2.26	3.09
	F = 235.62	df = 4,23748	p < .0001	

* Of the 38,550 observations, 23,771 occurred on a working journeyman position (breaks, data coordinator and supervisor positions were excluded).

** 23,753 observations; 18 observations occurred on non-classifiable sectors and were excluded.

*** Mean peak represents the mean of all observations of the maximum number of planes within an ATC's control during a 2-minute period.

The mean peak traffic was significantly different among the different facilities, positions, and sector types, ranging from 1.18 at the Providence Tower to 4.38 at the New York Air Route Traffic Control Center. The mean peak traffic varied from a low of 3.51 at the hand-off (or ground control) position to a high of 4.01 at a training position, and from a low of 3.20 on arrival/departure sectors to a high of 4.45 on en-route low sectors.

To control for these systematic differences, we devised a measure that we called "normalized peak traffic." To accomplish this we computed the mean and standard deviation of peak traffic for every combination of facility, sector type and journeyman position in the entire series of field study observations. All calculations were based on a minimum of ten observations for each combination of the three variables. In cases where fewer than ten observations were available for a given combination, we took the next higher order mean and standard deviation. The order of importance for this special step was facility, sector, and position from highest to lowest. All of the statistics for the mean and standard deviation of peak traffic by every combination of facility, sector, and position are presented in Appendix I, Tables 46-52.

Using these statistics, we then calculated a normalized peak traffic for each sample observation in a day. This normalized peak traffic was equal to the raw peak traffic of the particular observation minus the mean peak traffic, divided by the standard deviation of peak traffic, where the mean and standard deviation were those of the facility/sector/ position being worked when the peak traffic observation was made, as in the following formula:

$$NPT = \frac{PT \text{ of observation} - \text{Mean PT of Facility/Sect./Pos.}}{\text{S.D. P.T. of Facility, Sector, Position}}$$

S.D. P.T. of Facility, Sector, Position

If no peak traffic observation was made because the man was not working one of the journeyman positions, then a missing value was assigned. This method of calculating a normalized peak traffic was the equivalent of calculating a standardized z-score with a mean of 0 and a standard deviation of one for each of the 15 observations in a study day.

Therefore, the normalized peak traffic variable reflected the difference between the peak traffic at a particular point in time and the average peak traffic that could be expected for the facility/sector/position at that time. Since these normalized peak traffic measures were standardized in this

possible to compare men's response to change in workload regardless of the facility, sector, or position they

Other workload component variables were derived from observations within a work day.

Maximum Peak Traffic. The maximum peak traffic a man experienced during the five hours of observation provided a measure of maximum intensity of workload experienced. It was defined as the highest raw peak traffic count recorded for a man during a study day.

Maximum Normalized Peak Traffic. This variable represented the maximum normalized peak traffic experienced by a man during a study day. It was defined as the highest normalized peak traffic count recorded for a man but not including missing values. If a man never worked a journeyman position as previously defined, then the maximum normalized peak traffic was set to a missing value.

Range in Peak Traffic. A man could have a day characterized by a total number of planes and a high maximum peak traffic, but with little variability. In order to assess variability, we defined the range in peak traffic workload measure as the highest peak traffic count minus the minimum peak traffic count for a study day, where the minimum was not a missing value. This measure gave us an indication of fluctuation in a man's workload.

Range in Normalized Peak Traffic. Similarly, we defined the range in normalized peak traffic as the maximum normalized peak traffic for the day minus the minimum normalized peak traffic for the day, excluding missing values. Thus the range in normalized peak traffic represented the fluctuation in standardized workload.

Maximum Consecutive Time on Position. The amount of time a man spent on a journeyman working position seemed an important component of workload. One measure of time on position was defined as the maximum number of consecutive observation periods (out of a total of 15) during a study day that a man worked a journeyman position without a break. Thus this variable could range from zero, when a man never worked a journeyman position, to 15, when a man worked five hours straight without a break.

Total Time on a Working Position. A second method of evaluating time as a component of workload was the number of times, out of a possible total of 15 during a study day, that a man worked a journeyman position. This variable could also range from zero to 15.

Training Time. One of the questions to be answered in accordance with our contract was whether or not training imposed a particular stress upon controllers. Consequently, we devised two measures of training load. The first measure was the amount of time that a man spent doing live traffic training of developing controllers during the five-hour study day. This number could range from zero to fifteen, representing zero to three hundred minutes.

Training Work. We also assessed the amount of work accomplished at the training position by using the peak traffic counts of the trainee. This was done by summing the peak traffic reading only for those sample observations for which the subject controller's position was that of training.

For both the training time and training work variables a missing value was assigned if the individual never worked a journeyman position. If a man worked at any time on a journeyman position but did not have any sample observation in the training position, then the training time and training work variables were set to equal zero rather than a missing value.

Summary Workload Measures

The assessed and derived components of workload required evaluation and organization into one or more measures representing workload for the day. Our measures of workload needed to account for absolute level, duration and variability if we were to demonstrate any relationship between workload and the level, duration and variability of physiological responses to workload. As a consequence of these considerations, six major summary measures were devised.

A large number of preliminary analyses were conducted in order to reduce and combine the workload components into the six summary measures presented and discussed below.

Paceload. Paceload was defined as the sum of 1) raw peak traffic recorded during the 15 2-minute observation periods of a man's study day, 2) maximum peak traffic and 3) range in peak traffic over the study day. This measure included an assessment of the absolute magnitude of workload, a measure of the highest absolute magnitude, and a measure of variability.

Table 49 displays a comparison of paceload among the facilities in the study in two random split-half samples. For these analyses the man-day was the unit of observation and the entire set of 2600+ man-days was randomly split into two. This method was used to insure that any significant results were replicable.

TABLE 49
Comparison of Paceload
Among Facilities*

RANDOM SPLIT-HALF SAMPLE #1 (N=1302)

	<u>NYARTCC</u>	<u>BOSARTCC</u>	<u>BOSTON TOWER</u>	<u>NYCIFR</u>	<u>SMALLER FACILITIES</u>
of tion	636	340	78	164	84
*** ceload	<u>58.19</u>	<u>28.73</u>	<u>30.14</u>	<u>37.26</u>	<u>18.58</u>
	21.99	13.73	15.12	14.39	8.23
F=214.99 df=4,1297 p < .0001					

RANDOM SPLIT-HALF SAMPLE #2 (N=1304)

	<u>NYARTCC</u>	<u>BOSARTCC</u>	<u>BOSTON TOWER</u>	<u>NYCIFR</u>	<u>SMALLER FACILITIES</u>
of tion	635	348	81	164	76
*** ceload	<u>59.65</u>	<u>29.97</u>	<u>28.24</u>	<u>35.52</u>	<u>22.58</u>
	24.58	14.03	11.34	14.19	11.06
F=187.29 df=4,1299 p < .0001					

available man-days were used, including sixth visits, N=2606, for which load could be calculated.

onset, Otis, Providence, Bradley.

ceload = the sum of raw peak traffic recorded while a man was on a journeyman working position, maximum peak traffic and range in peak traffic over the study day.

There was a significant difference in the paceload among the different facilities, the New York Air Route Traffic Control Center (NYARTCC) being certainly the busiest facility in the study in both sets of analyses. The New York Common IFR (NYCIFR) was the second busiest facility. The Boston Tower (Logan) and the Boston Air Route Traffic Control Center (BOSARTCC) were approximately equal in their paceload and finally the smaller facilities were substantially below the other facilities in their average paceload.

Although expressed in units of planes, the paceload, such as 58 planes at the NYARTCC, represents an index of how much work and how variable the work was in each of the facilities rather than an actual number of aircraft controlled.

Table 50 displays comparisons between controllers of three age groups and three experience groups in two random split-half analyses. In both analyses there was a significant tendency for the oldest group of controllers to have a lower mean paceload. On the other hand, the difference in the mean paceload between three experience groups was not significant. The amount of work accomplished during study days appeared, therefore, to be more an age-related than experience-related phenomenon.

Figure E displays the change in paceload over the course of ten chronological field studies. The vertical axis represents paceload; the horizontal axis represents the visit numbers in chronological order. The numbers at data point on the graph represent number of men included at that point. As can be seen in this figure, paceload decreased over the first three field studies and slowly rose to more than 60 aircraft, representing greater than 50% increase in average paceload over the course of the study.

It could be argued that the change in paceload over time reflected differences in the between-visit intervals for the men. However, the graphing of days after intake into the study against field visits (Figure F) showed a near-linear relationship between visits and days elapsed, indicating approximately equal intervals between visits. Therefore the displayed change in paceload over the course of the study represents a real change in paceload over the ten visits, not an artifact of widely different times between field visits.

2) Normalized Workload. The primary reason for devising a normalized workload measure was to enable us to compare workload across facilities in spite of their different environments. Normalized workload was defined as the sum of normalized peak traffic, maximum normalized peak traffic and range in peak traffic.

TABLE 50
Comparisons of Pace load
Among Age and Experience Groups*

Random Split-Half Sample #1(N=1302)

	<u>Age(Years)</u>			<u>Experience(Years)</u>		
	<u>25-34</u>	<u>35-38</u>	<u>39-49</u>	<u>3-7</u>	<u>10-14</u>	<u>15-20</u>
of tion	441	392	469	430	493	379
** ceload	<u>45.70</u>	<u>45.23</u>	<u>40.33</u>	<u>44.73</u>	<u>44.32</u>	<u>41.46</u>
	<u>23.30</u>	<u>23.72</u>	<u>22.89</u>	<u>24.16</u>	<u>22.92</u>	<u>23.04</u>
	F=7.37 df=2,1299 p<.001			F=2.31, df=2,1299 p<.10		

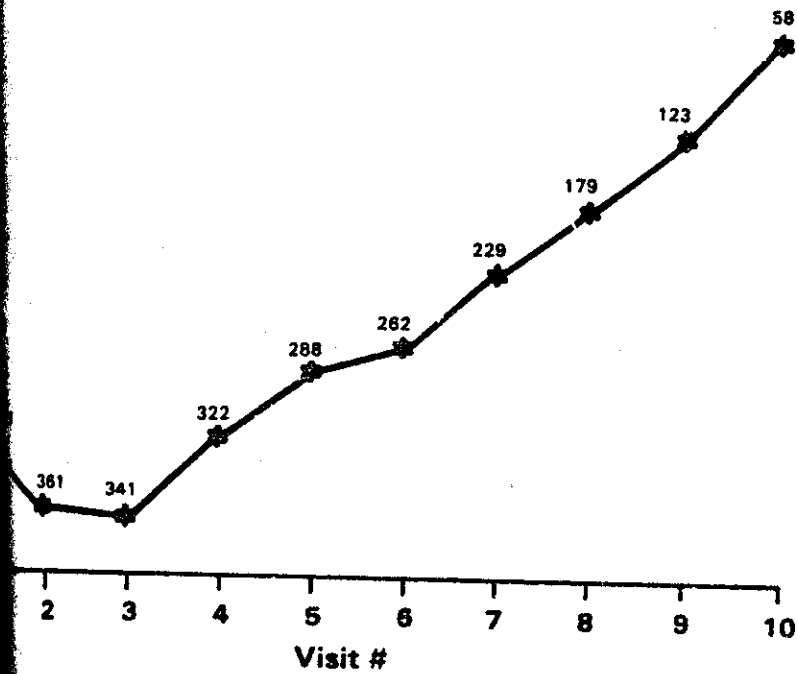
Random Split-Half Sample #2(N=1304)

	<u>Age(Years)</u>			<u>Experience(Years)</u>		
	<u>25-34</u>	<u>35-38</u>	<u>39-49</u>	<u>3-7</u>	<u>10-14</u>	<u>15-20</u>
of tion	451	404	449	460	461	383
** ceload	<u>46.57</u>	<u>45.00</u>	<u>42.67</u>	<u>45.92</u>	<u>44.59</u>	<u>42.97</u>
	<u>25.06</u>	<u>23.02</u>	<u>25.41</u>	<u>24.92</u>	<u>23.47</u>	<u>25.77</u>
	F=2.82 df=2,1301 p<.06			F=1.49 df=2,1301 p>.20		

available man-days were used, including sixth visits, N=2606,
 which paceload could be calculated.

load = the sum of raw peak traffic recorded while a man was on a
 man working position, maximum peak traffic and range in peak
 traffic over the study day.

FIGURE E
CHANGE IN PACELOAD OVER
TEN FIELD VISITS



Note:
The number above each data point is equal to the number of
man-days used to compute the average pace load at each visit.

The normalized workload variable was calculated first in a standard score from (mean = 0, standard deviation = 1) and then was converted to a scale where 500 represented the mean normalized workload across all men and all visits, with a standard deviation of 50.

Table 51 displays a comparison of normalized workload among facilities in two random split-half samples of over 2500 man-days of observation. In both samples, as expected, there was no significant difference between facilities; an average normalized workload in one facility was equivalent to the average normalized workload in another facility.

Table 52 displays a comparison of the normalized workload among age and experience groups. Again the analysis was done as two random split-half samples. In the first random sample there was neither a significant difference in the normalized workload between three age groups nor between the three experience groups. On the other hand, the second sample indicated a significant difference in both age and experience groups, where in both cases the middle of the age range and the middle experience range showed a significantly lower normalized workload. However, since these results were not replicated in the two random samples, they may be regarded as chance variation. We concluded that there was no systematic evidence of either older men exceeding younger men or the reverse in normalized workload over their entire period of time in the study.

The normalized workload across 10 field visits in chronological order is graphed in Figure G. As can be seen, the normalized workload decreased over the first three visits and increased over the remaining seven visits. Although this graph is of normalized workload, it is very similar to the payload graph depicted in Figure E. The normalization procedure did not alter the changing trend in workload over ten consecutive field visits.

3) Timeload. The variable, "timeload," was deduced from a number of preliminary analyses indicating that the two time components of workload, maximum consecutive time on position and total time on position, were related more to one another than to the other components of workload. Consequently, timeload was computed as the sum of maximum consecutive time on position and total time on position. The resulting numbers are in units of 10-minute periods, such that a timeload of 10 represents ten 10-minute periods or a grand total of 200 minutes.

Table 53 displays a comparison of the timeloads among the facilities in the study. Both split-half samples produced a significant difference in the timeload measured at the facilities.

TABLE 51
Comparison of Normalized Workload
Among Facilities*

Random Split-Half Samples #1(N=1302)

<u>NYARTCC</u>	<u>BOSARTCC</u>	<u>BOSTON TOWER</u>	<u>NYCIFR</u>	<u>SMALLER FACILITIES**</u>
636	340	78	164	84
<u>497.93</u>	<u>498.14</u>	<u>503.22</u>	<u>501.58</u>	<u>490.72</u>
<u>53.21</u>	<u>44.25</u>	<u>50.26</u>	<u>46.61</u>	<u>38.87</u>

F=.95 df=4,1297 p > .50

Random Split-Half Sample #2(N=1301)

<u>NYARTCC</u>	<u>BOSARTCC</u>	<u>BOSTON TOWER</u>	<u>NYCIFR</u>	<u>SMALLER FACILITIES</u>
633	348	81	163	76
<u>503.53</u>	<u>499.69</u>	<u>496.91</u>	<u>498.76</u>	<u>507.82</u>
<u>56.90</u>	<u>45.87</u>	<u>(34.84)</u>	<u>(43.60)</u>	<u>46.18</u>

F=.94 df=4,1296 p > .50

available man-days were used, including sixth visits, N=2603, for which normalized workload could be calculated.

onset, Otis, Providence, Bradley

normalized workload = the sum of normalized peak traffic, maximum normalized peak traffic and range in peak traffic.

Comparison of Normalized Workload
Among Age and Experience Groups*

Random Split-Half Sample #1(N=1302)

	<u>Age (Years)</u>			<u>Experience (Years)</u>		
	<u>25-34</u>	<u>35-38</u>	<u>39-49</u>	<u>3-7</u>	<u>10-14</u>	<u>15-20</u>
on Days	441	392	469	430	493	379
	<u>500.32</u>	<u>495.85</u>	<u>498.35</u>	<u>496.95</u>	<u>498.56</u>	<u>499.38</u>
	<u>49.07</u>	<u>48.48</u>	<u>49.83</u>	<u>49.48</u>	<u>48.28</u>	<u>50.03</u>
	F=.86 df=2,1299 p > .50			F=.26 df=2,1299 p > .50		

Random Split-Half Sample #2(N=1301)

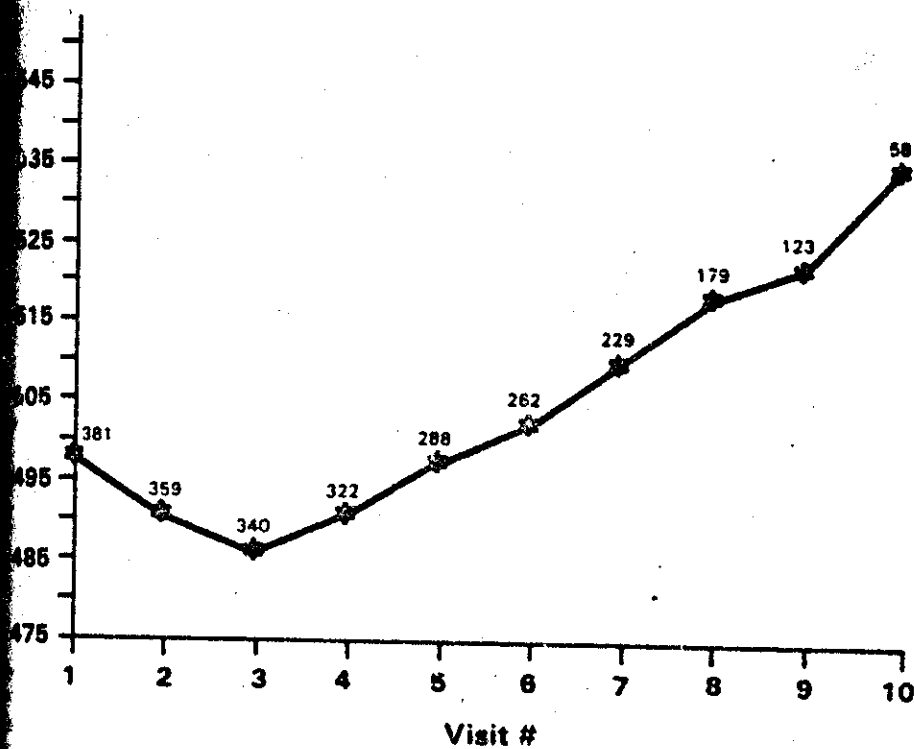
	<u>Age (Years)</u>			<u>Experience (Years)</u>		
	<u>25-34</u>	<u>35-38</u>	<u>39-49</u>	<u>3-7</u>	<u>10-14</u>	<u>15-20</u>
	449	403	449	458	460	383
	<u>506.47</u>	<u>498.41</u>	<u>500.01</u>	<u>506.66</u>	<u>498.02</u>	<u>500.34</u>
	<u>50.08</u>	<u>50.34</u>	<u>51.59</u>	<u>50.11</u>	<u>49.38</u>	<u>52.82</u>
	F=3.09 df=2,1298 p < .05			F=3.55 df=2,1298 p < .03		

*The man-days were used, including sixth visits, N=2603, for normalized workload could be calculated.

workload = the sum of normalized peak traffic, maximum peak traffic and range in peak traffic.

FIGURE G

CHANGE IN NORMALIZED WORKLOAD OVER TEN FIELD VISITS



Note:
The number above each data point is equal to the
number of man-days used to compute the average
normalized workload at each visit.

Comparison of Timeload
Among Facilities*

Random Split-Half Sample #1(N=1302)

	<u>NYARTCC</u>	<u>BOSARTCC</u>	<u>JOSTON TOWER</u>	<u>NYC1FR</u>	<u>SMALLER FACILITIES**</u>
of ation Days	636	340	78	164	84
<u>Time load***</u>	<u>15.66</u>	<u>11.87</u>	<u>13.21</u>	<u>13.96</u>	<u>13.79</u>
	<u>3.16</u>	<u>3.71</u>	<u>3.72</u>	<u>3.49</u>	<u>3.75</u>
F=70.54 df=4,1297 p<.0001					

Random Split-Half Sample #2(N=1304)

	<u>NYARTCC</u>	<u>BOSARTCC</u>	<u>BOSTON TOWER</u>	<u>NYC1FR</u>	<u>SMALLER FACILITIES**</u>
r of vation Days	635	348	81	164	76
<u>Time load***</u>	<u>15.50</u>	<u>12.28</u>	<u>13.53</u>	<u>13.48</u>	<u>13.13</u>
	<u>3.46</u>	<u>3.75</u>	<u>3.69</u>	<u>3.66</u>	<u>3.42</u>
F=49.97 df=4,1299 p<.0001					

available man-days were used, including sixth visits, N=2606, for which load could be calculated.

onset, Otis, Providence, Bradley

eload = sum of maximum consecutive time on position and the total time position.

The New York Air Route Traffic Control Center had the highest mean timeload. The Boston Tower, the New York Common IFR Room and the smaller facilities had approximately equal timeloads, and the Boston ARTCC had the lowest mean timeload.

Table 54 displays a comparison of the timeload among the several age and experience groups. The results for the first random split-half sample indicated that there was a significant difference between both age and experience groups. The oldest and the most experienced groups had significantly lower timeload. However, the second random split-half sample indicated that this result may have been spurious since there was no significant difference between the age or experience groups on the timeload variable. The same trend was, however, apparent in the second sample: the oldest group and the most experienced group tended to have lower timeload.

The mean timeload over 10 chronological field visits is graphed in Figure H. As with the paceload and normalized workload variables, timeload decreased from the first to the second visits, but while workload continued to decrease, timeload began to pickup between the second and third visits. The remainder of the figure shows that timeload generally tended to continue increasing over the remaining field studies.

Comparison of Figure H with E and G shows that the total amount of time men spent on position and consecutively on position increased very rapidly in advance of changes in either of the traffic workload variables. Timeload was characterized by rapid rises followed by a leveling off, which would seem to suggest an adaptation. It would seem that the men spent more time on position to cope with increased traffic, but after a while, their time on position leveled off, perhaps indicating greater efficiency. After a while at the same timeload, the traffic workload increased sufficiently to cause the men to increase their time on position again, after which it leveled off.

4) Arad Workload. Analyses reported in two previous studies caused us (Hurst and Rose, 1978a, Hurst and Rose, 1978b) to decide to calculate a summary measure of workload based on the formulations of Dr. Arad, a physicist who worked with the FAA to develop a theoretical framework for assessing what was called airspace control load (Arad, 1963, 1964a, 1964b). The previous two studies used data from all of the sectors involved in the present health change study and in addition, from all of the radar rooms at major airports in the U.S. The results of those studies indicated that Arad airspace load was best estimated by the number of transitioning aircraft plus a weighted index applied to the

TABLE 54

Comparison of Time-load
Among Age and Experience Groups*

Random Split-Half Sample #1(N=1302)

	Age (Years)			Experience (Years)		
	<u>25-34</u>	<u>35-38</u>	<u>39-49</u>	<u>3-7</u>	<u>10-14</u>	<u>15-20</u>
on Days	441	392	469	430	493	379
load **	<u>14.50</u>	<u>14.59</u>	<u>13.56</u>	<u>4.48</u>	<u>14.35</u>	<u>13.65</u>
	<u>3.55</u>	<u>3.79</u>	<u>3.88</u>	<u>3.56</u>	<u>3.88</u>	<u>3.82</u>
F=10.34 df=2,1299 p<.0001 F=5.56 df=2,1299 p<.005						

Random Split-Half Sample #2(N=1304)

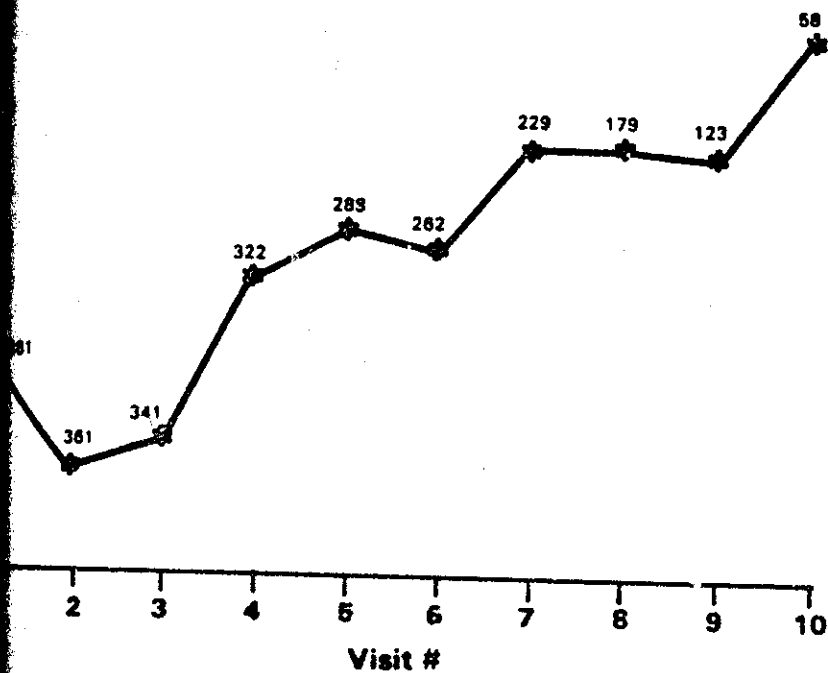
	Age (Years)			Experience (Years)		
	<u>25-34</u>	<u>35-38</u>	<u>39-49</u>	<u>3-7</u>	<u>10-14</u>	<u>15-20</u>
n Days	451	404	449	460	461	383
load**	<u>14.34</u>	<u>14.23</u>	<u>13.82</u>	<u>14.27</u>	<u>14.22</u>	<u>13.84</u>
	<u>3.86</u>	<u>3.88</u>	<u>3.76</u>	<u>3.88</u>	<u>3.68</u>	<u>3.96</u>
F=2.27 df=2,1301 p>.10 F=1.51 df=2,1301 p>.20						

able man-days were used, including sixth visits, N=2606, for which could be calculated.

sum of maximum consecutive time on position and the total time

FIGURE H

CHANGE IN TIMELOAD OVER TEN FIELD VISITS



Note:
The number above each data point is equal to the number
of man-days used to compute the average time load at each visit.

five types of sectors. The results showed a significant relationship between our simplified Arad airspace load and his airspace load calculated from complete data. Consequently we attempted to use the simplified Arad workload measure in the health change study.

The weights applied to different types of sectors, however, included a -12.84 for arrival/departure sectors because they tended to have very simple traffic patterns with many aircraft, whereas other types of sectors generally had fewer aircraft and more complex air traffic patterns. Because of this fact, the regression analysis gave a negative weight to arrival/departure sectors. The results of this negative weight on the overall calculations can be seen in Table 55.

Table 55 displays a comparison of the Arad workload across facilities in two random split-half samples of all man-days of observation. Both analyses indicated a significant difference in the Arad workload in the various facilities. However the difference seems primarily related to those facilities with many arrival/departure sectors compared to those without many arrival/departure sectors. The Boston Tower, the New York Common IFR Room, and the smaller facilities all have a predominant number of arrival/departure sectors and their Arad workload measurements were high negative numbers, whereas the centers had high positive workload measures. These results indicated that the simplified Arad workload computation probably would not be useful in the present study, since it was unacceptably biased by the weight for arrival/departure sectors.

Table 56 displays a comparison of Arad workload across age and experience groups in two random split-half samples. The results show no systematic significant differences between age groups or experience groups. In fact the pattern of results is not even repeated from one sample to the other. Again, these results suggested that the Arad workload measure was not particularly useful because it varied so much from one sample to another and in addition, was highly influenced by the proportion of arrival/departure sectors in facility. Therefore, we decided not to use the Arad measure in continuing analyses.

5) Time Training. Another one of our summary measures was a derived component discussed earlier. The amount of time spent in training during a day was considered both a component of workload, and a summary assessment of a particular type of work. It was used in both ways. Table 57 displays a comparison of time training across facilities in two random split-half samples of all man-days of observation. The analyses replicated one another and showed that there were significant differences in the amount

TABLE 55

Comparison of Arad Workload
Across Facilities*

Random Split-Half Sample #1(N=1302)

	<u>NYARTCC</u>	<u>BOSARTCC</u>	<u>BOSTON TOWER</u>	<u>NYCIFR</u>	<u>SMALLER FACILITIES**</u>
of tion Days	636	340	78	164	94
ed d ***	<u>217.96</u>	<u>434.08</u>	<u>-803.49</u>	<u>-1035.16</u>	<u>-807.62</u>
	<u>1032.42</u>	<u>374.04</u>	<u>514.37</u>	<u>3546.78</u>	<u>533.28</u>
	F=43.52 df=4,1297 p < .0001				

Random Split-Half Sample #2(N=1304)

	<u>NYARTCC</u>	<u>BOSARTCC</u>	<u>BOSTON TOWER</u>	<u>NYCIFR</u>	<u>SMALLER FACILITIES**</u>
of tion Days	635	348	81	164	76
rad ad ***	<u>239.89</u>	<u>454.22</u>	<u>-753.07</u>	<u>-1050.37</u>	<u>-759.66</u>
	<u>1072.68</u>	<u>394.59</u>	<u>414.10</u>	<u>3420.21</u>	<u>513.41</u>
	F=45.39 df=4,1311 p < .0001				

available man-days were used, including sixth visits, N=2606, for which workload could be calculated.
 set, Otis, Providence, Bradley
 d workload - number of transitioning aircraft plus a weighted index
 lled to the five types of sectors.

TABLE 56

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Comparison of Arad Workload
Across Age and Experience Groups*

Random Split-Half Sample #1 (N=1302)

	Age (Years)			Experience (Years)		
	<u>25-34</u>	<u>35-38</u>	<u>39-49</u>	<u>3-7</u>	<u>10-14</u>	<u>15-20</u>
Days	441	392	469	430	493	379
	<u>-25.60</u>	<u>37.51</u>	<u>-33.36</u>	<u>61.49</u>	<u>-113.95</u>	<u>47.67</u>
	<u>2372.10</u>	<u>948.91</u>	<u>876.90</u>	<u>928.48</u>	<u>2257.68</u>	<u>886.91</u>
	F=.26 df=2,1299 p>.50			F=1.81 df=2,1299 p<.20		

Random Split-Half Sample #2 (N=1304)

	Age (Years)			Experience (Years)		
	<u>25-34</u>	<u>35-38</u>	<u>39-49</u>	<u>3-7</u>	<u>10-14</u>	<u>15-20</u>
Days	451	404	449	460	461	383
	<u>39.48</u>	<u>23.47</u>	<u>-18.99</u>	<u>41.36</u>	<u>-123.97</u>	<u>148.83</u>
	<u>901.09</u>	<u>996.38</u>	<u>2229.86</u>	<u>888.90</u>	<u>2280.03</u>	<u>959.37</u>
	F=.17 df=2,1301 p>.50			F=3.40 df=2,1301 p<.04		

available man-days were used including sixth visits, N=2606.
which Arad workload could be calculated.
workload = number of transitioning aircraft plus a weighted
applied to the five types of sectors.

TABLE 57

Comparison of Time Training
Across Facilities*

Random Split-Half Sample #1(N=1302)

	<u>NYARTCC</u>	<u>BOSARTCC</u>	<u>BOSTON TOWER</u>	<u>NYCIFR</u>	<u>SMALLER FACILITIES**</u>
Number of Observation Days	636	340	78	164	84
Mean Time Training***	<u>1.91</u>	<u>.62</u>	<u>1.12</u>	<u>1.01</u>	<u>.68</u>
	<u>3.35</u>	<u>1.61</u>	<u>1.83</u>	<u>2.11</u>	<u>1.63</u>
	F=15.54 df=4,1297 p<.0001				

Random Split-Half Sample #2(N=1304)

	<u>NYARTCC</u>	<u>BOSARTCC</u>	<u>BOSTON TOWER</u>	<u>NYCIFR</u>	<u>SMALLER FACILITIES**</u>
Number of Observation Days	635	348	81	164	76
Mean Time Training***	<u>1.84</u>	<u>.47</u>	<u>1.42</u>	<u>1.14</u>	<u>.58</u>
	<u>3.30</u>	<u>1.31</u>	<u>2.00</u>	<u>2.46</u>	<u>1.70</u>
	F=16.98 df=4,1299 p<.0001				

*All available man-days were used, including sixth visits, N=2606, for which time training could be calculated.

**Woonsocket, Otis, Providence, Bradley

***Time training = time spent in training developmental controllers, with the units ranging from 0 to 15, representing 0 minutes to 300 minutes (all 5 hours of observation on a study day).

of time spent training in the various facilities in the study.

Men in the Boston Air Route Traffic Control Center and in the smaller facilities spent a significantly lesser amount of time training than men in the other facilities. Men in the New York Air Route Traffic Control Center spent the most time training.

The results in Table 57 indicate that the men spent anywhere between 20 minutes and 2 hours training controllers on the job each day. Clearly, training developmental controllers on the job was an important and common task for air traffic controllers, particularly in the busier and larger facilities.

Table 58 displays a comparison of time training across age and experience groups. The oldest and the most experienced air traffic controllers spent the least amount of time in training developmental controllers.

These results were consistent and replicable and were somewhat surprising since our expectation was that older and more experienced controllers would be the ones providing training for the new developments. However, our results suggest that this was not true. A number of reasons could be posited for this finding. Results presented elsewhere in this study suggest that training is a difficult, arduous and disliked task for many controllers, and it may greatly tax the controller's abilities and flexibility. Further, senior controllers may see this as a task for younger controllers due to these factors. Hence older controllers may avoid training. However, we do not really know the reason for these findings.

6) Work Training. The amount of work training also was both a derived workload component and a summary measure. We calculated the amount of work while training as the simple sum of peak traffic controlled by the trainee while the observed controller was providing the training.

Table 59 displays a comparison of the amount of work while training at the various facilities in the study. Again the analyses were accomplished in two random split-half samples in order to test for replicable effects. The results show that trainees at the New York Air Route Traffic Control Center handled a significantly larger number of aircraft than trainees at the other facilities in the study. The Boston Tower and the New York Common IFR Room handled somewhat less traffic while trainees at the Boston Air Route Traffic Control Center and at smaller facilities handled the fewest number of aircraft.

Table 60 shows the comparison of the amount of work while training across the age and experience groups of the observed controllers giving the training. There was a significant difference

TABLE 58

Comparison of Time Training
Across Age and Experience Groups*

Random Split-Half Sample #1 (N=1302)

	<u>Age (Years)</u>			<u>Experience (Years)</u>		
	<u>25-34</u>	<u>35-38</u>	<u>39-49</u>	<u>3-7</u>	<u>10-14</u>	<u>15-20</u>
Number of Observation Days	441	392	469	430	393	379
Mean Time Training **	<u>1.51</u>	<u>1.62</u>	<u>.92</u>	<u>1.63</u>	<u>1.37</u>	<u>.94</u>
S.D.	2.79	3.11	2.22	2.87	2.84	2.33
F=8.52 df=2,1299 p<.0004 F=6.55 df=2,1299 p<.002						

Random Split-Half Sample #2 (N=1304)

	<u>Age (Years)</u>			<u>Experience (Years)</u>		
	<u>25-34</u>	<u>35-38</u>	<u>39-49</u>	<u>3-7</u>	<u>10-14</u>	<u>15-20</u>
Number of Observation Days	451	404	449	460	461	383
Mean Time Training **	<u>1.45</u>	<u>1.32</u>	<u>1.09</u>	<u>1.50</u>	<u>1.23</u>	<u>1.10</u>
S.D.	2.82	2.86	2.41	2.83	2.75	2.46
F=2.00 df=2,1301 p<.15 F=2.44 df=2,1301 p<.10						

*All available man-days were used, including sixth visits, N= 2606, for which time training could be calculated.

**Time training = time spent in training developmental controllers, with the units ranging from 0 to 15, representing 0 minutes to 300 minutes (all 5 hours of observation on a study day).

TABLE 59

Comparison of Work Training
Across Facilities*

Random Split-Half Sample #1 (N=1302)

	<u>NYARTCC</u>	<u>BOSARTCC</u>	<u>BOSTON TOWER</u>	<u>NYCIFR</u>	<u>SMALLER FACILITIES**</u>
Number of Observation Days	636	340	78	164	84
<u>Mean Work Training***</u>	<u>8.50</u>	<u>1.78</u>	<u>2.50</u>	<u>3.35</u>	<u>.86</u>
S.D.	16.52	5.07	4.02	7.65	2.39

F=23.09 df=4,1297 p<.0001

Random Split-Half Sample #2 (N=1304)

	<u>NYARTCC</u>	<u>BOSARTCC</u>	<u>BOSTON TOWER</u>	<u>NYCIFR</u>	<u>SMALLER FACILITIES**</u>
Number of Observation Days	635	348	81	164	76
<u>Mean Work Training***</u>	<u>8.33</u>	<u>1.29</u>	<u>3.19</u>	<u>3.61</u>	<u>1.18</u>
S.D.	16.13	4.03	5.60	8.28	3.93

F=23.83 df=4,1299 p<.0001

*All available man-days were used, including sixth visits, N=2606, for which work training could be calculated.

**Quonset, Otis, Providence, Bradley.

***Work training = sum of peak traffic controlled by the trainee while the observed controller was providing the training.

TABLE 60

Comparison of Work Training
Across Age and Experience Groups*

Random Split-Half Sample #1 (N=1302)

	<u>Age (Years)</u>			<u>Experience (Years)</u>		
	<u>25-34</u>	<u>35-38</u>	<u>39-49</u>	<u>3-7</u>	<u>10-14</u>	<u>15-20</u>
on Days	441	392	469	430	493	379
	<u>5.88</u>	<u>6.67</u>	<u>3.42</u>	<u>6.58</u>	<u>5.30</u>	<u>3.61</u>
	<u>12.57</u>	<u>14.91</u>	<u>10.07</u>	<u>13.93</u>	<u>12.88</u>	<u>10.29</u>

F=8.11 df=2, 1299 p<.0006 F=5.68 df = 2, 1299 p<.004

Random Split-Half Sample #2 (N=1304)

	<u>Age (Years)</u>			<u>Experience (Years)</u>		
	<u>25-34</u>	<u>35-38</u>	<u>39-49</u>	<u>3-7</u>	<u>10-14</u>	<u>15-20</u>
Days	451	404	449	460	461	383
	<u>5.90</u>	<u>5.06</u>	<u>4.40</u>	<u>5.88</u>	<u>4.99</u>	<u>4.37</u>
	<u>12.94</u>	<u>12.60</u>	<u>11.48</u>	<u>12.62</u>	<u>13.04</u>	<u>11.10</u>

F=1.67 df=2, 1301 p<.20 F =1.61 df =2, 1301 p<.20

available man-days were used, including sixth visits, N=2606,
which work training could be calculated.

training = sum of peak traffic controlled by the trainee while
served controller was providing the training.

between the age and experience groups in how much traffic their trainees controlled. One of the analyses shows that the difference was highly significant in that older and more experienced controllers did not have their trainees handle as many aircraft. The second split-half analysis showed the same general trend although it was not statistically significant. Consequently, we can say only that there was a tendency for the trainees of older and more experienced controllers to handle fewer aircraft.

The difference in the number of aircraft handled by the trainees of controllers in different age and experience groups can be explained particularly by the fact that the older and more experienced controllers did not spend much time giving training. The number of aircraft handled by the trainees may have been a function of time exposure rather than of restraint by the training controller in allowing the trainee to handle planes.

Reliability and Stability of Summary Workload Measures

The summary workload measures were all based on assessments of particular components of workload as previously discussed. Considerable effort was expended in learning how to assess peak traffic, transitioning planes, weather, and so on. Before we began the field studies, we held a large number of training sessions with the medical technicians who were to make the observations in the field. We conducted a final series of 99 observations with 4 medical technicians and the senior investigators of this study. The intraclass reliability coefficients ranged from .93 to .99 for the assessments of peak traffic, transitioning traffic, proposals, percent of weather or military blockage, sector classifications and position classifications. Consequently we can be reasonably sure that the components from which the summary measures were derived were reliably assessed.

As medical technicians joined or dropped from the study team, new technicians were trained to the same standards. No one was allowed to make formal field assessments until he had a demonstrated reliability of over .9 with the continuing technicians and in particular with the chief medical technician. Typically this training took approximately a month since a new technician had to become familiar with the terminology and the reading of the radar equipment to make the assessments correctly.

The summary workload measures themselves were based not only on the directly assessed components of workload such as the observed peak traffic but also on derived components such as maximum peak traffic, calculated by computer and therefore entirely accurate.

Another question of some concern was the stability of workload. We were interested in whether or not the amount of work performed was consistent over time for individuals.

Table 61 displays the correlations between paceload, normalized workload, timeload, time training and work training over the first three visits. Paceload and timeload were significantly related from visit to visit for individuals. Time training and work training were only marginally stable between the first two visits. Finally, normalized workload was not significantly correlated from visit to visit.

Considering the differences presented earlier between facilities in paceload and timeload, and the inconsistency of normalized workload from visit to visit, we concluded that the relative constancy of the paceload and timeload measures from visit to visit was primarily the result of the constancy of traffic conditions and time required to handle the traffic in the various facilities. The correlational results shown in Table 61 reflected the constancy of environmental conditions rather than the constancy of workload for individuals. Once we took into account the systematic differences between facilities in peak traffic and the amount of time worked, there was no association of workload from visit to visit (e.g., using normalized workload). However, some individuals were nonetheless relatively consistent.

To obtain the best and most stable measure of workload performed by individuals, we devised variables which represented the average workload across all of the field studies of a given individual. These variables gave the best estimate of the average amount of work performed by an individual even though the work performed on given days varied considerably. In later sections of this report, the reader will occasionally note variables called average paceload, average normalized workload, average timeload, and so forth. These average measures of summary workload refer to the average across all field studies for given individuals. In other sections of the report, the notation might be normalized workload visit 1, visit 2, visit 3 and so forth. In these cases the workload measures specifically refer to a given observation day and not to the entire series of field studies.

Relationship Between Workload Variables

Table 62 displays the correlations between the summary workload measures at the first and second field studies for blood pressure. The results were essentially the same for both visits and hence the relationships were highly reliable.

Normalized workload was significantly related to paceload and work training. It was not significantly related to timeload or time training. Hence normalized workload was most clearly related to the

TABLE 61
Stability of Summary Workload
Across The First Three
Field Studies

<u>Summary Workload Measure</u>	<u>Correlations</u>		
	<u>First Study With Second</u>	<u>Second Study With Third</u>	<u>First Study With Third</u>
Paceload ¹	.49**	.50***	.49***
Normalized Workload ²	.10	.10	.08
Timeload ³	.27***	.26***	.24***
Time Training ⁴	.12*	.09	.08
Work Training ⁵	.21**	.11	.03

* $p < .05$, 2-tailed
 ** $p < .01$, 2-tailed
 *** $p < .001$, 2-tailed

¹
 N = 278 - 329

² N = 280 - 331

³ N = 280 - 331

⁴ N = 238 - 340

⁵ N = 288 - 340

TABLE 62
Correlations between
Summary Workload Measures

First Visit, N=373

	(1)	(2)	(3)	(4)	(5)
(1) Normalized Workload	1.00				
(2) Paceload	.57***	1.00			
(3) Time load	-.04	.52***	1.00		
(4) Time Training	.00	.20**	.24**	1.00	
(5) Work Training	.12*	.32***	.20**	.92***	1.00

* p < .05

** p < .01

*** p < .001

Second Visit, N=338

	(1)	(2)	(3)	(4)	(5)
(1) Normalized Workload	1.00				
(2) Paceload	.60**	1.00			
(3) Time load	.05	.59***	1.00		
(4) Time Training	.05	.21**	.22**	1.00	
(5) Work Training	.26**	.44**	.20**	.84***	1.00

* p < .05

** p < .01

*** p < .001

amount of work performed and not to the amount of time a man had been sitting at a position.

On the other hand, paceload, which was based on raw peak traffic measures, was significantly related to every other measure of workload. The strongest correlation was with normalized workload, but it was as strongly correlated with timeload. Hence, paceload had two major dimensions, the amount of work as well as the amount of time being worked. Paceload also was related to time spent training and work training, both of which could be components of paceload on days that a man, in fact, did training.

Timeload was significantly related to paceload, time training and work training, but not to normalized workload. It was most highly related to paceload and had a low magnitude correlation with time training and work training.

Work training and time training were very highly correlated with one another but they were only slightly related to other measures of workload.

These correlational results indicated that the workload measures were related to one another, but they were not so highly related that any one could be used as the sole measure of workload. Rather, each of these summary measures represented some unique dimension of overall workload. Consequently, throughout the remainder of this report, these summary workload measures will be evaluated as separate indices of the amount of work a man performed.

As noted earlier, for some purposes in this study, we have used the average normalized workload, the average paceload and the average timeload for men over as many as 10 or as few as 3 field visits. These average summary workload measures provided relatively stable indices of how much work a man did on the average. Other analyses used the normalized workload, paceload and timeload for a given field visit with defined characteristics. In these instances, the actual value for the particular field visit was used.

SUMMARY

Psychological and Behavioral Measures at Work

To ascertain whether or not moods of the ATCs at the beginning of a work day were related to, or modified, work performance, behavioral or physiological response, a highly reliable instrument for mood assessment, the Profile of Mood States (POMS), was administered. Comparisons of ATC scores with male college student norms revealed that the ATCs started their work days with about as much positive mood state as the students, and with far less negative mood state. No differences in mood levels between facilities, age or experience groups were noted, except that more experienced men felt more friendliness than less experienced men. No significant linear correlations were obtained between any of eight moods and five workload measures.

To ascertain possible relationships between behavioral arousal while working, workload, and mood states, behavior was assessed at work by use of a Behavioral Rating Scale devised for the purpose. Most of the ATC behavior on the job was found to be in the low moderate range of activity and arousal. Total behavioral arousal was highly related to timeload and paeload, and very weakly related to normalized workload, time training and work training. Range of behavior was not related to work performed. Behavior during the work day was very little affected by mood states at the beginning of the day.

To ascertain the influence of perceptions of difficulty or ease of a work day on other responses, the ATCs were asked to fill out a 17-item Subjective Difficulty Questionnaire after work on the days that their behavioral and physiological responses were studied and their workload was assessed. Only two facets of the work day were considered above average in difficulty: giving on-the-job training and participating in the field study itself.

Based on the first three field studies, 70%-75% of the ATCs considered the day they were studied to be average, and 8%-11% above average, in difficulty. Perception of difficulty was moderately related to objective measures of work accomplishment.

An additional predictor variable was created: psychological response to work, which was the difference between perceived difficulty and expected difficulties based on workload assessment.

A mood of friendliness before work was related to a perception of less difficulty over the day. No over moods were found to be related to perceptions of difficulty of the work.

Total behavioral arousal at work was related to perceived overall difficulty at work. The predictive utility of these measures is reported in Section V.

8. Psychological and Behavioral Measures at Work

In addition to the objective measures of work, we were interested in certain psychological and behavioral measures. We wanted to investigate whether an AIC's mood at the beginning of the day, his behavior during the day, or subjective response to the day was related to, or modified, his propensity for physiological response, either at work or in terms of illness over the course of the study. Consequently, we included in our field studies self-reports of moods and job difficulty as well as assessments of behavior on the job by trained observers.

Moods At Work

A large number of methods and instruments for mood assessment were available in the psychological literature. One of the best validated and most reliable instruments for this purpose was the Profile of Mood States (POMS). The POMS was originally devised to assess six mood states: tension/anxiety; anger/hostility; fatigue; depression; vigor and confusion (McNair, Lorr, and Droppleman, 1971). These six mood scales were devised on the basis of many studies of patients, college students and other adults in natural as well as in experimental settings. In all of these settings, and with these various subjects, it was found that these six mood scales were consistently and significantly related to other measures of the same moods as well as to mood states caused by experimental procedures using psychotropic medication, stressful films and stressful events. In addition, these scales were repeatedly created in factor analyses of the items comprising the POMS.

At the beginning of the field studies we were advised by the senior author of the POMS (Dr. McNair) that two new scales were being used with it. These new scales assessed moods of friendliness and elation. They were experimental scales, but the author thought that they might prove to be valuable. Therefore the POMS as used in this study included eight scales, the original six and the two new experimental ones, comprising a total of 78 items. A subject indicated how he felt with respect to each item at the time of administration, according to a scale running from 0 (not at all) to 4 (extremely). The items were descriptive adjectives such as friendly, tense, happy, angry, worn-out, and so on.

In the field studies, the controller to be studied for a day was randomly selected by a medical technician. After agreeing to be studied, the controller immediately completed the POMS. In this way we sought to control for possible modifying effects of the eight moods on a man's physiological responses, workload or subjective responses to the day.

Table 63 lists the names of the eight mood scales and the reliability figures reported by the original authors as well as the test-retest reliability over a nine-month period of time for controllers in this study. The table shows that the internal consistency of the scales is quite high, indicating accuracy of assessment. In addition the table shows that the moods were variable over time, as one would expect for state variables, with the stability coefficients ranging from .38 to .61 over 9 months. This is exactly the range one expects for state measures. Thus, we were confident that the POMS was appropriately assessing mood states.

The POMS scales could have been scored according to norms established for psychiatric inpatients and outpatients or college students. We selected the norms of male college students (N=340) because they would be more similar to our non-patient group of air traffic controllers than would samples of psychiatric patients even though the college students would be approximately sixteen years younger on the average.

To score the POMS we used T scores with a mean of 50 and a standard deviation of 10. Thus a score of 50 would correspond to the average of the male college students on a given scale. A score of less than 40 would be obtained by less than 17% of the college males, and a score of greater than 60 would be obtained by less than 17% of the college males. The average range for T-scores is 40 to 60. Thus the descriptive results that follow are in comparison to college student males using T-scores.

Table 64 displays the descriptive results for the friendliness and tension/anxiety scales of the POMS on the first three field studies. The results for friendliness indicated a strong similarity to the proportion of college males who would score low, average, and very high. This similarity was also reflected in the overall mean which was quite close to the expected value of 50. These results were replicated across the first three field studies.

The same table shows that more than 80% of the ATCs experienced very low tension/anxiety at the beginning of the day. Approximately 15% to 18% experienced tension/anxiety, in the average range. Very few (less than 1%) experienced tension/anxiety in the very high range. The overall mean on each of the field study days was substantially below the normative average of 50.

Table 65 displays the POMS results for the elation and anger/hostility scales. Approximately the same proportion of controllers experienced an elated mood as of normative college students. On the other hand the controllers experienced less anger and hostility than college students. Very few were very angry at the beginning of any of the first three field study days. Again the results were very consistent across the three studies.

TABLE 63

Profile of Mood States (POMS)
Mood Names, Internal Consistency, and Stability

	<u>Internal¹ Consistency</u>	<u>6-week¹ Stability</u>	<u>9 month² Stability</u>
ness	N/A*	N/A	.61
/Anxiety	.92	.51	.41
	N/A	N/A	.56
ostility	.92	.53	.40
	.94	.45	.38
ion	.95	.49	.47
	.89	.43	.57
ion	.87	.52	.45

not available. These were new experimental scales.

McNair, Lorr, and Droppleman (1971)

64 air traffic controllers

TABLE 64
Descriptive Statistics
and
Distribution of Men Experiencing
Friendliness at the First Three Field Studies
according to the Profile of Mood States

<u>Score</u>	<u>First</u> <u>Field Study</u>	<u>Second</u> <u>Field Study</u>	<u>Third</u> <u>Field Study</u>
Very low (< 40)	23.1%	23.4%	21.8%
Average (40-60)	65.7%	67.8	65.1%
Very high (> 60)	11.2%	8.8%	13.1%
<u>Number of Subjects</u>	<u>385</u>	<u>364</u>	<u>344</u>
<u>Overall Mean</u>	<u>47.54</u>	<u>46.64</u>	<u>47.28</u>
<u>Overall S.D.</u>	<u>11.01</u>	<u>10.97</u>	<u>10.81</u>

Descriptive Statistics and Distribution
of Men Experiencing Tension/Anxiety
at the First Three Field Studies
according to the Profile of Mood States

<u>Score</u>	<u>First</u> <u>Field Study</u>	<u>Second</u> <u>Field Study</u>	<u>Third</u> <u>Field Study</u>
Very low (< 40)	81.6%	81.4%	83.9%
Average (40-60)	18.4%	18.3%	15.8%
Very high (> 60)	.5%	.3%	.3%
<u>Number of Subjects</u>	<u>385</u>	<u>366</u>	<u>347</u>
<u>Overall Mean</u>	<u>33.88</u>	<u>34.30</u>	<u>33.69</u>
<u>Overall S.D.</u>	<u>6.77</u>	<u>6.59</u>	<u>6.01</u>

TABLE 65

Descriptive Statistics
and
Distribution of Men Experiencing
Elation at the First Three Field Studies
according to the Profile of Mood States

	<u>First</u> <u>Field Study</u>	<u>Second</u> <u>Field Study</u>	<u>Third</u> <u>Field Study</u>
Age			
< 40	18.2%	19.4%	15.9%
40-60	68.8%	70.8%	69.7%
> 60	13.0%	9.8%	14.4%
Number of Subjects	384	366	347
Mean	48.49	48.03	49.36
S.D.	10.64	10.60	10.78

Descriptive Statistics and Distribution
of Men Experiencing Anger
at the First Three Field Studies
according to the Profile of Mood States

	<u>First</u> <u>Field Study</u>	<u>Second</u> <u>Field Study</u>	<u>Third</u> <u>Field Study</u>
Age			
< 40	55.6%	57.4%	54.4%
40-60	41.8%	49.9%	42.7%
> 60	2.6%	2.7%	2.9%
Number of Subjects	385	364	344
Mean	41.18	41.45	41.51
S.D.	6.85	7.54	7.02

Table 66 displays the results for the POMS fatigue and depression scales. More than half of the men experienced very little fatigue at the beginning of the field study day. Approximately 40% scored in the average range, and less than 4% felt extremely fatigued at the beginning of the study days. Similarly 65% or more of the controllers experienced very little depressive mood at the beginning of the study day. Approximately 30% scored in the average range, and less than 3% had a depressed mood in the very high range. Again these results were consistent across the first three field studies.

Finally, Table 67 displays the results for the POMS vigor and confusion scales. The controllers matched the college student norms rather closely with respect to vigorous mood, but scored very differently from the student norm on the confusion scale. Ninety-five percent or more of the controllers scored in the very low range on the confusion scale. Five percent or more scored in the average range and no one scored in the very high range on the confusion scale.

These very consistent results showed that controllers beginning a work day felt reasonably good about themselves. Generally, they experienced an average amount of friendliness, elation and vigor. They experienced very little tension/anxiety, depression or confusion. A moderate number experienced average levels of anger and fatigue at the beginning of their work days. Hence, in general we can say that our field studies of physiological response to work were not confounded by extremely bad moods or extremely good moods, and further that the great majority of men began their work days in a clear state of mind without major affective states.

As one might expect with a state measure of mood there was some variability over the course of ten field studies in terms of the average level of the eight moods. Figures I-P display the changes in moods over the first ten field studies. They show, on the average, that controllers stayed within the average range for feelings of elation, friendliness, vigor, depression and anger. Although there were marked increases and decreases in these feelings over time, they stayed within the 40-60 average range. On the other hand, the controllers experienced less than average tension/anxiety, fatigue, and confusion over the entire course of the first ten field studies. These longitudinal results include variations in mood as a consequence of different controllers being studied at different times and of different work conditions over the ten field studies. By reference to Figures E-H in the previous section on Workload, it can be seen that there was no concurrent association of the controllers' moods and workload. That is, none of the mood variables showed the characteristic decrease over the first three visits and subsequent increase over the next seven visits that the workload measures showed.

TABLE 66

Descriptive Statistics
and
Distribution of Men Experiencing
Fatigue at the First Three Field Studies
according to the Profile of Mood States

<u>Score</u>	<u>First</u> <u>Field Study</u>	<u>Second</u> <u>Field Study</u>	<u>Third</u> <u>Field Study</u>
Very low (< 40)	53.9%	56.0%	56.5%
Average (40-60)	42.7%	40.7%	41.5%
Very high (> 60)	3.4%	3.3%	2.0%
Number of Subject	386	366	347
Overall Mean	39.78	39.63	39.32
Overall S.D.	7.69	7.76	7.18

Descriptive Statistics and Distribution
of Men Experiencing Depression
at the First Three Field Studies
according to the Profile of Mood States

<u>Score</u>	<u>First</u> <u>Field Study</u>	<u>Second</u> <u>Field Study</u>	<u>Third</u> <u>Field Study</u>
Very low (< 40)	71.7%	65.8%	66.0%
Average (40-60)	27.8%	31.8%	32.6%
Very high (> 60)	.5%	2.4%	1.4%
Number of Subjects	385	366	347
Overall Mean	40.18	40.48	40.57
Overall S.D.	4.38	5.06	5.08

TABLE 67

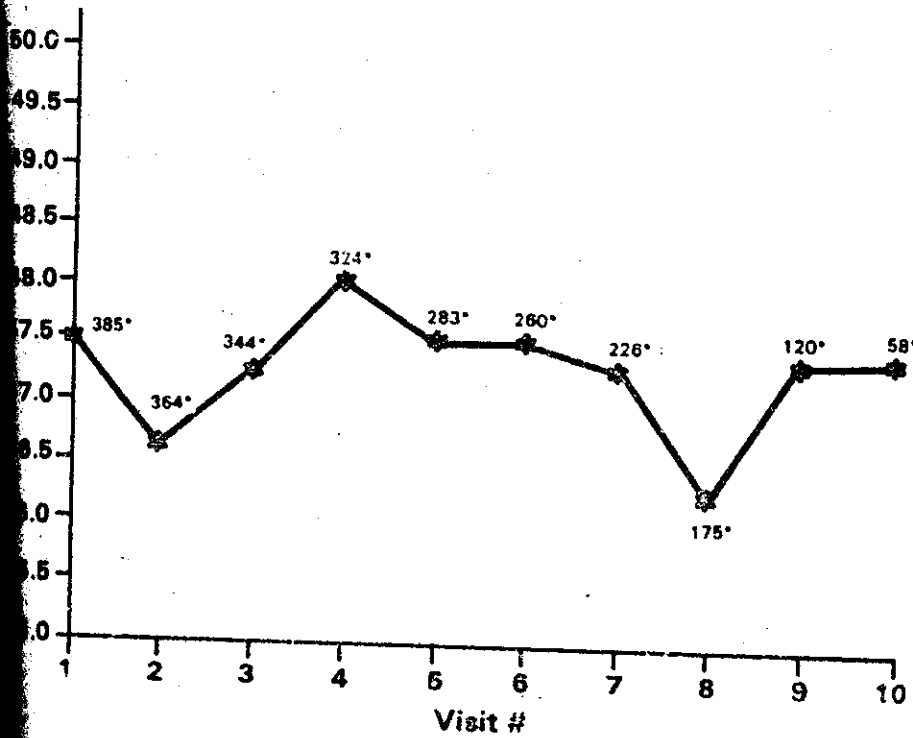
Descriptive Statistics
and
Distribution of Men Experiencing
Vinor at the First Three Field Studies
according to the Profile of Mood States

<u>Score</u>	<u>First</u> <u>Field Study</u>	<u>Second</u> <u>Field Study</u>	<u>Third</u> <u>Field Study</u>
low (< 40)	15.5	15.9%	15.4%
age (40-60)	60.4%	65.1%	63.1%
high (> 60)	24.1%	19.0%	21.5%
Number of Subjects	386	364	344
All Mean	51.33	50.08	50.94
All S.D.	10.57	10.37	10.56

Descriptive Statistics and Distribution
of Men Experiencing
Confusion at the First Three Field Studies
according to the Profile of Mood States

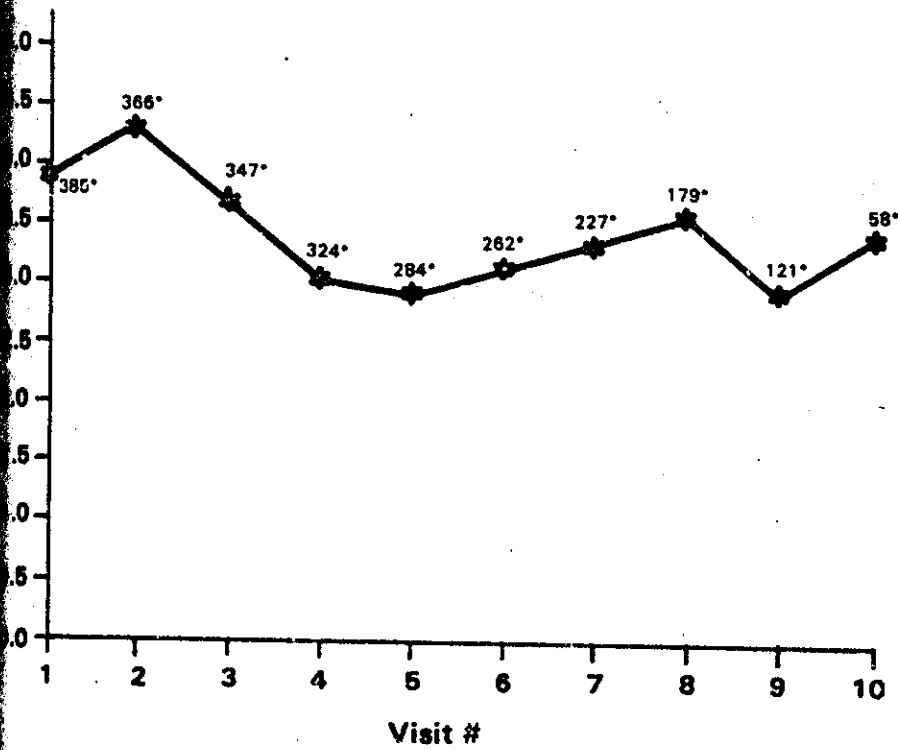
<u>Score</u>	<u>First</u> <u>Field Study</u>	<u>Second</u> <u>Field Study</u>	<u>Third</u> <u>Field Study</u>
low (< 40)	97.7%	94.8%	96.2%
age (40-60)	2.3%	5.2%	3.8%
high (> 60)	0.0%	0.0%	0.0%
Number of Subjects	386	364	344
All Mean	28.32	28.50	28.44
All S.D.	4.60	5.12	4.60

FIGURE I
PROFILE OF MOOD STATES: FRIENDLINESS
OVER 10 FIELD STUDIES



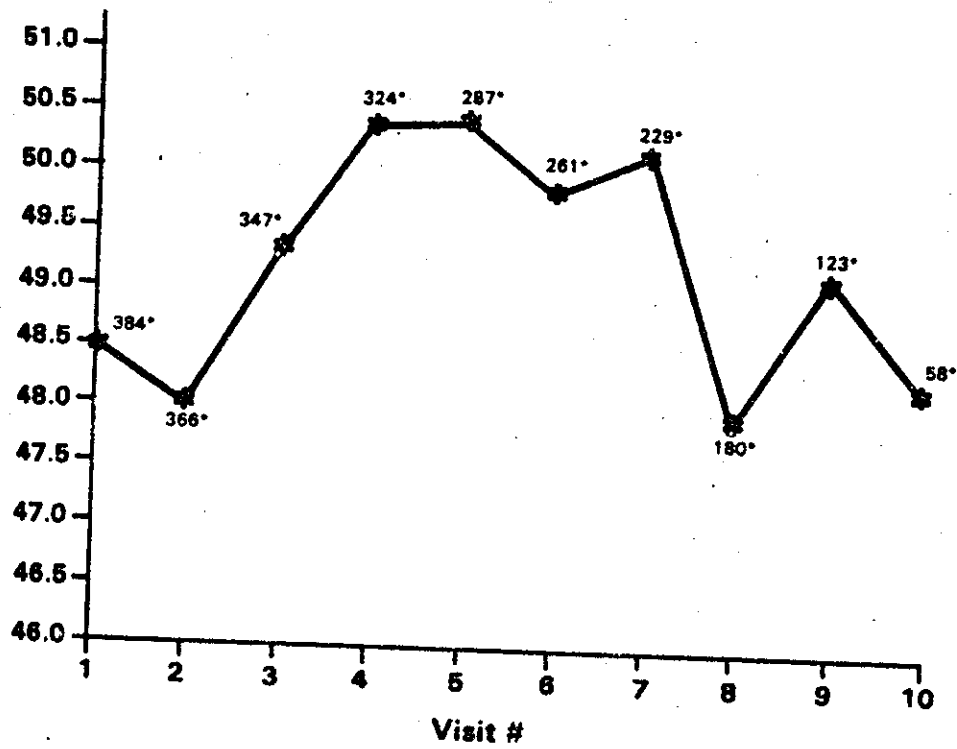
*Number of ATCs contributing to mean score at that visit

FIGURE J

**PROFILE OF MOOD STATES: TENSION/ANXIETY
OVER 10 FIELD STUDIES**

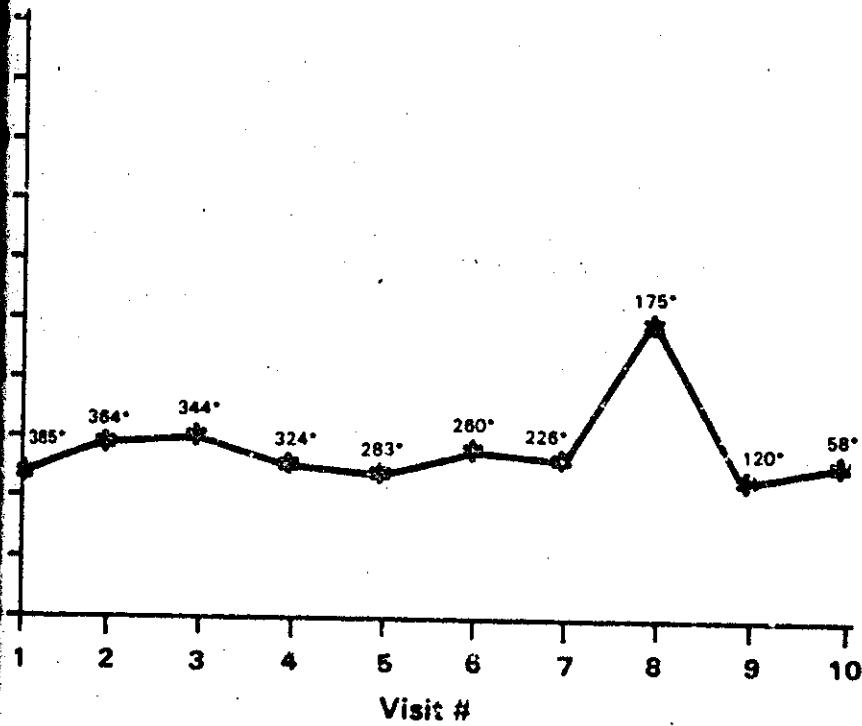
*Number of ATCs contributing to mean score at that visit

FIGURE K

**PROFILE OF MOOD STATES: ELATION
OVER 10 FIELD STUDIES**

*Number of ATCs contributing to mean score at that visit

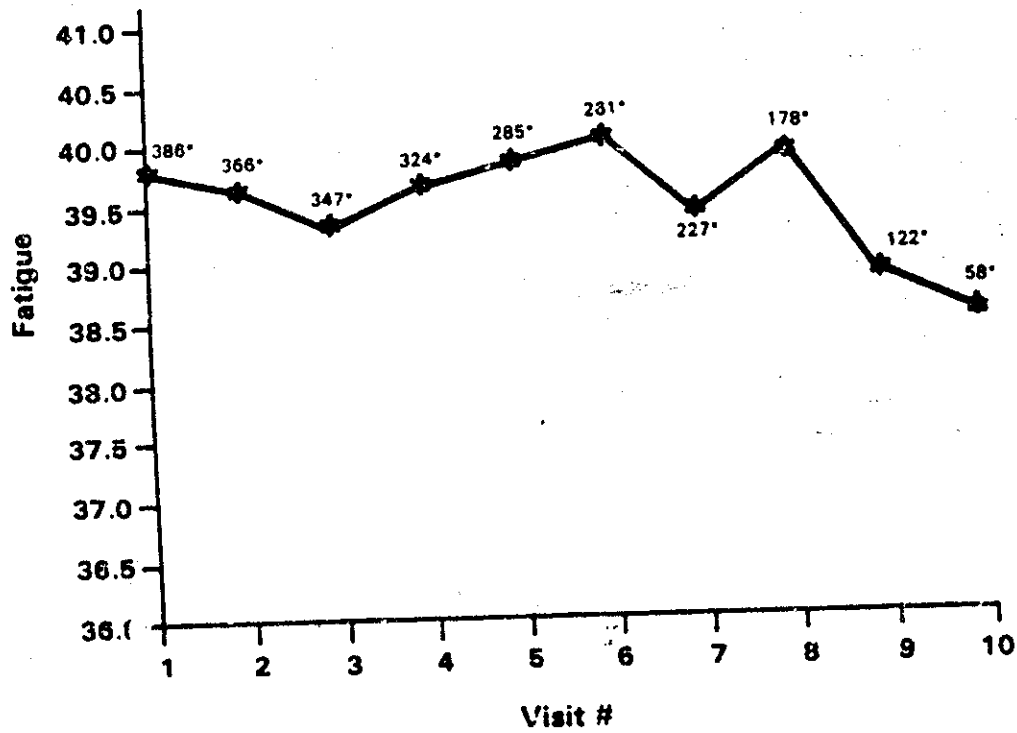
FIGURE L
PROFILE OF MOOD STATES: ANGER
OVER 10 FIELD STUDIES



*Number of ATCs contributing to mean score at that visit

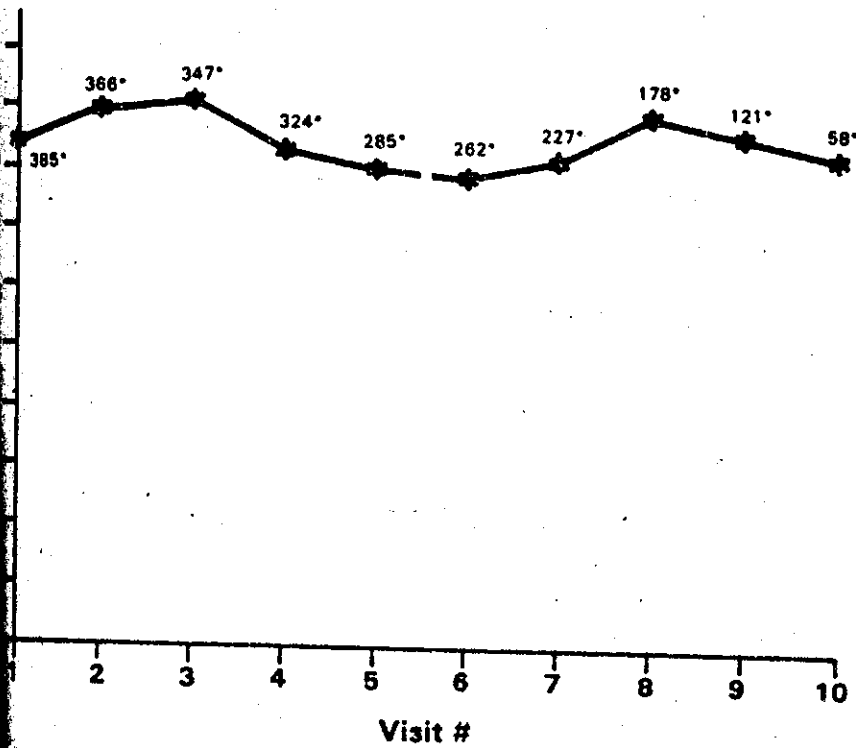
FIGURE M

PROFILE OF MOOD STATES: FATIGUE OVER 10 FIELD STUDIES



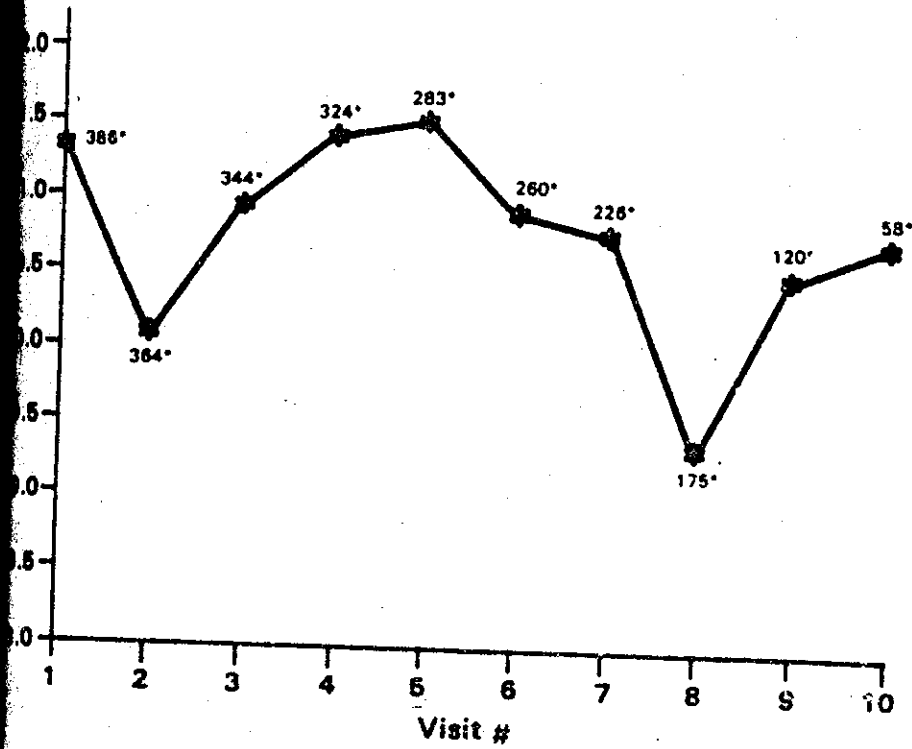
*Number of ATCs contributing to mean score at that visit

FIGURE N

**PROFILE OF MOOD STATES: DEPRESSION
OVER 10 FIELD STUDIES**

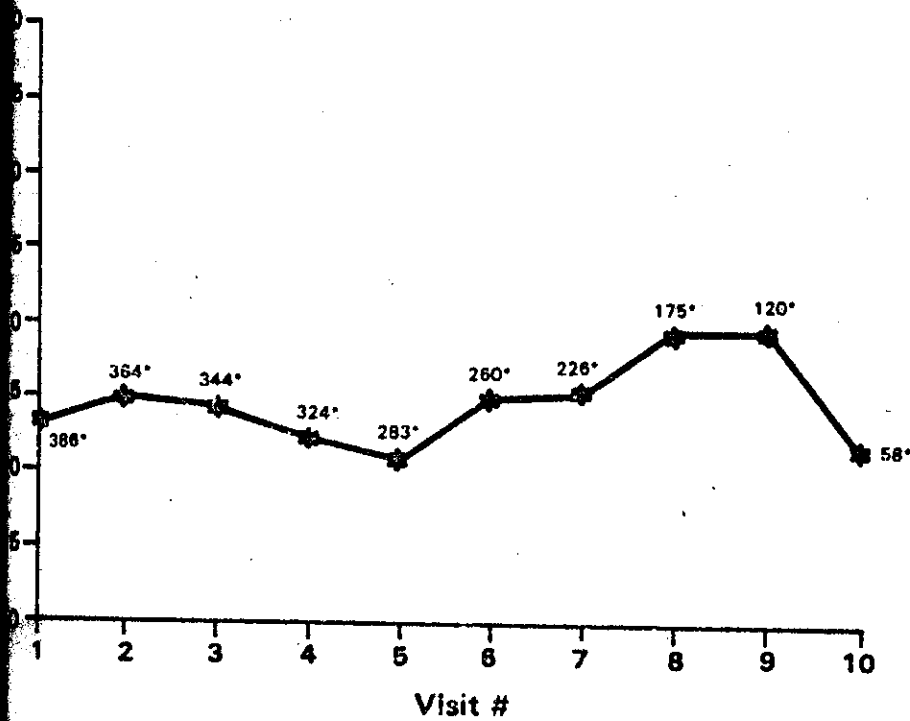
*Number of ATCs contributing to mean score at that visit

FIGURE 0
PROFILE OF MOOD STATES: VIGOR
OVER 10 FIELD STUDIES



*Number of ATCs contributing to mean score at that visit

FIGURE P
PROFILE OF MOOD STATES: CONFUSION
OVER 10 FIELD STUDIES



*Number of ATCs contributing to mean score at that visit

We also examined whether moods were different between facilities, age groups or experience groups. There was no consistent association between any of the moods and the facility within which a man worked, his age or his experience. There was a greater tendency for more experienced controllers to be in a friendly mood than less experienced controllers. This was the only mood associated with any of these groupings.

Table 68 displays the correlations between the eight moods and the five summary workload measures at each of the three first field studies. The table shows that there was very little, if any, significant association between any of the eight moods and the five summary workload measures. There were only five significant correlations in this entire set of results, about as many as one would expect to be significant at the .05 level among 120 correlations. Consequently we feel confident in concluding that the men's moods at the beginning of a study day had no effect on the amount of workload they subsequently performed. Results of studies on the relationship between moods at work and physiological, behavioral, and psychological responses to work are presented in later sections of the report.

In summary, by a highly reliable method of mood assessment, we determined that the controllers experienced very little negative affect at the beginning of the work days, and an average amount of positive affect at the beginning of their work days. Our results indicated that there were no differences between facilities, age groups or experience groups in the average levels of the eight moods, with the single exception that more experienced men tended to report more friendliness at the beginning of a work day. Finally, our results indicated that there was no significant linear correlation between any of the moods and our five summary workload measures.

ATC Behavior at Work

Our mood assessments at the beginning of the day were made as a prelude to assessments and measurements during the day of a controller's workload, behavioral responsiveness, and physiological responsiveness. In order to assess behavioral responsiveness, however, we had to devise an appropriate scale of values to assign to observable behavioral responses. We needed to develop a straight-forward instrument which (1) could be used easily by psychologically unsophisticated observers, (2) had a high level of face validity, (3) would be construct-valid in its relationship to physiological and psychological measures, (4) could be very reliable among multiple observers, and (5) would combine appropriate observable physiological responses with manifest behavior to indicate arousal.

An intense observation strategy was employed to provide a basis for assessing ATC behavior. Initially, a series of visits were used

TABLE 68

Correlations between Eight Moods
and Five Summary Workload
Measures at the First Three Field Visits

		Summary Workload Measure				
		Norma- lized Workload	Paceload	Timeload	Time Training	Work Training
Tenderness,	Visit 1*	.04	-.01	.03	-.01	.00
	Visit 2**	-.05	-.07	.01	-.08	-.07
	Visit 3**	-.04	-.10	-.05	-.02	-.03
Anxiety/	Visit 1	.09	.05	.00	-.05	-.02
	Visit 2	.00	.08	.08	.05	.04
	Visit 3	.03	.06	.10	-.02	-.04
Frustration,	Visit 1	.07	.08	.07	-.03	-.02
	Visit 2	-.04	-.03	.03	-.03	-.04
	Visit 3	.00	<u>-.12</u>	<u>-.14</u>	-.09	-.09
Anger,	Visit 1	-.06	-.07	-.04	-.04	-.03
	Visit 2	.03	.06	.06	-.07	-.06
	Visit 3	.06	.06	.06	.04	.01
Fatigue,	Visit 1	.04	.04	-.02	-.04	-.01
	Visit 2	-.05	-.01	-.02	-.01	-.01
	Visit 3	-.04	.01	.05	.08	.06
Depression,	Visit 1	-.02	<u>-.10</u>	<u>-.13</u>	-.04	.02
	Visit 2	.01	.00	.03	-.03	-.02
	Visit 3	-.01	.05	.10	.03	-.02
Annoyance,	Visit 1	.05	.01	.02	.02	.02
	Visit 2	-.01	-.02	.07	-.06	-.08
	Visit 3	.08	-.07	<u>-.12</u>	-.05	-.05
Confusion,	Visit 1	.03	.02	-.08	-.05	-.01
	Visit 2	-.02	-.03	-.03	.00	.01
	Visit 3	-.03	-.01	.04	.00	-.03

Visit 1, N = 376

Visit 2, N = 352

Visit 3, N = 336

Underlined values are significant at $p < .05$.

to allow the investigators to become familiar with the types of behavior to be seen on the job. A checklist of behaviors was then devised. The checklist used a three-point rating scale corresponding to low, moderate, and high behavioral arousal.

This initial behavioral scale was very easy to use and extremely reliable. However, we observed that the range of values and the complexity and meaning of specific behaviors was restricted. Therefore a new five-point scale was devised and field-tested by our medical technicians and the senior investigators of the study.

The five-point scale was tested in a total of 45 visits to air route traffic control centers. Approximately 200 controllers were observed working in light, moderate, and heavy air traffic conditions. The investigators observed any given controller for a half hour to three hours to provide adequate samples of behavior. The observers were provided with observation scales with spaces for recording additional behaviors not captured by the five-point scale definitions. Multiple discussions and feedback sessions yielded a seven-point scale embodied multiple dimensions of behavior and observable physiological responses.

The seven-point scale was tested in a three-day period at the New York Air Traffic Control Center with four medical technicians, two psychologists and a psychiatrist making concurrent observations. These concurrent observations permitted the evaluation of reliability. The final outcome of all of these preliminary studies was the ATCS Behavioral Rating Scale (BRS) displayed in Table 69.

A total of eight dimensions defined the interrelationship of the behavioral descriptors for each level of behavior. These eight dimensions were appearance, conversational orientation, attention, physical movement, joking/swearing, voice modulation, receiving assistance and coping with hand-off and pilot requests. Table 70 displays these dimensions with the descriptors for the highest and lowest levels of behavior for which they were associated.

To arrive at a global rating of behavior, an observer compared an ATC's behavior in a two-minute observation period with the descriptors for any given behavior level. At least one-half of the five to eight descriptors for each level had to be observed and the highest level satisfying this criterion was the overall behavioral rating assigned.

During our final checkout of the BRS, multiple observers made their ratings concurrently. The Pearson product-moment correlation coefficient of reliability between observers' ratings ranged from .85 to .98 over 69 observations of air traffic controllers. The coefficient of reliability for all combinations of raters over 99 observations was .91.

ATCs Behavior Rating Scale

At least half of the behavioral descriptors in each set must be appropriate for the two-minute observation period prior to the physiological sampling and concurrent with the tabulation of other environmental events (e.g., peak traffic count, transitions, etc.). If in doubt between two or more ratings, please select the maximum applicable.

Level 1:

- a.) Looks relaxed or bored or makes a comment to that effect.
- b.) Jokes around a lot.
- c.) Most, if not all, conversation is social in nature.
- d.) Scans radar, strips, and/or airfield rarely.
- e.) Physical movements are loose, spatially unrestricted, and usually unrelated to position activities.

Level 2:

- a.) Looks relaxed and at ease, other than occasional fidgeting or looking around.
- b.) Jokes around considerably.
- c.) Much, but not most, conversation is social in nature.
- d.) Scans radar, strips, and/or airfield occasionally.
- e.) Physical movements are relaxed, spatially somewhat restricted, and usually restricted to position activities.

Level 3:

- a.) Looks comfortable when involved in tasks.
- b.) May joke around occasionally.
- c.) Conversation is mostly task-related; little social conversation.
- d.) Scans radar, strips, and/or airfield regularly.
- e.) Physical movements are mostly restricted to position-related activities (e.g., moving "shrimpboats," marking strips, etc.).
- f.) Engages in no task-related swearing.

Level 4:

- a.) Conversation, if any, is generally restricted to controlling traffic; rarely initiates social conversation.
- b.) Generally quiet and concentrating when not engaged in task-related communications.
- c.) Physical movements are totally restricted to position-related activities.
- d.) Voice is even or calm.
- e.) Rarely or never jokes or swears.

Level 5:

- a.) Exhibits signs of mild adverse physical arousal (such as muscular tenseness and mild perspiration).
- b.) Responds to little social conversation.
- c.) Generally busy and concentrating with few quiet periods.
- d.) Physical movements are totally restricted to position-related activities and are somewhat constricted (i.e., quickened).
- e.) Voice is stronger, more variable, and/or more clipped than normal.

Trainer momentarily overrides trainee.
 Engages in occasional relatively quiet, task related swearing.
 Starts doing partner's job despite being busy himself.

Exhibits quite obvious, but controlled, signs of adverse physical arousal (such as tense movements, punching or otherwise striking at table or radar scope, sudden emotional gestures, etc.).
 Responds very infrequently to social conversation.
 Often refuses to accept additional traffic and/or refuses special pilot requests.
 Physical movements are totally restricted to position-related activities and are considerably constricted (i.e., hurried and abrupt).
 Voice is much stronger, much more variable, and/or much more clipped than usual but still restrained.
 Additional staff appear on scene to observe or assist and/or trainer takes over from trainee.
 Engages in considerable, easily audible, task-related swearing.

Exhibits signs of extreme adverse physical discomfort (such as sweating, becoming flushed, tremulous, etc.).
 Engages in absolutely no social conversation whatsoever, even when requested.
 Refuses to accept additional aircraft and/or refuses even normally acceptable pilot requests.
 Engages in obvious, agitated physical behavior (such as slamming fist, throwing pencil, strip, or shrimpboat, etc.).
 Voice is loud and extremely variable.
 Requests additional help or relief and/or additional staff appear on scene to assist and/or trainer takes over completely from trainee.
 Engages in loud and vehement task-inspired swearing (at aircraft, at other ATC or supervisor, or at other person(s)).

Dimensions of Behavior
being Rated at
Highest and Lowest Levels

Overt Appearance

- a. Level 1 - bored and relaxed
- b. Level 7 - extreme adverse physical arousal

Conversational orientation

- a. Level 1 - almost all social
- b. Level 7 - all task oriented, refuses social

Attention

- a. Level 1 - rarely looks at radar, strips, or airfield
- b. Level 7 - completely attending to radar or airfield

Physical movements

- a. Level 1 - loose, unrelated to job
- b. Level 7 - agitated, aggressive behavior

Joking/Swearing

- a. Level 1 - jokes around a lot
- b. Level 7 - job related swearing loud and vehement

Voice quality

- a. Level 1 - calm and even
- b. Level 7 - loud, explosive, unrestrained

Receiving assistance

- a. Level 1 - lets others do their jobs without paying attention to them
- b. Level 7 - requests extra help and assistance

Coping with hand-offs and pilot requests

- a. Level 1 - handles hand-offs and pilot requests without delay or strain
- b. Level 7 - refuses hand-offs, refuses pilot requests even when reasonable

Finally, the psychologists and psychiatrist compared their ratings with the medical technicians. Since the psychologists and the psychiatrist had extensive training in the observation and evaluation of behavior, while the medical technicians' training was primarily that involved with the development of the behavioral rating scale, their different perspectives might have yielded substantially similar or substantially different behavior ratings. However, in a special trial covering 69 observations of controllers, the concurrent validity coefficient was .80 between the professionals and the medical technicians.

Thus we felt that the BRS was a reliable and valid assessment of air traffic controller behavior on the job. The very high levels of interrater reliability suggested that measurement error and different perspectives would account for only a very minor proportion of the differences in behavior ratings.

Table 71 shows the behavioral ratings ranged from 1 to 7 where 1 represented a completely relaxed, non-aroused condition, and 7, an extreme form of behavior with verbal and overt physiological arousal. We combined all of the observations made over the ten field studies to examine the distribution of behavior ratings in total. Table 71 displays this distribution of 25,568 behavioral ratings. Sixty-seven behavioral ratings were omitted in error, and 13,755 were not made because men were not on a working journeyman position. The results shown in Table 71 indicate that almost 12% of the observed behavior was at the minimum level. Only two observations, of 25,000, were rated at the most aroused level of behavior. Most air traffic controller behavior on the job was found to be in the moderate behavior range from 2 to 4 as defined by the BRS, suggesting low levels of arousal, concentration on the task of separating planes, but also a moderate amount of non-task activities.

Two summary measures of behavior were devised for indexing the total behavioral arousal of a man during a study day. One summary measure was the simple total of the behavioral ratings for a day - the grand total amount of behavioral arousal while working. The second summary measure was the range in behavior; that is, the maximum behavior rating minus the minimum behavior rating for the day.

In order to give a clearer picture of the meaning of the total behavior for the day, Table 72 displays a distribution of the average behavior across the first three field studies. Average behavior was defined as the total behavior rating divided by the number of times a man was observed during the day. These average behavior ratings were grouped into four descriptors.

It is immediately apparent from the table that no controller had a sustained behavior in the range from 4-4.99. Five to ten percent

TABLE 71

237

Distribution of Behavior
Ratings over all Observations
(N = 25635)

<u>Behavior Rating</u>	<u>Number of Observation</u>	<u>% of Observations</u>	<u>Cumulative % of Observations</u>
1	3033	11.9	11.9
2	6749	26.4	38.3
3	11332	44.3	82.6
4	4129	16.1	98.7
5	304	1.2	99.9
6	19	.1	100.0
7	2	.0	100.0
<hr/>			
Totals	25568	100%	100%
Total Missing	67		
Total not on position	13755		
Grand Total	39390		

TABLE 72

Distribution Of Average
Behavior Across The First Three Field Studies

<u>Behavioral</u> <u>Category (Behavior Total/# of Readings)</u>	<u>First</u> <u>Field Study</u>	<u>Second</u> <u>Field Study</u>	<u>Third</u> <u>Field Study</u>
9 (Relaxed, non-task oriented)	5.0%	6.4%	9.4%
9 (Comfortable with task oriented activity)	53.3%	55.4%	51.3%
9 (Concentrating with some arousal; highly task oriented)	40.2%	37.7%	38.1%
9 (Overtly aroused behaviorally and verbally)	1.6%	.6%	1.2%
<hr/>			
Number of subjects	381	361	341
Overall Mean	2.81	2.75	2.73
Overall S.D.	.54	.55	.59

of the sustained behavior was in the range below level 2, and the great majority of behavior during the day averaged between 2 and 3.99.

The correlation of the average behavior with the total behavior for the day was .54 for the first visit, .64 for the second visit, and .65 for the third visit, indicating that the average behavior captured a substantial proportion, but not the entire amount of the variance in behavior observed for a whole day.

Table 73 displays the distribution of the range in behavior during each of the first three field studies. Between 1.6% and 3.8% of the men had no change in behavior ratings during the entire day. The modal range of behavior was two levels, such as from level 1 to level 3 behavior. Very few people experienced an intense range of behavior of four levels or more, as would be expected from the distribution of ratings already discussed. Sixty-five percent to 73% of the men experienced behavioral fluctuations of two or three levels as defined by the BRS.

Table 74 displays the correlations between the summary behavioral measures and the summary workload measures for the first three field studies. Total behavior observed for the day was most strongly related to the amount of time worked during the day, and to the panceload for the day. Relatively low but significant correlations were found between the total behavior for the day and normalized workload, time training, and work training. Thus, we concluded that the behavioral total score for the day was influenced primarily by how much time a man worked on a position, and the number of planes he had to handle.

On the other hand, behavior range was related to timeload and time training on the second visit, but it was not consistently related to these measures, nor was behavior range related to any of the other summary workload measures. The amount of fluctuation in an ATC's behavior was therefore not related to the amount of work imposed on him by his environment over the course of an entire day. This lack of a relationship was found in spite of the fact that both panceload and normalized workload had as one of their components the range in peak traffic or the range in normalized peak traffic respectively. Consequently, we concluded that the primary determinants of fluctuations in behavior were not in the workload as we assessed it in these five ways.

Not only had we hypothesized a relationship between moods and how much work a man would accomplish, but we also anticipated some possible relationship between behavior and mood. Table 75 displays the correlations between the two summary behavior measures and the eight moods over the first three field studies. The only consistent

TABLE 73

Distribution of
Behavioral Range On The Job
Across The First Three Field Studies

	<u>First Field Study</u>	<u>Second Field Study</u>	<u>Third Field Study</u>
ral	1.6%	2.2%	3.8%
)	18.4%	25.9%	27.4%
(2)	40.9%	44.4%	44.2%
3)	32.6%	21.8%	20.6%
(4+)	6.5%	5.7%	3.8%
	<hr/>	<hr/>	<hr/>
f subjects	386	367	346
Mean	2.24	2.04	1.94
S.D.	.88	.91	.89

TABLE 74

Correlations of Summary Behavior
Measures with Summary Workload
Measures, First Three Field Studies

Summary Workload Measure	Correlation with Behavior Measure at Respective Visits		Number of Subjects
	Behavioral Total	Behavior Range	
Unlabeled Workload, Visit 1	.18***	.05	381
Unlabeled Workload, Visit 2	.29***	.09	359
Unlabeled Workload, Visit 3	.23***	.07	340
Unlabeled Workload, Visit 1	.68***	-.09	381
Unlabeled Workload, Visit 2	.78***	-.04	359
Unlabeled Workload, Visit 3	.78***	-.05	340
Unlabeled Workload, Visit 1	.76***	.00	381
Unlabeled Workload, Visit 2	.76***	.11*	359
Unlabeled Workload, Visit 3	.79***	.05	340
Unlabeled Workload, Visit 1	.15**	.13*	381
Unlabeled Workload, Visit 2	.24***	.02	359
Unlabeled Workload, Visit 3	.22***	.08	340
Unlabeled Workload, Visit 1	.17***	.07	381
Unlabeled Workload, Visit 2	.29***	-.02	359
Unlabeled Workload, Visit 3	.26***	.03	340

.05

.01

.001

TABLE 5

Correlations of Behavior
with Eight Moods
for The First Three Field Studies
(Visit 1, N=376; Visit 2, N=352; Visit 3, N=336)

	<u>BEHAVIOR TOTAL, VISIT 1</u>	<u>BEHAVIOR RANGE, VISIT 1</u>
	<u>BEHAVIOR TOTAL, VISIT 2</u>	<u>BEHAVIOR RANGE, VISIT 2</u>
	<u>BEHAVIOR TOTAL, VISIT 3</u>	<u>BEHAVIOR RANGE, VISIT 3</u>
Stress	.00	.02
	-.06	.02
	-.07	-.00
Anxiety	.10	-.05
	.10	-.04
	.11	.05
	.06	.02
	-.02	-.01
	-.13	-.06
Hostility	-.03	-.03
	.08	-.01
	.07	.03
	-.01	-.02
	-.01	-.03
	-.00	.08
Loneliness	-.10	-.01
	.04	.01
	.11	.08
	.01	.04
	.01	.02
	-.07	-.08
Depression	-.03	-.02
	-.03	-.02
	.00	.04

Values in boldface are significant at $p < .05$, two tailed.

and significant relationship was a very low positive correlation between a mood of tension/anxiety at the beginning of the day and the subsequent total amount of behavior exhibited. All other relationships between behavior and moods were non-significant or inconsistent over the three visits. Thus the mood of air traffic controllers at the beginning of the work day had very little systematic effect upon either the total behavior exhibited while working or the range that occurred in behavior.

In summary, the Behavioral Rating Scale was devised to attain a reliable assessment of the controllers' behavior on the job. Our reliability studies indicated that the instrument served this purpose very well. In general most of the behavior exhibited by air traffic controllers on the job was in the low moderate range of activity and arousal. Very few controllers experienced intense behavioral arousal. Our findings also indicated that the total behavior exhibited during the day was highly related to the amount of time a man had to work and the panceload to which he was exposed during the day. There were low magnitude correlations between the total behavior and normalized workload, time training, and work training. On the other hand, the range in behavior exhibited during the day had no consistent relationship to the amount of work performed. Finally, the behavior of an air traffic controller during a study day was affected very little by any of eight moods at the beginning of the day. In fact we found that tension/anxiety at the beginning of the day was the only mood related consistently and significantly, though weakly, to total behavior. The range in behavior over a day was not systematically affected by any of the moods.

Behavior as a response to workload and other environmental determinants will be discussed in Section V.

ATC Subjective Difficulty

In addition to the assessment of eight moods at the beginning of the day and behavior during the day, we assessed an air traffic controller's subjective perception of the difficulty of his work on that day. After a man completed his shift on a study day, he filled out the ATC Subjective Difficulty Questionnaire.

This questionnaire contained seventeen items that were pilot tested at the Oakland ARTCC in 1973. The items are listed in Table 76. The response choices for 9 items were ordered negatively such that a low number indicated more difficulty and eight items had their responses ordered such that a high number indicated more difficulty. The items were counterbalanced in this fashion to preclude response sets. The items with negatively ordered response categories had their scoring reversed so that higher scores represented more subjective difficulty.

Questions in the
ATC Subjective Difficulty Questionnaire

Overall, how difficult do you feel your assignments have been today?
(1 = very easy...7 = very difficult)

Considering all of the tasks that composed your various assignments, how good a job do you feel you have done today?
(1 = best I've ever done...7 = worst I've ever done)

How heavy has been today's traffic in terms of number of aircraft handled? (1 = highest ever...7 = lightest ever)

What kind of aircraft mix have you had? (1 = totally commercial...
7 = totally military and general aviation)

How much did weather affect the ease of working traffic today?
(1 = made extremely easier...7 = made extremely difficult)

Compared to other times, what was the quality of help provided by your data man and handoff man? (1 = terrific...7 = the worst ever)

How many breakdowns or serious impairments of function (quality of return, fruiting, degradation, etc.) did your radar and communications equipment have today? (1 = greatest ever...7 = fewest ever)

How many failures and impairments of function did the communications equipment on the aircraft have today? (1 = greatest ever...7 = fewest ever)

How did your supervisor contribute to your performance today?
(1 = helped tremendously...7 = hindered completely)

How many interpersonal conflicts occurred for you today?
(Such as those arising from FAM flights, administrative policy, and other non-ATC action) (1 = most ever...7 = fewest ever)

How many potential traffic conflicts occurred today compared to "normal" times? (1 = most ever...7 = fewest ever)

How many changes from peak to slow controlling conditions occurred today compared to "normal" times? (1 = most ever...7 = fewest ever)

How many times did you feel you were about to "go down the pipe?"
(1 = most ever...7 = fewest ever)

How much did your general mood prior to coming to work affect the difficulty of your job today? (1 = made job much more difficult...7 = made job much more easy)

If you gave training (formal or informal) today, how much of a burden was it? (1 = lightened job extremely...7 = extremely burdensome)

16. How much did the requirements of this study contribute to the difficulty of your job today? (1 = made very much easier...7 = made very difficult)
17. Overall, in your experience as an ATC at this facility, how difficult were your assignments compared to most other assignments that you might have had? (1 = very easy...7 = very difficult)

Table 77 displays a comparison of the average item ratings in the Subjective Difficulty Questionnaire for the first three field studies. A score of four represented the exact mid-point for all of the items. In general this middle category indicated that the particular component of subjective difficulty was neither more difficult than average nor less difficult than average.

Table 77 indicates that only two facets of the work day were considered above average in difficulty: giving on-the-job training and participating in the field study itself. The controllers also consistently indicated that the sector at which they worked and the number of times they felt they were losing control ("going down the pipe") were much less than average difficulty for the first three studies. Aircraft communication outages and interpersonal conflicts also were ranked at a relatively low level in contributing to the subjective difficulty experienced on the study days.

A number of statistical analyses were conducted to determine if a sub-group of items focused most clearly on the overall subjective difficulty for a day. In particular, factor analyses were conducted on random split-halves across all man days. They revealed that seven items accounted for most of the variance between all of the items in the Subjective Difficulty Questionnaire. The seven items were replicated in the split-half random samples, and therefore we were confident that they represented the core dimension of subjective difficulty for an air traffic controller.

Table 78 displays the item composition and reliability of the summary subjective difficulty score eventually used. The scoring for each item is indicated in the direction of more subjective difficulty, though on the original form half of them had their responses ordered in the opposite direction. The seven main components of subjective difficulty were the man's overall assessment of the difficulty of the assignment, the perception of how heavy air traffic had been, the perception of potential separation conflicts, the number of times a man had to cycle from peak to slow controlling conditions, how many times he felt that he was about to "go down the pipe" (lose control) having to give training and finally, perception of the difficulty of this assignment relative to all other assignments. Responses to these items were added together to form a summary subjective difficulty score.

Table 78 also displays the internal consistency reliability for the summary subjective difficulty score. For the first three administrations the internal consistency reliability ranged from .82 to .86. These reliability figures were quite

TABLE 77

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Comparison of Average Item Ratings
for Subjective Difficulty over First
Three Field Studies

Item Content	Average at First Visit ¹	Average at Second Visit ²	Average at Third Visit ³
1. Overall sector difficulty	2.87	2.77	2.87
2. Self-rated competence	3.73	3.73	3.65
3. Traffic load*	3.41	3.48	3.46
4. Type of air traffic	3.82	3.87	3.90
5. Weather	3.41	3.49	3.60
6. Quality of help	3.78	3.71	3.89
7. Radar outages *	3.80	3.63	3.61
8. Aircraft comm. outages*	3.22	3.18	3.21
9. Supervisory help	3.90	3.90	3.84
10. Interpersonal conflicts*	3.29	3.32	3.26
1. # of potential aircraft conflicts*	3.39	3.38	3.38
2. Peak to slow traffic changes *	3.59	3.51	3.62
3. Feeling loss of control*	2.68	2.68	2.69
4. Mood prior to work*	3.78	3.84	3.78
5. Training	(N=106) 4.69	(N=96) 4.58	(N=96) 4.58
6. This study	4.22	4.30	4.30
7. Overall assignment difficulty	3.56	3.29	3.34

Scoring reversed such that high scores = more difficulty.

N = 389, except as noted.

N = 362, except as noted.

N = 346, except as noted.

TABLE 78

Item Composition And
Reliability Of Summary
Subjective Difficulty

Item Content

Overall, how difficult do you feel your assignments have been today?
(scored from 1 = very easy to 7 = very difficult)

How heavy has been today's traffic in terms of number of aircraft
handled? (Scored from 1 = lightest ever to 7 = highest ever)

How many potential traffic conflicts occurred today compared to
"normal" times? (Scored from 1 = fewest ever to 7 = most ever)

How many changes from peak to slow controlling conditions occurred
today compared to "normal" times? (Scored from 1 = fewest ever to
7 = most ever)

How many times did you feel you were about to "go down the pipe?"
(Scored from 1 = most ever to 7 = fewest ever)

If you gave training (formal or informal) today, how much of a burden
was it? (Scored from 1 = lightened job extremely to 7 = extremely
burdensome)

Overall, in your experience as an ATC at this facility, how difficult
were your assignments compared to most other assignments that you
might have had? (Scored from 1 = very easy to 7 = very difficult)

Internal Consistency Reliability*

First administration, reliability = .82
Second administration, reliability = .85
Third administration, reliability = .86

Efficient alpha (Nunnally, 1967)

high and consistent. Therefore we concluded that the summary subjective difficulty score was a coherent assessment of the overall difficulty experienced by a man as he reflected upon the work day he had just completed.

Table 79 displays the distribution of summary subjective difficulty scores over the first three field studies. Slightly more than 17% of the men thought that the day they were studied was much below average in difficulty while the great majority (70%-75%) thought the day was average. A small proportion (8%-11%) considered the day above average in difficulty.

We were interested in whether or not the subjective difficulty of a day was related to the objective difficulty of a day assessed by our summary workload measures. Table 80 displays the correlations between summary subjective difficulty score and the summary workload measures for the first three field studies.

Summary subjective difficulty was related most closely with the normalized workload measures, yielding moderate but highly significant correlations. Paceload also was moderately correlated with summary subjective difficulty. The correlation between paceload and summary subjective difficulty increased over subsequent visits. Time load had only a marginally significant relationship to summary subjective difficulty. Finally, the two training workload measures had moderately low correlations with subjective difficulty at the three studies. Thus, a man's perception of the difficulty of his day was moderately related to objective measures of how much work he accomplished.

The consistent and moderate correlation between normalized workload and subjective difficulty allowed us to compute another measure of subjective response to work. This measure, called psychological response to work, was equal to the difference between the actual subjective difficulty and the subjective difficulty that would be expected from the objective workload. Hence a high score on the psychological response measure indicated that a man experienced the day as more difficult than the objective workload warranted. Men who responded in this way were classified as augmentors. On the other hand, a low score indicated that a man perceived his day to be much less difficult than would be expected from the objective normalized workload. Men who responded in this fashion were classified as reducers, inasmuch as they underestimated how much work they had done.

The psychological response to work variable was calculated from our post hoc findings, and should be differentiated

TABLE 79
Distribution of Summary
Subjective Difficulty over
the First Three Field Studies

<u>Summary</u> <u>Subjective Difficulty</u>	<u>Percentage Scoring at</u>		
	<u>First Field</u> <u>Study</u>	<u>Second Field</u> <u>Study</u>	<u>Third Field</u> <u>Study</u>
<u>Total Score ≤ 14</u> <u>more than less than average</u> <u>difficulty</u>	18.5%	17.7%	17.6%
<u>Total Score 15-28</u> <u>average difficulty</u>	70.2%	71.3%	74.6%
<u>Total Score 29+</u> <u>above average</u> <u>difficulty</u>	11.3%	11.0%	7.8%
<hr/>			
<u>Total Subjects</u>	389	362	346
<u>Overall Mean</u>	20.77	20.32	20.62
<u>Overall S.D.</u>	6.37	6.23	6.19

Correlations Of Summary Subjective
Difficulty With Summary Workload
Measures, First Three Field Studies

<u>SUMMARY WORKLOAD</u>	<u>CORRELATION WITH SUMMARY SUBJECTIVE DIFFICULTY AT RESPECTIVE VISIT NUMBER</u>	<u>NUMBER OF SUBJECTS</u>
ormalized Workload, Visit 1	.44***	381
ormalized Workload, Visit 2	.42***	355
ormalized Workload, Visit 3	.43***	339
ceload, Visit 1	.33***	381
ceload, Visit 2	.37***	356
ceload, Visit 3	.43***	340
neload, Visit 1	.03	381
neload, Visit 2	.18*	356
neload, Visit 3	.18*	340
me Training, Visit 1	.27***	381
me Training, Visit 2	.27***	356
me Training, Visit 3	.31***	340
rk Training, Visit 1	.30***	381
rk Training, Visit 2	.26***	356
rk Training, Visit 3	.33***	340

* p <.01

* p <.001

from the summary subjective difficulty. The predictive utility of the psychological response to work, as well as of subjective difficulty and objective workload are discussed in Section V.

Finally, we were interested in the relationship between moods, behavior and the summary subjective difficulty measures. Table 81 displays the correlations between the summary subjective difficulty and the summary behavioral and mood measures at the first three field studies. Only one mood was consistently, though weakly, related to the subjective difficulty reported at the end of the day: friendliness. The correlation was negative, so that greater friendliness at the beginning of the day related to reports of less difficulty during the day. No other correlations between moods and summary subjective difficulty were consistent and replicable across the first three field studies.

Table 81 also displays the correlation between the summary behavior measures and the summary subjective difficulty for a day over the first three field studies. Total behavioral arousal (total behavior) during the day was significantly and positively correlated with reported overall difficulty (summary subjective difficulty) at the end of the day. Similarly we found that the range in behavior displayed during the day was positively related to the subjective difficulty reported at the end of the day. The correlation between behavior range and summary subjective difficulty, however, was much less than that between the total behavior and subjective difficulty, indicating that fluctuations in behavior were less important in the perception of a day's difficulty than was the total amount of arousal he experienced.

An average behavior rating also was calculated for illustrative purposes. The average behavior manifested during the day was moderately and significantly related to summary subjective difficulty. This result added further credence to the suggestion that the variability in behavior was less related to experiencing difficulty for a day; rather, the total continued amount of behavioral arousal was more important to men when they recalled the difficulty of their day. Correlations of average behavior rating and subjective difficulty decreased as the field studies progressed, whereas correlations of total behavior and subjective difficulty increased. We did not, therefore, continue to use the average measure since the total behavior measure displayed more consistent and increasingly strong associations with objective and subjective workload. The results reported in Table 81 illustrate this phenomenon over the first three studies.

Correlations of Summary Subjective
Difficulty with Summary Behavior
Measures and Eight Moods at
First Three Field Studies

<u>Profile of Mood States</u>	<u>Summary Subjective Difficulty</u>		
	<u>Visit 1</u>	<u>Visit 2</u>	<u>Visit 3</u>
Friendliness	-.13*	-.14*	-.11*
Tension/Anxiety	.19**	.03	.00
Elation	-.11*	-.10*	-.07
Anger/Hostility	.02	.00	.02
Fatigue	.09	.05	-.03
Depression	.04	-.01	-.01
Vigor	-.06	-.10*	.04
Confusion	.10*	-.01	.00
<u>Summary Behavior</u>			
Total Behavior	.26***	.34***	.36***
Behavior Range	.21**	.13**	.10*
Average Behavior	.44***	.40***	.39***

* p < .05

** p < .01

*** p < .001

In summary, the ATC Subjective Difficulty Questionnaire was devised to assess the components of workload which contributed to the perception of a difficult day.

The difficulty of a day as reported was moderately and significantly associated with the amount of work performed for the day. Only one mood was consistently related to subjective difficulty at the end of the day: a friendly mood in the morning was related to a report of less than average difficulty for the day. Total behavioral arousal during the day was significantly correlated with the total subjective difficulty reported by men at the end of the day. The range in behavior manifested during the day was significantly, but slightly, related to subjective difficulty. The average behavior manifested was moderately related to subjective difficulty reported by men at the end of the day.

SUMMARY

Cardiovascular Measures at Work

Levels and variability of blood pressure and heart rate at work were studied to ascertain whether or not the air traffic control work was producing increased cardiovascular response. Portable automatic recording sphygmomanometers were used to measure and record the ATCs' blood pressure every 20 minutes during a 5-hour study day while they were actually controlling traffic and while they were off position.

The following findings emerged:

- 1) The men's average blood pressures at work were highly correlated with their average blood pressures in the physician's office (.64 for both systolic and diastolic);
- 2) Daily average systolic blood pressure was 129 ± 13 mm Hg; daily average diastolic blood pressure was 87 ± 8 mm Hg; daily average heart rate was approximately 78 ± 10 beats per minute;
- 3) There was a slight tendency for blood pressures to be higher while men were on-position compared to when they were off-position;
- 4) On the average, systolic pressures ranged 35 ± 12 mm Hg over a day, and diastolic pressures ranged 27 ± 8 mm Hg;
- 5) There was a significant difference of 3 mm.Hg in the diastolic blood pressure averages of the oldest group of controllers, aged 39-49 at entry to the study vs. the younger controllers;
- 6) Working on the radar position had a consistently significant effect on range in blood pressure. Neither working other positions nor working any sector had a significant effect;
- 7) Controllers at Logan Tower, younger than controllers at other facilities, had highest systolic blood pressure values;
- 8) When each man's changes in blood pressure were calculated on the basis of his own record, on-position measures were significantly higher for most men than off-position measures;
- 9) On the average, level of systolic blood pressure increased 4 to 5 mm Hg and diastolic blood pressure increased 2 to 3 mm Hg under conditions of higher workload when days of varying workload were compared;
- 10) Variability of blood pressure was not affected by changing amounts of workload, but was influenced by time on-position, which did not influence average pressure.

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For predictive studies, a number of measures of cardiovascular responsiveness to work were derived in addition to measures describing blood pressure levels and variability for each man.

9. Cardiovascular Measures at Work

Introduction

The cardiovascular measures that we studied were levels of blood pressure and heart rate, and variability of blood pressure and heart rate. Systolic blood pressure, diastolic blood pressure and heart rate were used to assess the nature of men's cardiovascular responses while they were controlling air traffic as well as when they were on work breaks and carrying out other duties.

A standard protocol was followed for all observations. Systolic and diastolic blood pressures were recorded using portable automatic recording sphygmomanometers that measured and recorded pressure in the cuff and recorded Korotkoff sounds on magnetic tape during deflation of the blood pressure cuff. The sphygmomanometer was operated by a medical technician, and recordings were made every twenty minutes. During the 2-minute period just before each measurement of blood pressure, a number of other assessments were made, such as traffic conditions and men's behavior. These data were collected and recorded three times an hour for a period of five hours beginning at 7:30 during the morning shift and at 15:00 during the afternoon shift. During each 5-hour period of measurements, fifteen observations were made for each man on each day he was studied. It should be noted that men's average blood pressures while at work were highly correlated with their average blood pressures from the office visits (.64 for both systolic and diastolic pressures).

Cardiovascular Measures and Descriptive Statistics

Almost all of the men were studied during work on at least one day. Table 82 shows the number of men with complete blood pressure studies. Three hundred and eighty-two men (92% of our sample) had at least one blood pressure study. The majority of men (69% of our sample) were studied for five hours on three or more different days. Over the course of the study, we collected data during a total of 1,421 man-days and 7,105 hours of observations. In all, we collected over 21,000 blood pressure and heart rate measurements while men were at work.

Levels of systolic blood pressure, diastolic blood pressure, and heart rate were computed for each man every day he was studied at work. On the average, the systolic blood pressure measured over the whole day was 129 ± 13 (mean \pm S.D.) mm Hg and the average diastolic blood pressure was 87 ± 8 mm Hg. The average heart rate measured over the whole day was approximately 78 ± 10 .

TABLE 82

Number Of Men Completing Blood Pressure Studies

		<u>% of 416</u>
1st	382	92%
2nd	340	82%
3rd	288	69%
4th	249	60%
5th	162	39%
Total Man-days	1421	
Total Hours	7105	
Total Number Observations	21,315	

beats per minute. Tables 83 and 84 present the average systolic and the average diastolic blood pressures respectively for each of the first three visits. These tables list the mean across all men for the average pressures, the standard deviations of those averages, and the maximum and minimum average blood pressure. Additional tables presenting values for heart rate are included in Appendix I. Other tables listing similar statistics for the maximum systolic and diastolic pressures also are included in Appendix I.

Table 83 also shows that levels of blood pressure were not different when data from men receiving antihypertensive medications were included. In both groups of men, with and without those receiving antihypertensive medications, there was a slight tendency for blood pressures to be higher while men were on-position compared to when they were off-position. Furthermore, values for blood pressure for all men were slightly lower on subsequent days than during the first day they were studied. On the average across all men and across all visits, blood pressures were approximately 1 mm Hg lower each visit but the differences were not clinically significant. These minor reductions were evident in the all-day measures, the on-position measures, and the off-position measures.

The amount that blood pressure varied during the day was more impressive than the levels of blood pressure. Whereas average levels of blood pressure were within the limits of pressures recorded in other groups of subjects studied by other investigators, the ranges were much greater than we expected. Tables 85 and 86 present population statistics for systolic range and diastolic range. We calculated the range as the difference between the highest and lowest pressures observed for each man on one day. On the average, systolic range measured over the whole day was 35 ± 12 mm Hg and the average diastolic range was 27 ± 8 mm Hg. During the working day, systolic blood pressure rose on the average above 150 mm Hg and fell on the average below 115 mm Hg at least once. Diastolic blood pressure rose on the average above 100 mm Hg and fell below 75 mm Hg. This variation is of great clinical significance.

These measures of blood pressure levels and variability were calculated in three ways. First, we evaluated these measures over all assessments made for a day. These are referred to as daily measures. Secondly, these same measures of level and variability were calculated only for those times a man was working a journeyman position (see Section IIIB7).

TABLE 83

ATC
FIELD STUDY
CARDIOVASCULAR MEASURES
Average Systolic At Work

ALL SUBJECTS

AVERAGE SYSTOLIC	MEAN VISIT			STD. DEVIATION			MAXIMUM			MINIMUM			N V I S I T
	V I S I T 1	V I S I T 2	V I S I T 3	V I S I T 1	V I S I T 2	V I S I T 3	V I S I T 1	V I S I T 2	V I S I T 3	V I S I T 1	V I S I T 2	V I S I T 3	
DAILY	130.83	129.30	128.59	12.49	12.91	13.34	176.33	185.90	174.20	101.08	99.30	96.50	382 340 288
ON POSITION	131.32	129.46	128.87	13.48	13.47	14.12	181.33	185.36	178.22	98.43	98.00	97.75	375 338 286
OFF POSITION	130.63	128.72	127.84	13.16	13.24	13.46	172.00	187.50	173.83	102.67	92.75	94.25	376 336 287

EXCLUDING SUBJECTS ON ANTI-HYPERTENSIVE MEDICATIONS

AVERAGE SYSTOLIC	MEAN VISIT			STD. DEVIATION			MAXIMUM			MINIMUM			N V I S I T
	V I S I T 1	V I S I T 2	V I S I T 3	V I S I T 1	V I S I T 2	V I S I T 3	V I S I T 1	V I S I T 2	V I S I T 3	V I S I T 1	V I S I T 2	V I S I T 3	
DAILY	130.93	129.33	128.75	12.50	13.09	13.46	176.33	185.90	174.20	103.79	99.30	96.50	360 320 269
ON POSITION	131.41	129.44	129.00	13.51	13.68	14.26	181.33	185.36	178.22	100.91	98.00	97.75	353 318 268
OFF POSITION	130.70	128.80	128.01	13.22	13.39	13.57	172.00	187.50	173.83	102.67	92.75	94.25	354 316 268

TABLE 84

ATC
FIELD STUDY
CARDIOVASCULAR MEASURES

Average Diastolic At Work

<u>AVERAGE DIASTOLIC</u>	<u>MEAN</u>			<u>STD. DEVIATION</u>			<u>MAXIMUM</u>			<u>MINIMUM</u>			<u>N</u> <u>VISIT</u>		
	<u>VISIT</u> <u>1</u>	<u>VISIT</u> <u>2</u>	<u>VISIT</u> <u>3</u>	<u>VISIT</u> <u>1</u>	<u>VISIT</u> <u>2</u>	<u>VISIT</u> <u>3</u>	<u>VISIT</u> <u>1</u>	<u>VISIT</u> <u>2</u>	<u>VISIT</u> <u>3</u>	<u>VISIT</u> <u>1</u>	<u>VISIT</u> <u>2</u>	<u>VISIT</u> <u>3</u>		<u>VISIT</u> <u>1</u>	<u>VISIT</u> <u>2</u>
DAILY	87.39	86.64	86.71	0.46	8.39	7.60	113.92	109.00	110.40	65.54	66.40	67.60	382	340	288
ON POSITION	88.32	87.15	87.16	9.06	8.62	7.97	120.00	111.00	110.10	66.11	66.30	68.17	375	338	286
OFF POSITION	86.46	85.82	85.75	9.18	9.09	8.39	115.40	114.75	112.00	55.00	65.00	64.50	376	336	287

ALL SUBJECTS

EXCLUDING SUBJECTS ON ANTI-HYPERTENSIVE MEDICATIONS

<u>AVERAGE DIASTOLIC</u>	<u>MEAN</u>			<u>STD. DEVIATION</u>			<u>MAXIMUM</u>			<u>MINIMUM</u>			<u>N</u> <u>VISIT</u>		
	<u>VISIT</u> <u>1</u>	<u>VISIT</u> <u>2</u>	<u>VISIT</u> <u>3</u>	<u>VISIT</u> <u>1</u>	<u>VISIT</u> <u>2</u>	<u>VISIT</u> <u>3</u>	<u>VISIT</u> <u>1</u>	<u>VISIT</u> <u>2</u>	<u>VISIT</u> <u>3</u>	<u>VISIT</u> <u>1</u>	<u>VISIT</u> <u>2</u>	<u>VISIT</u> <u>3</u>		<u>VISIT</u> <u>1</u>	<u>VISIT</u> <u>2</u>
DAILY	87.45	86.67	86.77	0.47	8.42	7.68	113.92	109.00	110.40	65.54	66.40	69.40	360	370	269
ON POSITION	88.36	87.15	87.22	9.03	8.64	8.00	120.00	111.00	110.10	66.11	66.30	68.86	353	318	268
OFF POSITION	86.54	85.78	85.79	9.26	9.03	8.33	115.40	114.75	112.00	55.00	65.00	64.50	354	316	268

TABLE 85

-AIC
FIELD STUDY
CARDIOVASCULAR MEASURES

Range Of Systolic At Work

RANGE - SYSTOLIC	MEAN			STD. DEVIATION			MAXIMUM			MINIMUM			N
	VISIT 1	VISIT 2	VISIT 3	VISIT 1	VISIT 2	VISIT 3	VISIT 1	VISIT 2	VISIT 3	VISIT 1	VISIT 2	VISIT 3	
DAILY	37.38	34.64	33.84	12.36	11.42	12.39	103.00	91.00	75.00	11.00	13.00	11.00	382
ON POSITION	29.77	28.62	28.43	12.35	11.72	12.41	71.00	75.00	70.00	0	0	5.00	375
OFF POSITION	24.17	22.11	20.84	14.25	11.80	12.60	100.00	65.00	75.00	0	0	0	376

ALL SUBJECTS

EXCLUDING SUBJECTS ON ANTI-HYPERTENSIVE MEDICATIONS

RANGE - SYSTOLIC	MEAN			STD. DEVIATION			MAXIMUM			MINIMUM			N
	VISIT 1	VISIT 2	VISIT 3	VISIT 1	VISIT 2	VISIT 3	VISIT 1	VISIT 2	VISIT 3	VISIT 1	VISIT 2	VISIT 3	
DAILY	37.45	34.77	34.07	12.43	11.56	12.53	100.00	91.00	75.00	11.00	13.00	11.00	360
ON POSITION	29.77	28.64	28.82	12.29	11.97	12.41	71.00	75.00	70.00	0	0	5.00	353
OFF POSITION	24.39	22.17	20.71	14.31	11.91	12.74	100.00	65.00	75.00	0	0	0	354

TABLE 86

ATE
FIELD STUDY
CARDIOVASCULAR MEASURES
Range of Diastolic At Work

RANGE - DIASTOLIC	MEAN			STD. DEVIATION			MAXIMUM			MINIMUM			N
	VISIT 1	VISIT 2	VISIT 3	VISIT 1	VISIT 2	VISIT 3	VISIT 1	VISIT 2	VISIT 3	VISIT 1	VISIT 2	VISIT 3	
DAILY	26.86	27.05	25.70	8.92	8.11	7.37	78.00	55.00	50.00	8.00	12.00	10.00	382
ON POSITION	20.93	21.89	21.61	8.94	8.65	8.11	57.00	55.00	50.00	0	0	1.00	375
OFF POSITION	17.67	18.25	15.25	9.76	9.36	9.09	65.00	55.00	47.00	0	0	0	376

EXCLUDING SUBJECTS ON ANTI-HYPERTENSIVE MEDICATIONS

RANGE - DIASTOLIC	MEAN			STD. DEVIATION			MAXIMUM			MINIMUM			N
	VISIT 1	VISIT 2	VISIT 3	VISIT 1	VISIT 2	VISIT 3	VISIT 1	VISIT 2	VISIT 3	VISIT 1	VISIT 2	VISIT 3	
DAILY	26.91	27.13	25.70	8.92	8.12	7.40	78.00	55.00	50.00	8.00	12.00	10.00	360
ON POSITION	21.05	22.02	21.66	8.71	8.67	8.19	50.00	55.00	50.00	0	0	1.00	353
OFF POSITION	17.69	18.20	15.13	9.83	9.41	9.09	65.00	55.00	47.00	0	0	0	354

These measures are referred to as calculated only for those times in a day that a man was not working a journeyman position. These times included when a man was on break, working a data position, or in a supervisory position (see Section IIIB7.). These assessments are referred to as off-position measures in our tables. We were primarily interested in men's experiences as journeyman controllers. Therefore, to investigate blood pressure responsivity to work, we used the on-position measures. We could examine thereby the possible effects of changes in traffic on blood pressure during the time a man was actually working a journeyman position.

Factors Other Than Workload Affecting Blood Pressure

Before investigating blood pressure responsivity to work-related phenomena, we checked to see whether a number of other factors affected blood pressure. First, comparisons of the morning and afternoon readings of blood pressure across the first three visits showed no consistent differences in blood pressure between the morning and afternoon readings. Thus, we could collapse across morning and afternoon visits.

Other factors checked for their effects on blood pressure measures were age and amount of experience as an air traffic controller. No consistent differences were found between experience groups. The only significant differences attributable to age were in average values for diastolic blood pressures. Table 87 shows that the group of oldest controllers, men age 39-49 at the beginning of the study, had significantly higher diastolic averages than the controllers in the younger age groups across all three visits. The difference between the oldest group and the youngest group was 3 mm Hg.

Other factors examined were the possible effects of working different journeyman positions and working in different types of sectors. Working on the radar position did have a consistently significant effect on men's range in blood pressure across the first three studies. However, there were no consistent effects of working a particular type of sector.

Significant differences between facilities for all three visits were observed. These results are summarized in Table 88. The measures that consistently discriminated between facilities were systolic range and systolic maximum. Men studied at Logan Tower had the highest values for systolic blood pressure among the controllers during two of three visits. Diastolic average and maximum, significantly different on one of three visits, were also highest at Logan Tower. Controllers at Logan were younger than controllers at other facilities.

TABLE 87

265

Differences in Age in Blood Pressure Response To Work

	<u>Younger</u>	<u>Middle</u>	<u>Older</u>		
Age	25-34	35-38	39-49		
# subjects	115	105	132		
<u>Diastolic Averages</u>				<u>F</u>	<u>P</u>
Visit 1	86.9	87.9	90.2	3.72	.0246
Visit 2	85.3	87.2	88.9	5.16	.0065
Visit 3	86.4	86.1	88.9	3.42	.0330

FACILITY	ISLIP		NASHUA	COMMON IFR	LOGAN TOWER	QUONSET, OTIS WINDSOR, PROV.		F	P
	VISIT 1	N =							
Systolic Aver.	130.0	(152)	(84)	(57)	(27)	(32)			
Systolic Range	39.3		130.3	133.2	139.1	132.3	3.15	.0144	
Systolic Max.	152.2		33.8	36.2	<u>70.2</u>	36.9	3.27	.0115	
			147.2	152.3	<u>159.8</u>	153.9	3.29	.0115	
VISIT 2	N =	(140)	(79)	(49)	(24)	(26)			
Systolic Range	34.4		33.1	37.5	39.8	31.8	2.76	.0275	
Systolic Max.	147.5		146.6	153.1	<u>154.9</u>	144.2	2.52	.0403	
Diastolic Aver.	86.4		88.8	84.4	89.3	89.2	2.99	.0188	
Diastolic Max.	99.2		100.0	98.4	<u>104.5</u>	103.1	2.72	.0291	
VISIT 3	N =	(125)	(73)	(35)	(19)	(16)			
Systolic Aver.	131.1		122.8	131.5	136.2	126.8	6.04	.0003	
Systolic Range	35.1		32.1	35.7	<u>40.1</u>	24.8	4.29	.0026	
Systolic Max.	149.3		141.2	149.7	<u>156.7</u>	137.7	5.45	.0005	

Therefore, these high pressures cannot be explained by age. On the average, controllers at the Common IFR Room had the second highest pressures.

Interrelationships Among Cardiovascular Measures

The interrelationships among the daily cardiovascular measures are presented in Table 89. In order to determine responsiveness to variations in traffic, we derived measures to describe men's variability and level of blood pressure at work. Both range and level of blood pressure might be expected to be affected by variations in traffic. Because the range correlated highly with the standard deviation (0.94 and 0.93) the standard deviation measure was not included in our analyses. As presented in Table 89, the average systolic blood pressure correlated 0.35 with the range, and the average diastolic blood pressure correlated 0.15 with its range. While there was considerable independence between the range and the average blood pressure (indicated by low correlations), the relationships between these measures were statistically significant. Men with higher levels of blood pressure tended to have more variability in blood pressure during the course of the day.

A more accurate reflection of variability in blood pressure independent of average level was obtained by calculating a residual systolic and a residual diastolic range. The residual range measures were calculated as the difference between the actual range for a man and the range predicted from his average blood pressure. Therefore, a residual range of 4 means that a man's actual range in blood pressure was 4 mm Hg higher than that expected from his average blood pressure. Similarly, the maximum blood pressure measurements were significantly correlated with the average blood pressures (0.86 for both systolic and diastolic). Men with higher levels of blood pressure had higher maximum blood pressures. Therefore, for the purposes of analysis, we also calculated a residual maximum measure for each man which is interpreted in the same way as the residual range measures. That is, a residual maximum of 4 means that a man's maximum blood pressure exceeded that expected from his average blood pressure by 4 mm Hg.

Although blood pressure levels measured on three different days were highly correlated, ranges observed varied on different days. Table 90 shows how stable the blood pressure measures were across three studies for the men who were studied on three occasions. The average blood pressure measure was the most stable measure.

Specifically, the average correlated approximately 0.5 to

TABLE 89

Correlations Among Daily Cardiovascular Measurements Of
Air Traffic Controllers At Work: First Study

N* = 358-360

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
<u>SYSTOLIC</u>												
Average	1.00											
Range	.35	1.00										
Maximum	.86	.73	1.00									
Standard Deviation	.36	.94	.71	1.00								
<u>DIASTOLIC</u>												
Average	.57	.08	.44	.11	1.00							
Range	.25	.26	.28	.26	.15	1.00						
Maximum	.57	.23	.50	.26	.86	.54	1.00					
Standard Deviation	.27	.26	.28	.28	.13	.93	.49	1.00				
<u>HEART RATE</u>												
Average	.25	.22	.26	.22	.18	.06	.17	.08	1.00			
Range	.07	.26	.19	.26	.13	-.01	.11	-.01	.35	1.00		
Maximum	.23	.27	.27	.27	.21	.06	.19	.07	.89	.68	1.00	
Standard Deviation	.05	.18	.13	.19	.13	.03	.13	.02	.40	.89	.68	1.00

cluding subjects on anti-hypertensive medications; some correlations are based on
r subjects than others because for some subjects there were too few observations
calculate a measure. (e.g. there is no range when only one measurement was made).

Correlations Among Daily Cardiovascular Measurements Of
Air Traffic Controllers At Work: Across Three Studies

N* = 256-320

	<u>First vs Second Study</u>	<u>First vs Third Study</u>	<u>Second vs Third Study</u>
<u>SYSTOLIC</u>			
Average	.59	.57	.49
Range	-.02	.14	.24
Maximum	.41	.44	.39
Standard Deviation	.03	.20	.25
<u>DIASTOLIC</u>			
Average	.61	.47	.52
Range	.00	.12	.04
Maximum	.46	.30	.36
Standard Deviation	.04	.15	.09
<u>HEART RATE</u>			
Average	.54	.47	.51
Range	.04	.10	.25
Maximum	.40	.36	.44
Standard Deviation	.08	.07	.19

Excluding subjects on anti-hypertensive medications; some correlations are based on fewer subjects than others because for some subjects there were too few observations to calculate a measure. (e.g. There is no range when only one measurement was made). In addition, the correlations could only be calculated for subjects having a particular measure for all three studies.

0.6 across the first three studies for both systolic and diastolic pressures. But while the correlations indicated considerable stability of level of pressures, the correlation coefficients were not so high as to obviate the need for multiple studies. Maximum blood pressure also correlated significantly across studies for both systolic and diastolic (0.39 to 0.44 for systolic and 0.30 to 0.46 for diastolic). However, the maximum was a less stable measure than the average pressure. Finally, range was the least stable measure (correlations ranged from - 0.02 to 0.24 in systolic and 0.0 to 0.12 for diastolic).

Additional tables in the Appendix present the correlations among the on-position measures. Three of these tables list the correlations among all the on-position measures for Study 1, Study 2, and Study 3. The fourth table lists the correlations among the on-position measures across the three studies. The daily measures were highly correlated with the on-position measures, the average correlation coefficient being 0.95. Thus, for a given individual's values, the daily measures and the on-position measures were interchangeable. However, the on-position measures were generally more stable over time than the daily measures. This may be due to the fact that men's activities while working a journeyman position were fairly consistent. In comparison, when off-position and on break, for example, men could be walking, eating, playing sports and carrying out other activities.

Relationships Between Work and Cardiovascular Measures

Turning now to the relationship between workload and blood pressure, we saw differences between the on-position and off-position blood pressure measurements across all men. These differences were slight, but suggested that the differences would be more substantial if we compared measures within individuals. Thus each man would serve as his own control.

As shown in Table 91 we found that the on-position measures were significantly higher for most men than their off-position measures. For example, on the third visit, the maximum systolic and diastolic blood pressures were 5 and 4 mm Hg higher on-position than off-position. Similar changes were observed in heart rates. Furthermore, there was a combination effect evident in that average blood pressures decreased from visit 1 to visit 3. This decrease was much greater for the off-position averages than for the on-position averages.

Heart rate measures also were significantly different between the times when a man was on-position and the times he was off-position. However, there were a number of confounding factors

that affected heart rate. Men who smoked cigarettes had higher average heart rates and higher maximum heart rates on-position than men who were former smokers or who did not smoke. On the other hand, smoking did not have a significant effect on blood pressure and therefore we concentrated our analyses on blood pressures.

The higher blood pressures recorded on-position compared to off-position required further analysis. We found that, on the average, blood pressure increased under conditions of higher workloads and we undertook extended analyses to determine the strength and sources of these effects.

Two methods were used to investigate the differences in individual responses to increasing workload. Method A included individuals whose workload fell in the highest quartile on one day and in the lowest quartile on another. That is to say, the work they performed on the high day was in the highest 25% of all work done by individuals for that visit, and on the low day, their work fell into the lowest quartile of all values for that visit. One hundred and twenty-three men fulfilled these criteria. The comparisons of their blood pressures on their high day and their low day of workload are presented in Table 92. The average and maximum systolic and the average and maximum diastolic blood pressure levels were significantly higher on the high workload day than on the low workload day. The average systolic difference on these two days was 4 to 5 mm Hg while the average difference in diastolic was 2 to 3 mm Hg. These results were all statistically significant at the .005 level or better. These data showed that, on the average, men who were exposed to very different workloads on two different days had significantly increased blood pressure responses on the high workload day.

Method B compared men's values for both blood pressure and workload to each man's own average of blood pressure and workload across all of his studies. The grand average for workload included the amount of work done while blood samples were withdrawn. This yielded an average of 7 to 8 days that we could use to calculate each man's average workload. We then selected individuals who exceeded their workload average on one day by 10%, and on another day fell below their workload average by 10%. One hundred and sixty-one men fulfilled these criteria. Results of these comparisons are shown in Table 93. Again, the differences in blood pressures between the two days were measured by comparing the values on each day to an individual's own grand average for all blood pressure studies. This permitted a parallel analysis of both the independent and dependent variables.

Comparison Of Men With Themselves When They
Had Very High Workload On One Day And Very
Low On Another Day
 (N = 123)

METHOD A: Work Compared to Population Values
 Men in the Highest Quartile of Normalized Workload
 On Day One and in the Lowest Quartile on Day Two

	<u>HIGH WORKLOAD</u>	<u>LOW WORKLOAD</u>	<u>DIFFERENCE</u>	<u>t</u>	<u>P.</u>
Average Systolic mm Hg	131.85	127.51	4.34	3.73	.0005
Average Diastolic mm Hg	88.73	85.80	2.93	4.32	.0005
Maximum Systolic	147.59	141.88	5.71	3.29	.005
Maximum Diastolic	99.30	96.45	2.85	3.13	.005

TABLE 93

Comparison of Men With Themselves When They
Had Very High Workload On One Day And Very
Low On Another Day
 (N = 161)

METHOD B: (Ipsative) Work Compared to Man's Own Average For 5
 Field Studies. High Day Exceeds 10% Of Own Average Workload
 by 10%, Low Day Falls Below Own Average Workload by 10%

	<u>HIGH WORKLOAD</u>	<u>LOW WORKLOAD</u>	<u>DIFFERENCE</u>	<u>t</u>	<u>p</u>
<u>DAY AVERAGE MINUS</u> <u>GRAND AVERAGE FOR</u> <u>ALL BP STUDIES</u>					
Systolic BP mm Hg	+ 2.09	- 2.32	<u>4.41</u>	4.01	.001
Diastolic BP mm Hg	+ 1.76	- 2.41	<u>4.17</u>	6.69	.001
Maximum Systolic	2.64	- 1.66	4.30	2.90	.01
Maximum Diastolic	1.61	- 1.52	3.13	4.00	.001

The results were impressive whether Method A or Method B was used. The difference in systolic average blood pressure between a high workload day and a low workload day was approximately 4 mm Hg, and the difference in the maximum systolic pressure for high and low workload days also was approximately 4 mm Hg. The difference in diastolic values was 3 to 4 mm Hg. All of these results were statistically significant. Although only a subsample of the population fulfilled the criteria of having significantly different workloads on their study days, it was clear that on the average, systolic blood pressure increased for that subsample by approximately 4 to 5 mm Hg on days of increased workload compared to days of significantly less workload. There was a similar increase of 3 to 4 mm Hg in diastolic blood pressure, for both maximum and average values.

In contrast to levels of blood pressure, variability of blood pressure was not affected by changing amounts of workload. The residual ranges for systolic and diastolic blood pressures were the same under high and low workload conditions. However, residual range was influenced by time on position whereas the average pressure was not. Time-load, our summary measure, was the sum of maximum consecutive time on position and the total time on position during the course of one day. We found that the residual range measures were significantly related to the number of on-position blood pressure observations a man had for that day. For this analysis, we chose to include only the men whose measurements of range were based on more than five observations. Sixty-five men had residual range measures based on six or more on-position observations for the days when they were in the highest quartile of time-load and for the days when they were in the lowest quartile of time-load. Table 94 shows that for both systolic and diastolic pressures, men tended to exceed the amount of variability expected from their level pressures by about 3 mm Hg on extremely high time-load days. They tended to have almost 1 mm Hg less variability than expected from their level pressures on extremely low time-load days. These results were significant at or beyond the 0.05 levels.

In summary, Tables 92-94, demonstrate that blood pressure values were increased or decreased in accord with different workload conditions. Men's average and maximum pressures were significantly higher under extremely high workload conditions compared to men's average and maximum pressures under extremely low workload conditions. Further, when comparing time-load, defined as time on position summed with maximum consecutive time on position, there were substantial differences in men's blood pressure variability. These differences were all statistically significant and seem to represent a real physiological difference.

TABLE 94

Comparison Of Systolic And Diastolic Residual Range Measurements
Under Conditions Of High Timeload And Low Timeload
For
Days Including At Least Six Measurements On Position

Pressure Measurement	N ²	High Timeload Mean (S.D.)	Low Timeload Mean (S.D.)	r	t**	p
Systolic Residual	65	3.17 (9.30)	-0.58 (11.57)	-0.05	1.99	p < .05
Diastolic Residual	66	3.12 (7.76)	-0.82 (7.62)	.26	3.43	p < .01

and is the sum of maximum consecutive time on a working position and the time on a working position. High timeload represents the first occurrence of the top quartile of timeload over five field studies. Low timeload represents the first occurrence of the bottom quartile of timeload over five field studies.

anti-hypertensive medication during any of the first three field studies are excluded. In addition, men who never experienced the top quartile of timeload or men who never experienced the bottom quartile are excluded. Further, men who were not studied at least six times are excluded. Finally, the blood pressure measurements were calculated while men were on a working position. Therefore, men who were never on a working position are also excluded.

Residual range = Actual Range minus Predicted Range given his average blood pressure.

t** for correlated means

Cardiovascular Predictors for Future Health Change

The next major question was whether blood pressure responsivity to work influenced future health change. The previously described results led to the definition of three variables that captured blood pressure responsivity to work. Specifically, we computed the difference in average level pressures between the high and low workload days. However, when comparing the two days, the men who had the least amount of change in blood pressure levels tended to have had higher values on the low day than the men who experienced larger increases in blood pressure levels. Therefore, to get a more meaningful value of blood pressure responsivity to work, we again calculated residual measures, this time holding the initial level on the low day constant. These measures were:

1. Difference in systolic average between high and low normative man work days, controlling for initial level on low days.
2. Difference in diastolic average between high and low normative man work days, controlling for initial level on low days.
3. Difference in mean pressure average between high and low normative man work days, controlling for initial level on low days.

For the purposes of predicting future health change, we also devised a series of summary blood pressure measures that averaged individual values for the day across three or more blood pressure studies. To obtain characteristic and stable values for individuals, we eliminated the data for the men who had been studied only one or two times. Further, we excluded data for the men receiving any antihypertensive medications. The eight summary measures that were used as potential predictors of future health change were:

1. Grand average of systolic average for the day.
2. Grand average of diastolic average for the day.
3. Grand average of systolic maximum for the day.
4. Grand average of diastolic maximum for the day.
5. Grand average of systolic residual maximum for the day.
6. Grand average of diastolic residual maximum for the day.
7. Grand average of systolic residual range for the day.

Further discussion of the significance of our findings of blood pressure response to differences in work, in terms of its influence on development of health change can be found in Section V.

SUMMARY

Endocrine Measures at Work

Cortisol and growth hormone measurements, determined by radio-immunoassay of blood samples taken while the men were at work showed that:

- 1) the controllers as a group were secreting more cortisol than other groups reported in the literature;
- 2) there was considerable variability in cortisol secretion among and within individuals over time;
- 3) cortisol response did not relate consistently to any measures of work load;
- 4) there was a tendency for maximum levels of cortisol to be higher while men were on position;
- 5) levels of cortisol were not related to body weight, age, cigarette or coffee consumption;
- 6) other factors that may explain or relate to cortisol secretion are not yet known;
- 7) only 2% to 3% of blood samples taken showed significant levels of HGH secretion;
- 8) maximum HGH secretion during the day was not consistent within individuals;
- 9) maximum HGH secretion for most men was so small as to be undetectable in most analyses, confirming that most men are not responsive in HGH secretion to challenging tasks,
- 10) characteristics associated with the relatively few high HGH secretors were: lower weight, pulse rate and blood pressure, less psychiatric symptomatology (as measured by the PSS), less use of physical activity as a coping mechanism.

10. Endocrine Measures at Work

Among possible variables that might be studied for their ability to predict future health, we selected two endocrine measures that had been suggested in the scientific literature as responsive to stress - cortisol and growth hormone (see Section II). We hypothesized that individual differences in these hormonal responses, particularly with respect to workload, would be related to health change. Our procedures for determining the amounts of these hormones secreted by the men, and the methods of analyzing the data, are related below, together with the results.

Procedure

Over the course of the study, we collected blood for cortisol and growth hormone determinations during 1,156 participant-days. Similar to the procedure during measurement of blood pressure, we observed the work the man was doing, noted his behavior, and in addition, before the start of the work day, individuals filled out the Profile of Mood States Questionnaire and at the end of the day, the Subjective Difficulty Questionnaire. They also noted the nature of their sleep and any time off schedule in the past month, as well as any change in sleep pattern. As a consequence of differences in work schedules, 369 men, or 89% of our population, had at least one day in which blood was withdrawn, 316 of these 369 men were studied 2 days, 243 men were studied 3 days, 58 men were studied 4 days and 63 men were studied 5 days.

During each day of blood collection, a small non-thrombogenic catheter was implanted in the vein of each man's forearm, and this catheter was attached to a sphygmomanometer pump, permitting continuous collection of blood. Five ml samples were collected every 20 minutes to a total of 15 samples or 300 minutes of observation. This five-hour period of study began either at 0800, continuing until 1300, or at 1500, continuing to 2000. A total of 16,792 samples of blood were withdrawn from the volunteers over the course of the study, and the same number of observations were made of workload and behavior.

Blood samples were collected in heparinized tubes, and within ten minutes of being collected, they were centrifuged and the plasma was withdrawn and frozen with dry ice. All tubes to be used in a given day for an individual were labeled with a master label identified by color coding as well as numerically. In addition, a label was placed on the data sheet containing the observations for that individual for the day and another was placed in the master log next to the name of the man on whom the samples were collected. An open I.D. system was used in storing the blood samples, as no attempt

was made to introduce secret I.D.s for the blood collection procedure. This was different from the procedure used with blood pressure measurements. Because of the potentially sensitive nature of the blood pressure data, a code procedure was used to mark the tapes on which the blood pressure readings were recorded.

The frozen plasma samples were kept stored in a freezer at the field facility and then transported in batches to the laboratory at Boston University where they were stored in a specially designed freezer that maintained the temperature at -25°C . This freezer was protected with dual compressors, as well as an auxiliary generator for power when the electricity was interrupted. The freezer never defrosted during the course of the study, and no samples were thawed except those removed for analysis.

Both cortisol and growth hormone were determined by radio-immunoassay. Cortisol was stripped from the corticosteroid-binding globulin (CGS) by adding 40 microliters of plasma to a methanol-borate buffer and heating for 30 minutes at 60°C . Fifty microliters of this mixture were then removed and transferred to assay tubes for binding. No further chromatography or separation of cortisol was performed, as the antibody would provide adequate specificity. A 1:2500 dilution of the antibody (made to cortisol hemisuccinate-BSA conjugate) was added to the tubes and incubated for three hours at room temperature. Separation of bound and free cortisol from the antibody was accomplished by adding 250 microliters of saturated ammonium sulphate solution and centrifuging at 3,000 rpm for 10 minutes. A 400 microliter aliquot was removed from each tube to a scintillation vial, 10 milliliter scintillation solution added, and counted to 2% statistics. The standard curve was made up in triplicate with values ranging from one to 50 nanograms per 100 milliliters with a sensitivity equivalent to detecting one nanogram per 100 milliliters.

Nonspecific binding for standard tubes ranged from 4% to 6% and for the samples, 9% to 12%. The nonspecific binding value was used to correct the counts in calculating the sample values from the standard curve.

There was excellent reproducibility of the cortisol assay. The coefficient of variation (standard deviation over the mean \times 100) for duplicates, or within assay reproduction, was 2.96%. The coefficient of variation between or across assays was 6.41%.

Human growth hormone was determined by double-antibody radio-immunoassay. Samples were determined in duplicate, using 200 microliters of plasma in each determination. Purified growth hormone standard was provided by Dr. A.F. Wilhelmi from the National Pituitary Agency in the National Institute of Arthritis and Meta-

Public Diseases (NIAMD) (Lot #1652C). The 125 I growth hormone was purchased from Abbott and antisera that was used was produced in rabbits and used at final dilution of 1:600,000 (v:v).

The assay was carried out at room temperature for 24 hours, with each tube containing 200 microliters of the sample plasma, 10,000-14,000 DPM of 125 I-HGH, 50 microliters of growth hormone antibody, diluted with normal rabbit sera-human serum albumin-BPS buffer. Separation of bound from free HGH was accomplished by addition of a 1:20 dilution of goat anti-rabbit gamma globulin and incubation for 20 hours at room temperature. At this concentration, the percent binding equaled 58.5 ± 2.7 percent ($n = 30$).

Standards were made up in triplicate, with eight values ranging from 0 to 32 nanograms per milliliter in blank plasma, which was assayed to contain 0.25 nanograms per milliliter.

Sensitivity of the assay varied between 0.25 and 0.5 nanograms per milliliter, and the contribution from nonspecific binding averaged between 3% and 5%. Correction was made for this in calculations.

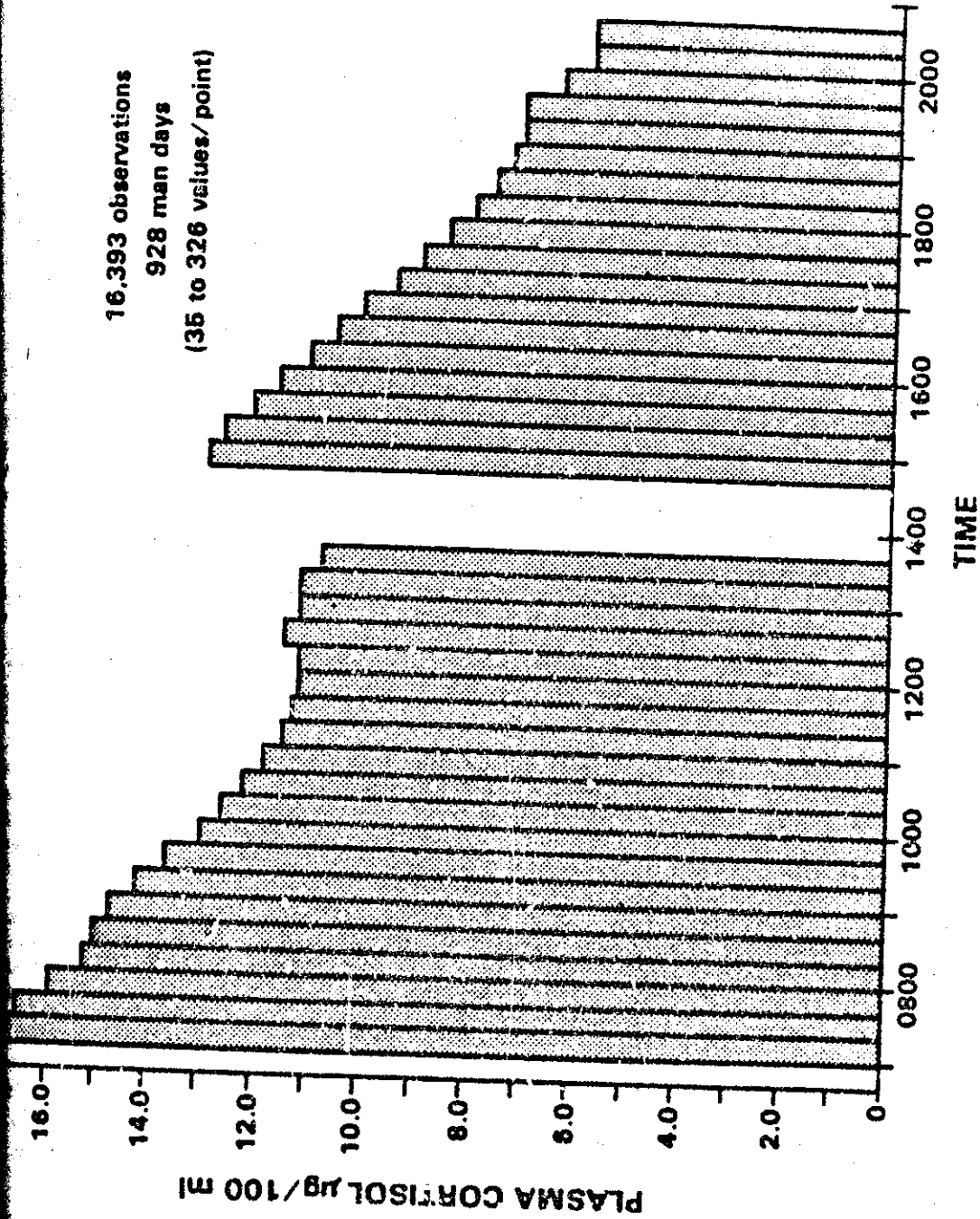
As with the cortisol assay, reproducibility of the growth hormone assay was excellent. The coefficient of variation within assay (duplicates) equaled 2.20% and between assays was 2.92%.

Cortisol Results

The cortisol results for 12,393 values are plotted in Figure 1. Because there was some variability in the time at which men were sampled both morning and afternoon collections, our data covered times from 0700 to 2040. The resulting curve was similar to that reported in the literature showing the clear diurnal trend both in the morning and afternoon. Several things were noteworthy. First, the values were high in comparison with those reported in the literature. The values averaged 5 to 7 $\mu\text{g}/100$ ml than values reported by other investigators using instantaneous collections. Second, in comparison with either values of integrated collections or values of instantaneous collections, the controllers as a group were secreting significantly more cortisol during the morning and afternoon than other groups reported in the literature. These groups, however, were largely patients in hospitals or others who differed from our ATC group in that blood collections were not taken while the other groups were actively working.

We evaluated the effect of venipuncture by comparing the morning and afternoon samples of 214 men who were studied at both times. There was some variability in the exact time that people started, so we compared the samples collected during the first hour, i.e., samples 2-4 with those samples collected during the second hour of

FIGURE Q



observation, i.e., samples 5-7. Sample 1 was eliminated from this analysis as it was an instantaneous sample obtained when the catheter was first inserted and represented only the value of cortisol at that particular moment rather than the integrated value over 20 minutes. In all cases the samples collected during the first hour were higher than the samples collected during the second hour with time of day held constant. These data suggested, as was reported in the literature, that there was a moderate effect of venipuncture apparent in the first hour, producing an average increase in cortisol from 1 to 2 $\mu\text{g}/100\text{ ml}$.

Selection of Measures for Analysis

As noted, samples 2-15 were similar in that they represented values obtained for an integrated 20-minute sample, while the first sample was an instantaneous value. Therefore, for all analyses using cortisol results, we eliminated the first sample. We also wanted to obtain a measure of daily cortisol for an individual free of the influence of venipuncture present during the first hour of sample collection. However, because the venipuncture effect was of relatively small value and was not a constant across all individuals, we also chose another measure which would not eliminate values obtained during the first hour.

Four measures were chosen to reflect cortisol secretion during the day. The first measure was the total amount of cortisol secreted, the sum of all values for samples 2-15. Individuals with less than 11 samples for a day were dropped from the analysis, leaving a total of 1,196 man-days of studies. More than 90% of the men remaining in the analysis had all 15 samples during the day they were studied.

The second measure calculated for each man-day was related to whether or not an episode was observed. An episode began, by definition, with a value that exceeded the previous value by 2 $\mu\text{g}/100\text{ ml}$. This was a conservative estimate as previous investigators used the 2 $\mu\text{g}/100\text{ ml}$ cutoff with instantaneous samples. When a 20-minute sample differs from a previous 20-minute sample by 2 μg , it is highly likely that sometime during that 20-minute period, the cortisol may have increased by as much as 6 or 8 $\mu\text{g}/100\text{ ml}$. Episodes were calculated from samples 5 to 15, eliminating the first four samples in order to free the analysis of any influence of venipuncture. An episode ended when a subsequent sample was equal or lower than the sample defining the start of the episode.

The third measure of cortisol was the number of peaks that occurred during the day, and these ranged from zero to three with an average of approximately .8 peaks for all samples observed.

The fourth measure was the maximum value of cortisol observed either during the entire 5 hours or while a man was on position.

Normalization of Cortisol Data

One of our major goals in collecting the cortisol data was to be able to divide men into responders and non-responders according to cortisol values. We planned to compare men in terms of the magnitude of cortisol response to varying workload over the numerous times we studied them. We were able to study 243 men on three different occasions during the three years they were in the study. Thus, 58% of the men could be assessed in terms of cortisol responsiveness using three days of data and 316 or 76% of the men could be assessed on the basis of two days of data. However, since men were studied both in the morning and the afternoon, it was essential that we find a way to combine the results for these two periods of time. It is now well established that cortisol exhibits a very strong diurnal trend, with values in the afternoon averaging approximately 4 to 5 $\mu\text{g}/100\text{ ml}$ lower. This effect is so strong that one finds a small but significant correlation between the exact time in which a study was started in the morning or afternoon and the total amount of cortisol for that day. It was therefore decided to compare every cortisol value determined for each individual with the average of all cortisols observed for that exact period of time. The individual value was thus normalized with respect to the average for that exact period of time of the day. A total of 13,480 cortisol values were used in 46 different time blocks to calculate normalized values. The results were expressed in terms of deviation from 100 such that if the normalized value equaled 100, it was equivalent to the raw mean of that period of time. We therefore could combine morning and afternoon visits, controlling for the different times during the day when plasma was collected for cortisol determination.

Relationships Between Cortisol Measures

The four measurements of cortisol responsivity during the day were significantly correlated with one another. The average correlation between total area and peak area for visits 1, 2 and 3 was .49. The average correlation between total area and number of peaks was .29, and the average correlation between the number of peaks and the peak area was .62. Maximum cortisol also showed an average correlation of .84 with total cortisol and .50 with peak cortisol.

Despite the consistency within a given visit between the four measures of cortisol response, there was relatively low reliability across visits. The only measure of cortisol response that had a significant between-visits correlation was that for normalized

total cortisol. Neither peak area nor number of peaks were consistent between visits. The correlation of normalized total area from visits 1 to 5 ranged from a low of .23 to a high of .40 with an average correlation across all 5 visits of .29. However, the first visit did correlate .71 with the average of 3 visits, and visits that were closer to one another in time were generally more highly correlated. Cortisol response on any single visit was obviously not a trait phenomenon, and it was therefore decided to average the cortisol values to obtain a more stable or characteristic value for each man.

Cortisol Responses as Predictors

We decided to include only those individuals who had at least three studies in the field involving blood collection and for whom we had at least eleven of a total of fifteen possible samples during the five hours they were studied. These criteria were fulfilled by 231 men. As many of these same men had been studied four or five times, the average number of studies performed on these men was 3.9, approaching a more stable or valid picture of the cortisol responses at work for these subjects.

We assessed three different measures of cortisol response for these 231 men: average normalized total cortisol; average normalized peak cortisol; average normalized maximum cortisol while on position. Table 95 divides the men into low, middle and high groups and translates the normalized values into raw cortisol levels for AM and PM separately for total and maximum cortisol measures, and Figure R shows high, middle and low groups throughout the day. As noted, values tended to be higher than reported in the literature, especially since these values represented a 20-minute average level rather than instantaneous values.

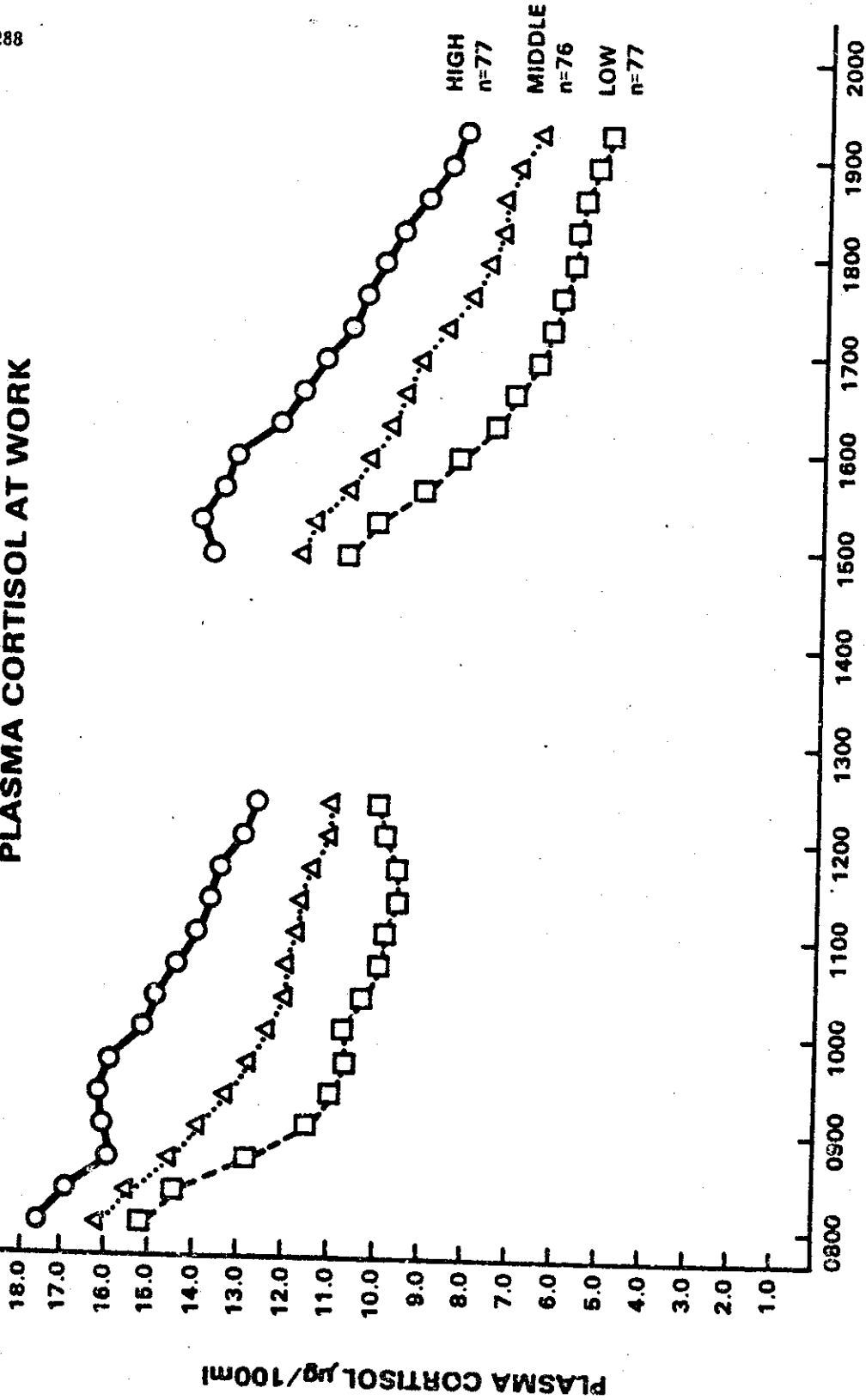
The table also translates total cortisol into an average value for the AM or PM to facilitate comparison with published data. This was done by simply dividing total for AM or for PM by the average number of samples (12).

It is apparent that there was considerable variation in average daily cortisol output among the men studied. The high AM group range was 13.9 to 21 $\mu\text{g}/100\text{ ml}$ for the five hours studied, which represents very considerable cortisol secretory levels, as does the high PM group range from 10.2 to 17 $\mu\text{g}/100\text{ ml}$. Similar variation is seen for maximum cortisol on position with impressively high levels seen for the high AM and PM groups. Also, as indicated in Figure S and T, the differences between high, middle and low groups were not due to differences in the response to venipuncture. Levels during the first hour, and the slope of the curves do not differ significantly in visits 1, 2 and 3 as they would if the groups had differing responses to venipuncture.

Average Total and Maximal Cortisol
Across All Visits For Men Who
Had Three or More Studies

<u>Average for Day</u>	Group Mean	Low Group	Middle Group	High Group
Normalized value	100	77-95	96-103	104-140
N.	231	77	77	77
<u>Cortisol</u> <u>(µg/100ml)</u>				
Study	13.0	8.7-11.9	12.1-13.7	13.9-21.8
Study	9.4	4.1-8.2	8.6-9.8	10.2-17.0
<u>Maximum Value</u> <u>Position</u>				
Normalized	120	88-112	113-125	126-180
<u>Cortisol</u> <u>(µg/100ml)</u>				
Study	16.5	10.3-15.8	15.8-17.8	18.3-29.0
Study	13.1	6.7-11.0	11.6-13.1	13.5-25.1

AVERAGE PLASMA CORTISOL AT WORK



TIME

FIGURE 5

HIGH VS. LOW CORTISOL RESPONDERS A.M.

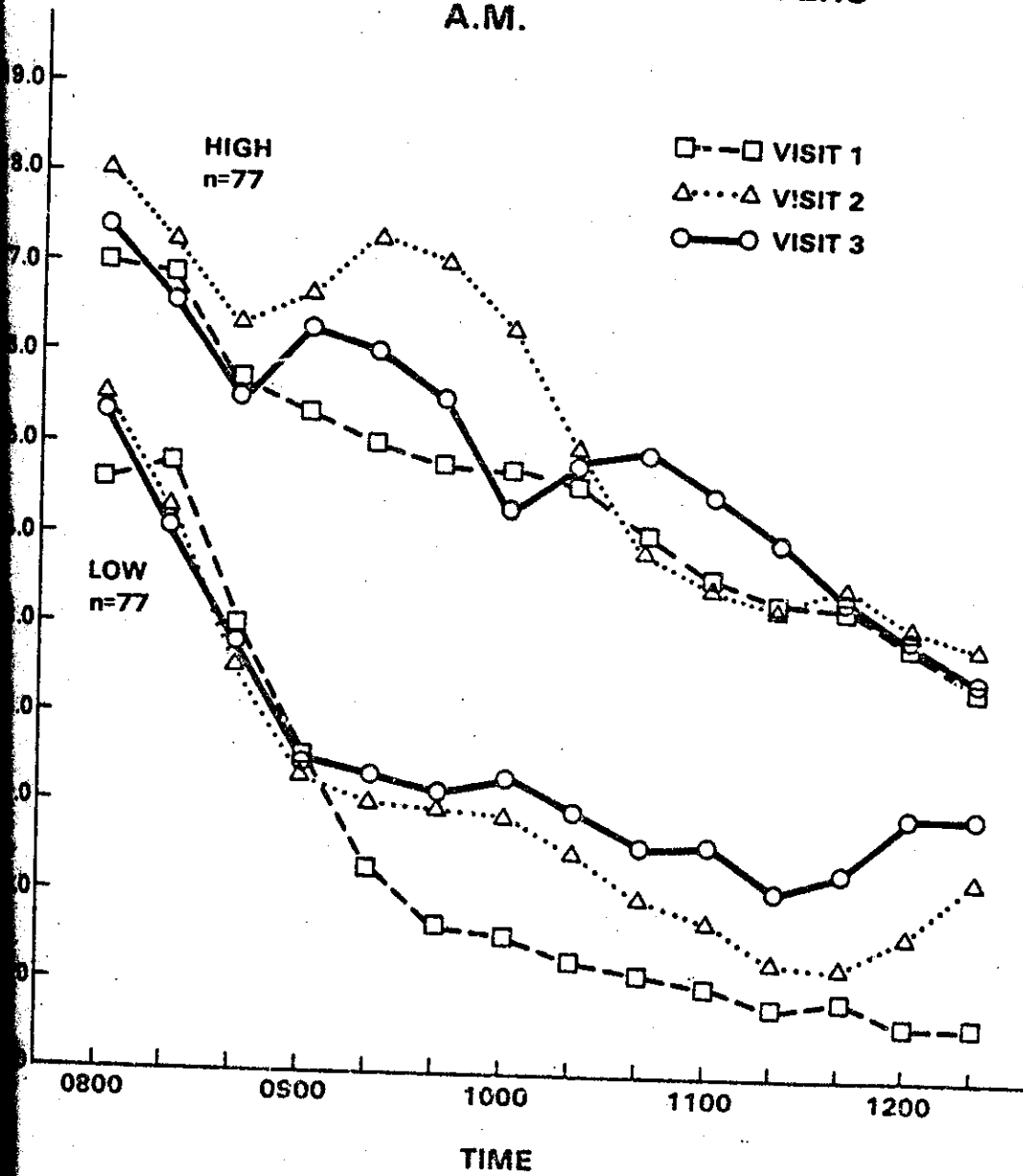
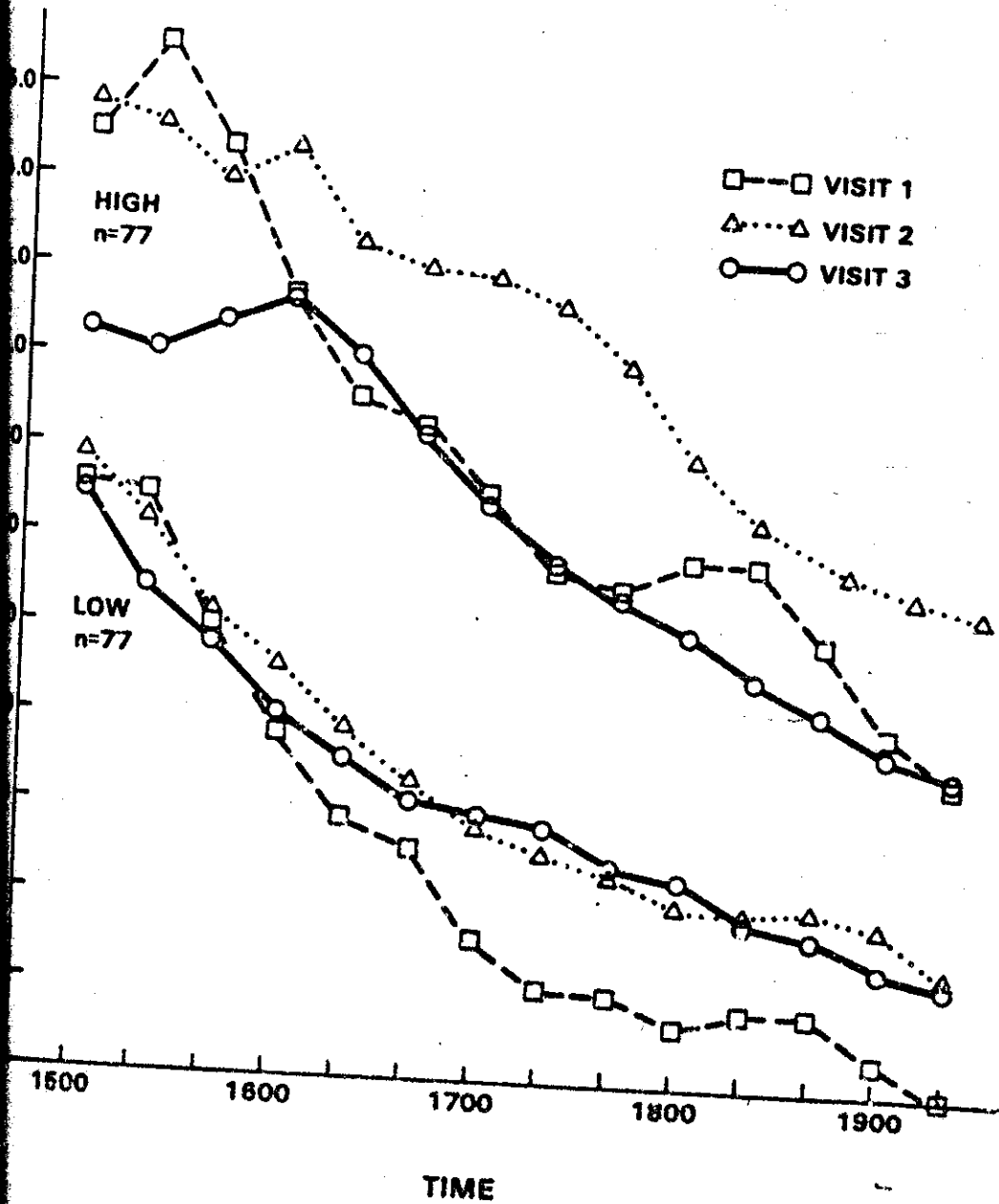


FIGURE 1

HIGH VS. LOW CORTISOL RESPONDERS P.M.



The average total, peak and maximum cortisol values for these 231 men were studied as potential predictors or correlates of psychological and physical health change. These studies are reported in Section V.

Cortisol Levels and Workload

Extensive analyses were performed to assess any relationship between cortisol and various measures of work (e.g., number of peak planes, range of peak planes, time on position, etc.). Initially each visit was studied separately and correlations were calculated between a man's cortisol responses and various measures of workload. No consistent relationships across the three visits were found between cortisol levels and various measures of work. This inconsistency reflected in turn the separate inconsistencies of each of the variables being correlated, i.e., men neither showed a consistent level of cortisol over time nor were they particularly consistent across studies in the number of planes they controlled or the total time spent on position. The nature of work performed is discussed in Section III B 7, Measurement of ATC Workload.

In order to control for differences across visits, we also analyzed the relationship between work and cortisol within a visit. As shown in Table 96 the maximum cortisol while on position was significantly higher than the value off position for all three visits. Off position included data position as well as being on break or assigned to other details for a short time. On position included radar, handoff, training, check code monitor. Although statistically highly significant, the actual difference in cortisol levels between on versus off position averaged only five normalized units or approximately 1 $\mu\text{g}/100\text{ ml}$ of cortisol. However, as is discussed in the predictive section, men showed significantly different responses to increased workload.

Total cortisol for the day, peak cortisol or number of secretory episodes were not significantly higher while on position than while off position.

We also were able to compare men on two different visits with respect to varying workload. We selected 90 whose workload on one day was in the lowest quartile and on another day was in the highest quartile. This method of selection maximized the opportunity for observing any influence of changing workload on cortisol. The results are summarized in Table 97. Maximum cortisol was significantly higher during high workload. The difference in actual cortisol levels between high and low workload days was 1.44 $\mu\text{g}/100\text{ ml}$ (7.20 normalized units). However, total cortisol or peak cortisol were not significantly higher on high workload days.

TABLE 96

Comparison of Cortisol Levels When Working
On Position Versus Off Position

Maximum Cortisol Observed, Normalized (controlling) For Time Of Day

N = 227

	Visit 1	Visit 2	Visit 3
<u>Max. On Position</u>	117.76	120.71	120.33
<u>Max. Off Position</u>	113.47	117.23	113.07

<u>Average Maximum On Position</u>	119.60
<u>Off Position</u>	114.59
Diff	5.01

Way Analysis of Variance
Repeated Measures

On vs. Off F = 38.51 p < .0001
(df 2,226)

TABLE 97

Comparison Of Maximum Cortisol Response In Men
During Very High And Very Low Workload

N = 90

	<u>Highest Quartile</u> <u>Workload</u>	<u>Lowest Quartile</u> <u>Workload</u>	<u>Difference</u>
<u>Maximum Cortisol</u> <u>(Normalized)</u>	125.54	118.34	7.20

One-way Analysis of Variance for Repeated Measures

F - 4.52 (df = 1,88) p < .05

We were surprised that cortisol levels were not more directly related to workload. Several qualifiers must be added to this point. We have focused our efforts primarily at whole day analyses, with the exception of comparing on versus off position within a given visit. These analyses did support the conclusion that maximum levels were higher while working. However, the effect was not large. We were not able within our report deadline to analyze more carefully within a day, for example, whether or not cortisol rises following a major rise in traffic. We also were not able to control for mood at the beginning of work, amount of sleep in recent nights, or subjective responses to the day's work. Nevertheless, a rather unexpected finding emerged and is discussed under predictors of mild and moderate illness. Men who consistently showed lower cortisol responses to work had significantly more illness than those with middle or high cortisol levels.

In summary, it is apparent that on the average our participants showed very substantial differences among themselves with respect to total daily cortisol, peak cortisol and maximum cortisol levels while working. Levels of cortisol were not related to body weight, age, cigarette or coffee consumption. We found that there was a tendency for maximum levels to be higher while men were on position. Cortisol responses at work as a possible predictor of health change were examined by comparing the frequency of illness among those with low, middle and high cortisol levels when we studied them at work. This comparison is reported in Section V.

Human Growth Hormone (HGH) Results

All blood samples from the first and second rounds of blood collections in the field were also analyzed for their growth hormone content, using the laboratory methods already described. In the first round of studies, 368 men participated, yielding a total of 5,349 blood samples whose HGH content was determined. In the second round of studies 299 men participated for a five-hour day, with blood samples taken every 20 minutes. A total of 4,361 of these samples were analyzed for HGH content. As the sensitivity of the laboratory assays varied, but was assured at the two nanograms per milliliter level, we decided to consider all HGH values at or below 2 ng/ml as a single category. In this way, we avoided the possible errors introduced in attempting to distinguish between very small, clinically unimportant levels of HGH. For many of the growth hormone data analyses, four levels of secretory activity were identified: 0 to 2 ng/ml, 2.1 to 4.9 ng/ml, 5.0 to 9.9 ng/ml, and 10.0 or greater ng/ml.

The distribution of growth hormone levels for all plasma samples of visits one and two are displayed in the table below:

Distribution of HGH Levels for All Plasma Samples of Visits 1 and 2

<u>Visit</u>	<u>Less than 2.0</u>	<u>2.1 to 4.9</u>	<u>5.0 to 9.9</u>	<u>10.0 plus</u>
1	91.1%	6.2%	2.0%	0.8%
2	93.9%	3.8%	1.8%	0.5%

It can be readily seen that the vast majority of blood samples contained minimal or even undetectable levels of growth hormone. Only 2% to 3% of all samples showed levels of 5.0 ng/ml or greater, the threshold commonly used in the growth hormone literature to indicate a significant level of secretion.

The following table shows the maximum level of growth hormone experienced by the men in the course of a study day:

Percent of Men at Different Levels of Maximum Daily HGH Secretion

<u>Visit</u>	<u>Less than 2.0</u>	<u>2.1 to 4.9</u>	<u>5.0 to 9.9</u>	<u>10.0 plus</u>
1 (368 men)	60.1%	22.8%	11.3%	5.7%
2 (299 men)	68.6%	16.4%	10.9%	4.0%

Although 90% of the growth hormone samples had concentrations of 2.0 ng/ml or less, only 60% to 70% of the men completed an entire five-hour shift without having a value above that level. There was also a tendency for higher HGH values on Round 1 than on Round 2. This was consistent with the hypothesis that anticipated pain or discomfort, or simply the novelty of the initial day of blood sampling created stresses that may have raised HGH levels.

Catheterization Effect

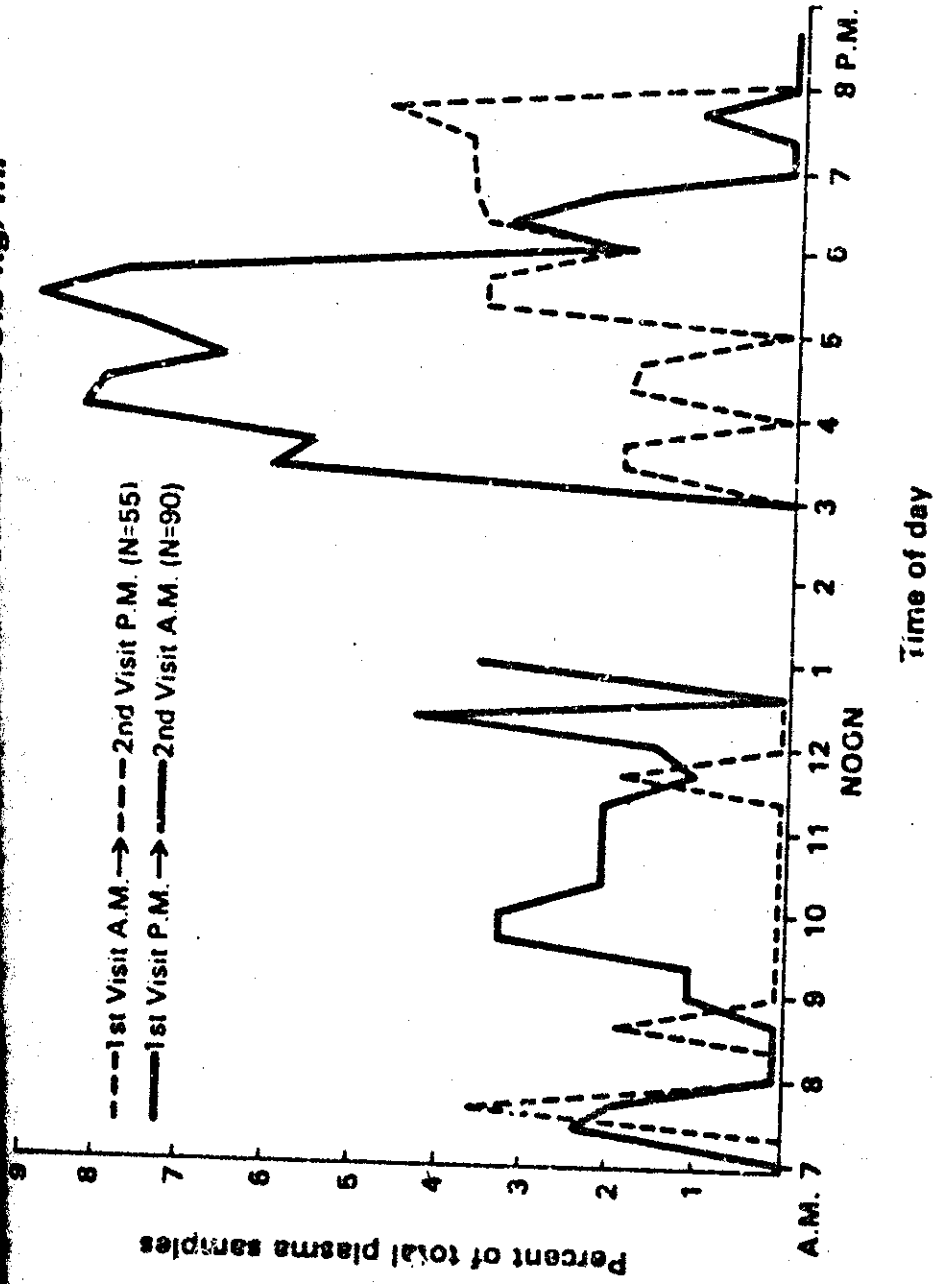
To examine for the possibility of a catheterization effect, all samples collected were sorted by their ordinal position during the day for each man studied. Thus, regardless of the time of day when the catheter was inserted, the first sample was labeled #1 and the sample drawn one hour later, #4. For the entire first round of studies only 3.8% of the samples had a HGH level greater than 4.0 ng/ml. However, for samples 3 through 7 of the 15 samples drawn on each man during his first day, the percentage of values greater than 4.0 ranged from 6.1% to 8.5%, the latter being the frequency of elevated readings on sample 5. It should be noted that the third sample was gathered 40 minutes after insertion of the catheter and represents a moving average of HGH levels from the period 21 to 40 minutes after catheterization. Only 3.6% of the blood samples representing the accumulation from 1 to 20 minutes after catheterization were greater than 4.0 ng/ml. What is surprising is that the

level of modest and higher elevations in HGH continued through the 7th sample which represented blood gradually gathered from 101 to 120 minutes after insertion of the catheter. It would seem, therefore, that if in fact these elevations represented a catheterization effect, the responsiveness of the growth hormone system (1) must have taken at least 20 minutes, (2) was highly variable from subject to subject and (3) occurred in only a minority of all subjects undergoing this procedure. This elevated frequency of higher growth hormone levels from 21 to 120 minutes after catheterization observed for visit 1 did not replicate in visit 2. For this visit only 2.8% of all samples had HGH concentrations greater than 4.0 ng/ml, and the highest percentages among the five samples 3 through 7 were 3.6% and 3.7%. The two ordinal sample numbers having the highest percentages of HGH greater than 4.0 ng/ml were samples #10 and #15 which occurred toward the end of the day. This leaves the question of whether or not HGH is normally elevated as a function of a catheterization effect with rather equivocal results. The modest, occasional, somewhat delayed set of elevations during visit 1, which might be construed as a catheterization effect, clearly did not replicate in visit 2.

Diurnal Variation

The next issue we investigated was whether or not there was a diurnal effect on HGH secretion, such as that consistently observed for cortisol. It was necessary to control for visit number in order to test the difference between morning and afternoon, inasmuch as it has been shown that first visit HGH values tended to be higher than those at the second visit. We therefore selected two groups of men: those whose first study was during a morning and second study was during an afternoon, and the second group whose first study was during an afternoon and whose second study was during the morning. For each of these men in the two groups, HGH levels were plotted by time of day according to the same 20-minute intervals at which blood was gathered. Figure J shows the percent of total samples drawn at each 20-minute period with HGH values of 5.0 ng/ml or greater.

The following inferences can be drawn from the graph: (1) more high values of HGH were observed in the afternoon than in the morning; (2) there were no trends hour-by-hour within the morning or within the afternoon; (3) for the two groups selected by these definitions, visit number was not important. The previously observed "visit effect" must have come from persons who were studied in the afternoon on both days or in the morning on both days or those who had only one study and refused participation on later days; and, (4) these two groups differed in total potential of HGH secretion, in that the group whose first study was in



the afternoon and second study was in the morning tended to have more high HGH secretions no matter what time of day they were studied. This may have been either a random phenomenon, "the luck of the draw," or it may have been due to some self-selective process related to who was willing to have their first study performed during a given shift.

Consistency of HGH Responsivity Over Time

Did the men who showed HGH spikes during the first day of study also have the same secretory pattern on other days? HGH assays are time consuming and expensive and therefore were performed only on blood samples of field visit days 1 and 2, with a small additional analysis from visit 3, described later. Two hundred and ninety-nine men had completed HGH data for 2 study days. Table 98 shows the consistency of the maximum value for these men on each of these two days. It will be noted that consistency is very low and that the maximum reading for most men on most days is so close to zero as to be undetectable in most lab analyses. Even for the 75 men who had one or more HGH values between 5.0 and 9.9 ng/ml on the first study day, 60% had all values less than 2.0 on the second study day. Only for the 17 men with a value of 10.0 ng/ml or greater on the first day did a majority also have at least a 5.0 ng/ml secretion on the second day. The 59 men who had at least one HGH value of 5.0 ng/ml or greater on one (but not both) of the two study days were checked to see what their secretory pattern was on their third study day, if in fact a third day's blood samples had been drawn. Complete sets of frozen plasma samples from the third study day were located for 54 of the 59 men who had on one occasion showed one or more samples with HGH levels of 5.0 ng/ml or greater. Of these 54, only 5 had one or more samples again at that elevated HGH level for the third day. This relatively low yield again underscored the strong tendency for usual day-time levels of HGH activity to remain very low in most persons most of the time despite mentally demanding tasks. The finding also underscored the low consistency of response patterns on different study days.

Physical Correlates of Elevated HGH Secretion

The next major set of analyses concerned the search for characteristics of those persons showing the potential for secretory bursts of HGH. To those 19 men who had HGH values of 5.0 ng/ml or more on both of the first two study days, we added the 5 men among the 54 whose third study day plasmas were analyzed and who thus qualified as having one or more high HGH levels on two of three days. This high secretory group (N = 24) was then compared with 131 men who had no values exceeding 2.0 ng/ml for the first days, ninety men who had one or more values greater than 2.0 ng/ml but

TABLE 98

Human Growth Hormone

Consistency of Maximum Value on Two Study Days
with Fifteen Blood Samples Analyzed Each Day

Maximum HGH Value (in nanograms)
 Second Day

	≤2.0	2.1 - 4.9	5.0 - 9.9	10.0+	Total
2.0	131* 73.6%**	31 17.4%	14 7.9%	2 1.1%	178 100%
2.1-4.9	46 66.7%	13 18.8%	6 8.7%	4 5.8%	69 100%
5.0-9.9	21 60.0%	4 11.4%	8 22.9%	2 5.7%	35 100%
10.0+	7 41.2%	1 5.9%	5 29.4%	4 23.5%	17 100%
TOTAL	205	49	33	12	299

Maximum HGH Value
 First Day

* Number of Men

** Percentage of men at each First Day's Maximum Level having stated
 Maximum on Second Study Day.

less than 5.0 ng/ml on either of the two days, and 54 men who had a value of 5.0 ng/ml on only one of the three days for which data were available for them.

A substantial number of physical exam findings were associated with the tendency to have at least occasional secretory episodes of HGH during waking hours. The 24 high secretors were substantially lower in weight at intake than the rest of the men. Their average weight was 170 pounds compared with 183 pounds for the entire group participating in field studies ($P = .02$). Their pulse rates were also considerably lower at 68 bpm vs. 72.3 bpm for the entire group ($P = .02$). They also were closer to ideal weight, being only 2% overweight, whereas the 131 men who never had a measurable elevated HGH averaged 12% overweight ($P = .007$). These same findings were replicated at the second round physical examination and in addition, resting casual blood pressures were studied and found to be lower in the HGH secretors. This group had average blood pressures, 124/86, whereas the nonsecreting group had pressures of 130/90. The systolic blood pressure difference was marginally significant, ($P = .07$), while the diastolic blood pressure difference was clearly significant ($P = .02$).

Psychosocial Correlates of Elevated HGH Secretion

Several psychosocial characteristics of the various HGH secretion groups were also found to be of marginal or clear significance. For most analyses of variance, the bulk of the F statistic for significance came from the distinction between the high secretors ($N = 24$) and the other three groups with varying levels of low HGH. The men with demonstrated capacity for high growth hormone secretions showed less pathology on the PSS at Round 2. They had no instances of significant alcohol abuse ($P = .04$) and no instances of serious work role impairment ($P = .06$). Nevertheless, they tended to show somewhat more depression on the POMS at intake into the study ($P = .04$).

Men with higher HGH secretions tended to report more life changes at the Round 2 examinations. This only reached significance for the self-ratings of how distressing these changes had been ($P = .03$). The high secretors also were the least likely to use physical activities as a coping mechanism ($P = .03$). A number of other findings were statistically significant or marginally so, but some of these represented curvilinear associations which were essentially uninterpretable.

In summary, men in this study who were HGH responders tended to be close to ideal weight, to have somewhat lower pulse rates and blood pressures, to show more depression, and to be more distressed by their recent life changes. Despite this tendency to emotional

sensitivity, they did not let these unpleasant affects interfere with their work role performance or lead them into alcohol abuse problems.

SUMMARY

Special Interview Ratings of Investment, Coping and Burnout

On the basis of answers to questions regarding the ATCs' investment in their occupational identity, their methods of coping with heavy workdays and their assessment of their possibility of burning out, two psychologist interviewers provided ratings for each ATC on these dimensions.

It was found that most men were highly invested in their ATC identity and were coping moderately well with heavy days. Less than 5% were rated at very high levels of burnout.

The interviewer ratings tapped somewhat different facets of the investment and coping constructs than the self-ratings and provided an evaluation of these aspects.

11. Special Interview Ratings of Investment, Coping and Burnout

Because a large number of our psychological predictor variables were self-reports, we added a special series of interviewer-rated characteristics. These characteristics were: investment in the ATC identity, coping with the stresses of the job, coping with very heavy workdays, coping with training duties, overall coping, and overall burnout. In each area a key question or two was asked, and then the interviewer followed up responses to clarify his clinical impression of the rating to be made.

The interview and ratings were made by the psychologist who administered the PSS to an ATC. The two psychologists who made all of these ratings, Dr. Thomas Hefele and Dr. Michael Hurst, conducted 20 interviews together and made separate ratings. The inter-rater reliability was over .90 and ratings differed by no more than plus or minus one unit on a scale from one to seven.

Two questions were used to develop a clinical sense of investment. Controllers were asked how important it was to them personally to be an ATC. Their answers were rated from one (not at all important) to seven (extremely important). A large percentage responded that it was very important because of the money and the status, but we inquired further to determine whether their reasons were purely pragmatic, producing lower ratings, or whether they involved the controller's sense of who he was as a person, resulting in higher ratings.

For the second investment question, we asked the controller to provide six words that would help answer the question, "Who am I?" The words were recorded in their exact order of presentation. If an ATC failed to mention the word "controller" or "ATC," we asked where he would put it among the six he presented.

The interviewers then considered the importance a subject attached to being an ATC and the rank order of his placement of "ATC" in response to the question, "Who am I?" A high rating was given if the importance was high and "ATC" was the first or second word in the list of six. A low rating was given if the importance was low and "ATC" was mentioned last or not at all. Middle ratings were given for responses between these extremes.

The coping ratings were based on the responses to three pre-questions, followed up with whatever questions the interviewer considered necessary to make the rating with confidence. The three questions were:

1. How do you handle the stresses of the job?
2. What do you do when you have a very heavy day?
3. How do you handle training duties?

The interviewers made a rating from one ("no coping mechanisms") to seven ("very effective mechanism") for each of these questions. High ratings were given for active, problem-solving and effective approaches. Low ratings were given for drug use, explosive behavior, and no problem-solving activity. For example, a high rating would be accorded to someone who did something relaxing during a break, and a low rating would be given to someone who obsessed over a difficulty. Similarly, one who would take a walk and work out the difficulty was given a high rating whereas one who tried to avoid thinking about the problem because he would get upset was given a low rating. The main criterion used to make ratings was whether or not the coping activities were goal-oriented, effective, and healthy behavior.

The three coping ratings then were used as the basis for assigning an overall coping rating. Again the rating was from one to seven and was a total clinical assessment combining all the information obtained from lead-in and follow-up questions.

Four general questions were used to provide a basis for making a burnout rating:

1. When things are starting to go "down the pipe" for you, how do you react?
2. Do you find yourself worrying about your controlling ability when this happens?
3. Do you expect to last until normal retirement age?
4. If not, why not?

For these questions, the interviewers concentrated on comparing past behaviors and expectations with present ones. Those who got more upset in the present than in the past, who did not expect to last until retirement, and who anticipated medical/psychiatric difficulties were given high burnout ratings, with "seven" the highest burnout rating and "one" the

lowest. Men who were calmer, more confident, and hopeful about working to retirement were given low burnout ratings.

Table 99 displays the distribution of ratings for each area assessed by the clinical interviewers. Most men were highly invested in the ATC identity in the personal psychological sense. Only 16% had very low investment. The majority of men were rated in the moderate range on the coping indices with only 9% to 15% rated very highly. Finally, less than 5% were rated at very high levels of burnout.

Table 100 displays the correlations of the interviewer ratings with the most similar self-rated scales from the ATC Questionnaire. Interviewer ratings of investment were only slightly related to self-ratings, indicating very little overlap between the two. Burnout ratings were highly related to the bounceback-burnout self-rated factor, suggesting that an external evaluator's assessment can be quite similar to an individual's own assessment of burnout. The interviewer-rated coping variables had little or no relationship to an individual's own rating of how effective his coping mechanisms were.

Since the investment and coping factors were multi-dimensional, the interviewer ratings provided independent evaluations of some dimensions that were different from those self-reported. The lack of correlation between self-reports and interviewer ratings of these factors was therefore understandable and the comparative utility of the interviewer-ratings and self-ratings can be evaluated from our predictive findings reported in Section V.

TABLE 99

Distributions Of Interview Ratings
Of Investment, Coping, And Burnout At Intake

<u>Qualitative:</u> <u>Quantitative:</u>	<u>% Of ATCs Rated At Each Level</u>			<u>Number</u> <u>Rated</u>
	<u>Very Low</u> <u>1 - 2</u>	<u>Moderate</u> <u>3 - 5</u>	<u>Very High</u> <u>6 - 7</u>	
Investment	16.2%	39.0%	44.8%	415
Coping with stresses on the job	32.8%	56.7%	10.5%	411
Coping with heavy work-days	26.8%	56.6%	16.6%	415
Coping with training duties	26.0%	64.3%	9.7%	415
Overall coping	21.7%	69.2%	9.1%	415
Burnout	65.1%	20.3%	4.6%	415

Correlations Between Interviewer And Self-Rated
Investment, Coping Effectiveness And Burnout*

<u>Interviewer Rating</u>	<u>Correlation with</u>	<u>Self-rated scale on the ATC Questionnaire</u>
Investment	$\frac{.10}{(p < .05)}$	Investment Factor
Burnout	$\frac{-.62}{(p < .0001)}$	Bounceback (High)- Burnout (Low) Factor
Coping with stress on the job	$\frac{.05}{(N.S.)}$	Coping effectiveness scale
Coping with heavy workdays	$\frac{.09}{(N.S.)}$	Coping effectiveness scale
Coping with training	$\frac{.08}{(N.S.)}$	Coping effectiveness scale
Overall coping effectiveness	$\frac{.08}{(N.S.)}$	Coping effectiveness scale

*N = 402 with all measures used to compute correlations.

SUMMARY

Methods of Measurement

The data collection system devised to ascertain health changes included the following:

- 1) Health History Form
- 2) Monthly self-reports via a checklist of symptoms mailed to the ATC and back (The Monthly Health Review)
- 3) Monthly self-report of anxiety and depression via a checklist of symptoms (Zung Anxiety and Depression Scales)
- 4) Physical examinations by a physician at approximate 9-month intervals at Boston University Medical Center
- 5) Psychological examinations during the same visits to Boston University Medical Center by two psychologists
- 6) Audiological examination at Boston University Medical Center
- 7) Laboratory tests (blood chemistry, urinalysis)
 - a) Serologic tests for syphilis
 - 9) X-rays of the chest
- 10) Electrocardiogram
- 11) Tests of pulmonary function.

1. Methods of Measurement

The essential central consideration for the Air Traffic Controller Health Change Study (ATC HCS), or any other project involving the continuing surveillance of health states, was the establishment of a system for ascertaining the full gamut of illnesses and injuries during the surveillance. Many longitudinal studies of the health of industrial groups have been performed, and it was expected that we would be able to select from among several well-established health reporting systems on one which was well suited to this project. A sufficiently comprehensive health ascertainment system with established validity was not found, but we were able to profit by prior work in our efforts to assemble such a system for this study. This section describes our general approach to this task, indicating some weaknesses and problems to be avoided. Later sections describe in detail each of the several components of our final health ascertainment system.

"Health change" is indeed a broad concept. It includes changes of a positive as well as a negative nature. In view of the generally good health enjoyed by all of the ATC HCS participants at the beginning of our project, and taking into account the direction of emphasis usually present in the medical model of diagnosis and treatment, our study concentrated on negative health changes rather than positive ones.

Definition of Health Change

The determination of a change from a "healthy" or "normal" state is quite simple for clearcut instances of serious disease or injury. The task of determining a change from a healthy state is more problematic, however, when one attempts to include the full range of human ills, particularly minor conditions.

Which conditions are considered illness or diseases and which are considered merely variations of the "normal state" is, in the final analysis, determined by society. Different social groups vary in what they consider to be illness. This holds, not only for other cultures, but also within our own society where different social classes and the two sexes differ sharply in what conditions they consider to be "symptoms of disease" and what circumstances lead them to take sick leave or to consult a doctor. In consulting a variety of sources, including the work of the National Center for Health Statistics of the Department of Health, Education and Welfare (US DHEW, PHS Publication No. 1000, May, 1970), the study team defined negative health change as any condition involving one or more of the following characteristics:

- (a) it creates unequivocal sustained pain or discomfort to the subject;
- (b) it causes a loss of ability to perform one's usual activities for a day or more;
- (c) it is determined by medical examination or laboratory test to pose a threat for the future continued well-being and normal functioning of the subject.

If the deleterious health change was attributable to an identified physical insult, whether the agent was mechanical, thermal or chemical, the health change was termed an injury. Otherwise, it was termed an illness.

The issue of distinguishing between true illness and complaint behavior is a critical one for any study of health change. The ideal circumstance would be to be able to diagnose disease completely independently of verbal report of the study subject. This can only be done for a few conditions, such as hypertension. For the great majority of genuine health changes, however, verbal report by the study subject plays an essential part in the diagnosis. The larger the part played by more objective findings from medical examination or laboratory, the more convincing the diagnosis decision. Nevertheless, even if no objective findings are possible, if the complaint behavior leads to assuming the "sick role" with its attendant reduction in occupational and social functioning, we must conclude that we are dealing with genuine disease in the historic and social definition of the term. The only question remaining is whether the disease is somatic, psychosomatic, or more purely emotional. For these reasons, as well as the consequence of our criteria of disease (above), we included as health changes not only somatic disorders, but psychiatric disorders as well, providing that they created unequivocal sustained pain or discomfort, or caused a loss of usual function, or posed a threat to the future well-being of the subject. Our range of procedures for ascertaining health change was constructed to be appropriately broad to cover this full range of forms of pathology.

Health Change Data Collection System

The system designed for ascertaining health changes in the MCS had the following attributes: it relied both upon frequent report and periodic in-depth examination by a physician and psychologist; it employed laboratory tests to detect subclinical changes in somatic health and, in like manner, used quantified biological procedures to determine subclinical changes in emotional and social adjustment; it probed systematically for indications of physical illness, injuries and emotional problems; it

screened monthly in a superficial manner for the more common signs and symptoms of health change in order to insure relatively complete detection of those conditions which were mild and of short duration, and hence, likely to be forgotten after a month or more; it examined at nine-month intervals for more serious or chronic conditions. This schedule represented an optimum solution to three different needs: the need to monitor health change closely, to keep examination costs within feasible limits and to maintain participant motivation to continue in the project. The balancing of frequency and depth of data collection on health change was guided by research from the National Center for Health Statistics. Reports from NCHS showed that the relative volume of illness reported per unit of time declined as the length of recall period increased. One study found that in sample of persons known from physician's office data to have visited the doctor within a two-week period, 36% of doctor's visits failed to be reported to survey interviewers, even though other relatively sensitive health data were often volunteered. More serious medical events had a higher probability of being recalled over longer periods (US DHEW, National Center for Health Statistics, Series 2, No. 7, July, 1965). Although weekly or biweekly reporting by mailed questionnaire would have been desirable in the ATC HCS from the point of view of reducing forgetting, it was decided that a request for more frequent comprehensive reports would probably lead to greater subject resistance to the study, and thus, to more carelessness in reporting and a greater failure to respond. Similarly, the scheduling of the comprehensive physician examinations was derived by balancing the costs of repeated examinations, the yield of newly discovered events as a function of interval, the desire to maintain high rates of cooperation, and the likelihood of failing to discover important if transient health changes if the interval between examinations were too long.

The data collection procedures which comprised the system for ascertaining illness and injuries in the ATC HCS are listed in Table 101. The table specifies what data were collected each month, those collected at periodic medical examinations, and those special sources of information sought out at irregular intervals from hospitals, doctors, and other sources when participants gave indication (usually through the Monthly Health Review) that they had in all probability incurred a health change and had consulted one of these sources.

Instruments and Methods Used in Data Gathering

The non-copyrighted data-gathering instruments listed in Table 101 are appended as Exhibits to this report. A brief description of each follows:

	PER INCIDENT	MONTHLY
Medical Questionnaire	X	X
Past medical history	X	X
Family history	X	X
Smoking, eating, drinking habits, medications, and review of systems	X	X
Physical findings, SP	X	X
Timed vital capacity	X	X
EKG	X	X
Chest films	X	X
Urinalysis, CBC, ESR	X	X
Serology	X	X
Audiological examination	X	X
Psychiatric Status Schedule	X	X
Psychiatric Interview	X	X
Health Checklist	X	X
Physical signs and symptoms as episodes, continuing problems, or isolated events	X	X
Accidents and injuries	X	X
Days lost from work and days below par	X	X
Visits to physician or hospitalization	X	X
Mood Checklist	X	X
Zung anxiety and depression questionnaires	X	X
Physician and Hospital Reports	X	X
Records of illnesses, diagnoses	X	X
Special Diagnostic Tests & Consultations	X	X
As required to make diagnosis	X	X
Sleep Questionnaire	once	once
Characteristics of sleep complaints	once	once
Headache Questionnaire	once	once
Characteristics of headache complaints	once	once

Review of Health History

Usually, the first task facing each ATC participant at each of his five examination visits at nine-month intervals to Boston University Medical Center was to complete this comprehensive health history form. Early in the study the questions were displayed and responses made at a computer video terminal. Later, however, it was found more efficient for the participant to fill out a printed form and take this with him to the internist at the time of his physical examination. This permitted immediate review by the internist of all replies, questions about uncertain points, and greater emphasis on certain parts of the physical examination and medical history guided by positive answers on the health history form. After the participant's visit, the health history, as clarified by discussion with the internist, was entered into computer files, enciphered, and added to the rest of the participant's health data. The health history consisted of a 12-page form which dealt with the following categories of data in sequence: his own and his family history of major diseases (after the intake round, only changes in this family history were recorded), smoking history, regularity of meals, consumption of caffeinated beverages, sleep patterns, use of "over the counter" and prescription medications, a symptoms checklist reviewing the following systems: ophthalmic, otolaryngologic, respiratory, cardiovascular, gastrointestinal, musculoskeletal, genitourinary, hematologic, endocrine, dermatologic, and neurologic, allergies, exposure to toxic substances, and surgical interventions.

These data were stored on computer tape and were used in a number of analyses dealing with later development of symptoms in various organ systems. The ability of the data to predict later health change was also analyzed. We were particularly interested in the development of respiratory, gastrointestinal, and cardiovascular conditions — the categories which have proved to be most frequently involved in the health changes in this study population. The main immediate use of these data, however, was to help the physician to gather a comprehensive primary and interval medical history, to suggest the need for more specific non-routine diagnostic procedures, and to assist in making diagnoses. Diagnoses of medical conditions derived from this data-gathering instrument, as well as all others, were recorded on diagnostic health change forms by the physician and entered into a separate computer file. The fact that the health history contributed data to the making of the diagnosis is recorded where applicable on the diagnostic summary. The protocols and procedures for the diagnosis of health change are described in sections of the report to follow.

Physical Examination

The physical examination made at nine-month intervals was guided by an extremely detailed checklist form which reviewed 19 systems of anatomy and physiologic function in a sequence compatible with the usual thorough medical examination. All systems were examined at the initial and final visits; the third visit omitted rectal examination; the briefer Round 2 and Round 4 examinations included only heart, lungs and abdomen, in addition to recording vital statistics. Positive findings were checked on the pre-coded forms, or occasionally, for unusual findings, written in space provided. These data were then entered into participants' files in terms of a possible vocabulary of over 900 six-digit entries, each signifying a specific type of clinical observation. These were, in turn, enciphered, and in addition, the identification number of the participant was enciphered so that a double protection of confidentiality was assured. The bulk of these data files contained negative findings reflecting the general good health of the study group. The relatively few positive irregularities noted reflect a great variety of usually minor deviations from the norm. Many of these deviations appear to have no long-term implications for health, but they were recorded, nevertheless, in the interests of completeness and thoroughness. The data within the physical examination which are most amenable to statistical treatment are a series of continuously distributed variables recorded on the face sheet of the exam form. These include height, weight, pulse, respiration, and repeated measures of blood pressure in standing, sitting and supine positions. Findings from the physical examination and medical history at intake were carefully recorded and referred to periodically to determine whether new medical findings represented a continuation or exacerbation of a condition existing at intake or whether they represented a new health change.

Laboratory Studies

At each of the five visits participants made to Boston University Medical Center for physical and psychological examination, comprehensive laboratory studies were performed. These tests, performed on fresh specimens obtained at each visit, were erythrocyte sedimentation rate, complete blood count which included automated analyses of hemoglobin, hematocrit, red blood cell count and indices (mean corpuscular volume, mean corpuscular hemoglobin, mean corpuscular hemoglobin concentration), white blood cell count, and differential count of leukocyte varieties. Also performed was a urinalysis, including a description of the sediment of the centrifuged specimen.

At the first and last visits, serologic tests for syphilis were made, as well as posterior-anterior and lateral roentgenograms of the chest, standard 12-lead electrocardiogram, and two tests of pulmonary function -- total vital capacity and first-second forced expiratory volume. Stool specimens obtained at the time of digital examination of the rectum were tested for the presence of blood.

A chemical analysis of the blood was also made at the initial examination. This was the standard package, "SMA-12" (calcium, phosphate, glucose, urea nitrogen, uric acid, cholesterol, total protein, albumin, bilirubin, alkaline phosphatase, lactose dehydrogenase, and glutamic-oxaloacetic transferase), plus glutamic-pyruvic transferase. For Rounds 3 and 5, an expanded package became available and was utilized -- "SMAC," including all of the above analyses and triglycerides, iron, sodium, potassium, chloride, carbon dioxide content, creatinine, and calculated albumin/globulin ratio.

The hematologic examinations and urinalyses provided not only specific data about primary blood cell disorders (e.g., anemias and leukemias) and urinary tract diseases (e.g., nephritis, cystitis), but also general information about the presence of other problems (e.g., allergies, diabetes, infections). The erythrocyte sedimentation rate is a non-specific measurement made frequently because of its value as a clue to potentially significant systemic problems needing investigation. The group of chemical tests provides a scan for the presence of dysfunction involving liver, kidney, endocrine, and other systems, dysfunction that in many cases has not yet created symptoms. The pulmonary function tests seek to identify individuals with restrictive or obstructive lung diseases, such as emphysema.

This schedule of tests had a variety of aims. The initial group sought to help establish baseline health status with a comprehensive array of both specific and non-specific measurements, looking for the presence of current conditions or diseases as well as for risk factors that might presage illness. The finding of abnormal results (unless they reflected already-known, stable conditions) led to repeated testing and, where appropriate, special investigation and consultation.

The routine followed for all subjects reflected the kinds of changes in health status most likely to develop in this population of men, and the frequency of examination was adjusted so as to minimize study costs and inconvenience to participants while at the same time assuring maximal ascertainment of health changes.

Monthly Health Review

Most minor short-term health changes which occur during a year cannot be discerned by physical examinations or by laboratory studies performed six to twelve months apart. Many of these health changes do not receive medical attention, and hence records of consulting a physician or clinic are also an inadequate approach. Finally, it has been shown that even self-report information gathered at six to twelve-month intervals is severely diminished by forgetting (Jenkins, Hurst and Rose, in press). Therefore, a method for more frequent ascertainment of minor health changes was needed. To complete this part of the clinical picture of health events, two self-report forms were sent to each participant each month. The rate of completion and return of these forms was exceptionally high, greater than 90% complete data for more than 80% of the participants.

The first of these self-report forms, called the Monthly Health Review, was a checklist of 30 specific symptoms of ill health, which included the most common signs and symptoms of dysfunction in the physiological systems most frequently afflicted by disease, particularly respiratory, gastrointestinal and musculoskeletal. Each month each respondent was asked to report which, if any, of the 30 health symptoms had occurred and whether these had occurred as part of an illness episode (a cluster of symptoms occurring together at about the same time and recognized as part of the same disease), as isolated symptoms occurring occasionally apart from illnesses, or as continuing chronic problems present on more than half the days of the month. In addition, participants were asked whether each illness episode or aggregate of isolated events or continuing problems was brought to medical attention and how many days below par and days of reduced physical activity accompanied each health change.

The Monthly Health Review also included a separate section in which to record injuries. Five types of trauma were listed so that the specifics of the injury could be reported. Severity of the injury was inferred by level of medical care received (self, medical professional, inpatient hospitalization) and the number of days of restricted activity.

Each month all Monthly Health Reviews which contained checks indicating an illness episode, more than occasional isolated symptoms, or a non-trivial injury were reviewed individually by the project internist. Where indicated, telephone calls were made to the participant to obtain further information, and such health changes as were determined to be present were recorded on a diagnostic summary form and given a numeric diagnosis according to the International Classification of Diseases, Adapted.

Further description of the Monthly Health Review, evident of its validity, and descriptions of the seasonal prevalence of a variety of symptoms therein reported are presented in a paper by Jenkins, Kreger and Rose (submitted for publication).

SUMMARY

Indexing Health Changes by Levels of Severity

Three criteria were applied to define a negative health change and to determine its level of severity: pain or discomfort, restriction of usual activities, and/or extent of threat to future well-being.

Four levels of severity of illness or injury were established, from Level 0, considered trivial, to Level 3, considered severe. Computer assignment of level of severity was made by reference to tables indicating criteria for assignment of each ICDA code to a level of severity.

2. Indexing Health Changes by Levels of Severity

The value of the ATC Health Change Study, both for administrative and scientific purposes, was greatly dependent on a system involving not only the specific diagnosis of particular diseases and health changes, but also a method for consistent rating of the severity or seriousness of each health change episode. The characteristics that make an illness undesirable, both to individuals and society, are its effects on feelings, functioning and future. In fact, if a condition does not make one feel bad and does not impair function and also does not have implications for future welfare or survival, it is not considered a disease or illness. Our system for sorting health changes into levels of severity was based on the same criteria used to determine health change: pain, dysfunction, and threat to future well-being.

We were concerned, however, that differences in reporting discomfort or pain might have an undue influence on judgments regarding the presence of disease or its severity. Persons whose psychological style was to complain most loudly might then appear to have the most frequent and most serious health changes. We were skeptical, therefore, about the reporting of pain or discomfort and were intent on "validating" such reports by additional evidence, e.g., that the patient sought medical care and, preferably, received a medical diagnosis from his own physician or the ATC study physician. Thus, the receipt of medical care, the giving of a diagnosis, the loss of time from usual activity due to illness, and the possible long-term deleterious implications of a medical diagnosis all went into the assignment of a "level of health change." Specific definitions of severity relating to each specific medical diagnosis (based on the number assigned it from the International Classification of Diseases, Adapted) were decided upon, taking into account three possible levels of medical care received (self-care, ambulatory medical care, inpatient hospitalization), and number of days restricted from one's usual activities due to illness. These definitions were entered as tables into the computer and each diagnosis rendered by the project physician, accompanied by all of the above data (also entered into the computer), was assigned a health-change-level score by the computer. Four levels of health change, described below, were identified. The specific rules for assigning health change levels to specific illness episodes or chronic conditions are included in Appendix I, Section III C.

Levels of Health Change

Level Zero was reserved for symptom complaints such as headache, pain in the limb, nausea, and other symptoms to which a more specific medical diagnosis could not be given. Level Zero was also assigned to rather specific physical signs, e.g., deformity of foot, excessive coughing, certain skin and dental conditions

which appeared to represent genuine physical findings whether or not brought to the attention of a health professional, but which were attended by no days of restricted activity.

Level One was assigned to brief self-limiting illnesses. These often resulted in one to six days of restricted activity, but if medically attended, in many instances were not associated with specific numbers of "days down." Peripheral nerve disease, gout, otitis media, upper respiratory infection and gastroenteritis are typical examples. Level One health changes rarely involved seven or more days of restricted activity, and never involved hospitalization. The average upper respiratory infection, non-specific viral infection, or occasional exacerbations of conditions like allergy or back problems are typical of Level One health changes. Most injuries treated by a physician, possibly in an emergency room (but not involving overnight hospitalization) were also considered Level One.

Level Two health changes were more extended or aggravated illnesses and injuries, all of which received medical attention. They also all involved some limitations of activity, usually a week or more. A number of exceptions included conditions which had greater-than-average chances for complications or future health problems, such as urinary calculus, hospitalizations for cellulitis, short episodes of acute hepatitis, recurrence of pain plus days of restricted activity in a previously diagnosed ulcer of the stomach. Despite its lack of pain and absence of hospitalization, glaucoma was always rated Level Two. Had conditions like these developed into more serious diagnoses, a Level Three would have been recorded.

Level Three illnesses were serious ones requiring medical attention, and having in addition at least one of the following attributes: (a) more than 30 days limitation of activity (this occurred a number of times with moderate illnesses which developed severe complications, and with serious injuries); (b) hospitalization for a life-threatening or career-threatening disease; (c) longstanding or permanent disability from injuries; and (d) emergence of any disease which typically involves a serious threat to longevity or future functioning (even without hospitalization), such as discovery of a malignancy, coronary heart disease, hypertension, gastric ulcer, diabetes.

As might be expected in a healthy population screened annually to meet job requirements, the number of Level Three health changes encountered in the ATC MCS was relatively small, and Level Two and Level One diseases were progressively more frequent. The frequencies of the most common illness or injury conditions diagnosed by level of health change are presented in Section III C, Prevalence and Incidence of Physical Health Changes.

SUMMARY

Illness by Etiological Category: Frequency
of Specific Conditions

The most common medical problems among the ATCs at entry into the study were hypertension (32.5%), hemorrhoids (30.5%), hay fever (22.6%), and a combination of skin conditions (boils, tinea, pilonidal cysts and sebaceous cysts) that together affected almost 39%. Chronic bronchitis was prevalent among 12% of the men at intake, and active peptic ulcers were prevalent in 6.5%.

In order to use the data on health changes gathered in the ensuing three years of health surveillance, it was necessary to have a summary index that would represent each man's illness experience and that could be used in analyses of possible predictors. Such an index was calculated for each man by summing his Level 1 and 2 illness and injuries during each interval, weighting the Level 2 events by counting each such event as two, then annualizing the interval data to produce a comparable period at risk for all men, and finally, averaging the annualized rate for the four intervals. This "compressed, annualized incidence rate" was used in all further analyses of moderate illness and injury. Level 3 illnesses and injuries were analyzed separately.

The most common diagnoses during the 3 years after intake were upper respiratory infection (20% of the total), sprains, common cold, non-specific viral disease and gastroenteritis.

On the average, participants in the study had 2.5 (compressed, annualized) health changes per year.

Of Level 3 events, 21 severe injuries were incurred by 18 men, 36 men were newly diagnosed as hypertensive, 25 other Level 3 diagnoses were in various categories of illness and were diagnosed in 23 men.

a. Illness by Etiological Category: Frequency of Specific Conditions

Three paramount objectives of this study were: 1) to determine the frequency, severity, and types of health changes within our sample of air traffic controllers, 2) to establish whether or not these health changes were related to work facts, and 3) to ascertain whether or not health changes among our study population could be predicted by psychological, work, or other factors.

As described in IIIC, a comprehensive system was established to monitor and record health changes and to index their severity. In this section we will report first on physical (somatic) disease or illness conditions existing at entrance into the study (prevalence at intake) and then on physical health changes diagnosed during the 36 months of surveillance following intake into the study (incidence of illness). The two most frequent acute physical health changes, respiratory illness and injuries, are described in separate sections following the general report of findings. The most common chronic disease, hypertension, is also examined separately. Psychological health outcomes are reported in Section D.

Physical health states and changes were classified by physiological-anatomical system into the following categories: Respiratory; Nonspecific Viral; Acute Gastrointestinal; Non-infectious Gastrointestinal; Hemorrhoids; Skin; Bones, Muscles, and Joints; Allergies; Eye; Ear; Dental; Genitourinary; Hypertension; Injuries; and Other. Within these categories, diagnoses were coded according to the International Classification of Diseases, Adapted.

Conditions existing at the intake examination, as well as illness in the past, were recorded by whether the condition was: 1) a single event in the past; 2) a chronic condition inactive for at least the past two years; 3) a chronic condition active at the time of intake, or, 4) a problem newly discovered at intake. Physical health changes developing after intake were recorded by their level of severity as determined by computer algorithms taking into account ICDA code, type of care received, and days of restricted activity. This system is described in IIIC, Indexing Health Changes by Levels of Severity.

A total of 6,217 diagnoses of physical illness conditions were rendered: 31% (1,916) of them were conditions observed at intake or reported at that time as past events, while the remaining 69% were illness episodes and conditions that developed after the beginning of the study.

Prevalence of Illness Conditions at Intake

The illness conditions recorded at entry were categorized by their chronicity and current status, and were distributed as follows: single illness events in the past (approximately 22% of the 1,916 intake diagnoses), conditions reported as formerly chronic in the medical history but inactive for at least two years prior to the initial examination (6%); chronic conditions active at the time of the initial examination or recently active (48%) and problems newly found at the initial examination (24%).

We were interested in the illness conditions experienced by the men before entrance into the study primarily because of their possible value in predicting future illness. The illness conditions existing, and those discovered, at the intake examination also provided a base measure of the general health status and the prevalence of specific conditions among ATCs at entry into the study. This permitted us to distinguish between continuing health difficulties and the development of new disease in the ensuing three years.

Certain illnesses and illness conditions were prominent in the profiles of the ATCs at entrance into the study. These conditions are shown in Table 102 with the number and percent of the study participants who reported them as "currently inactive conditions" (i.e., single events or chronic but inactive conditions) and the number and percent experiencing them as chronic and active, or new-found at intake.

Examination of Table 102, "The Most Common Medical Diagnoses Among 416 ATCs At Intake Into The ATC HCS," reveals a substantial excess of chronic active and newly discovered conditions as contrasted with currently inactive conditions. Careful methodological studies have shown substantial underreporting of illness conditions in the past, particularly of minor self-limiting illnesses. Furthermore, many minor conditions which do not have a name used in common parlance (e.g., varicocele) are unlikely to be named even if their prior existence was recollected. Although the information about past illnesses or conditions inactive at time of entry into the study, to whatever extent it was recalled, was of interest to us for our predictive analyses of future health change, the prevalence of each condition, by definition, was determined by those conditions which were documented by the examining physician as present (chronic or newly-found) at the time of intake into the study.

Condition	Icex	Condition (#)	Total Reported	
			(#) Men	(%) Men
N=416				
RESPIRATORY				
Chronic Bronchitis	490-491	1	49	12.0%
NON-INFECTIOUS GASTROINTESTINAL				
Peptic Ulcers	531-533	13	27	9.6%
Chronic Enteritis	563.9	--	15	3.6%
Irritable Colon	564.1	1	14	3.4%
Liver Inflammation	573.	2	23	5.5%
HEMORRHOIDS	455.	25	102	30.5%
SKIN				
Boils (all sites)	680.	16	27	10.3%
Tinea pedis, cruris	110.1, 110.9	--	40	9.6%
Pilonidal cyst	685.	23	34	8.2%
Sebaceous cyst	706.2	24	45	10.8%
BONES, MUSCLES, JOINTS				
Varicose veins, legs	454.9	1	26	6.5%
Low back pain	728.7--.9	--	40	9.6%
ALLERGIES				
Asthma	493.	2	17	4.6%
Hay Fever	507	4	94	22.6%
Adverse Effect: Penicillin	960.	1	13	3.4%
GENITOURINARY				
Gonorrhea	980	43	44	10.6%
Varicocele	456.1	--	30	7.2%
Prostate Problems	600-602.	11	41	9.9%
OTHER SYSTEMS				
Inguinal Hernia	550.	27	32	7.7%
HYPERTENSION	401	3	135	32.5%

The most common medical problem prevailing among ATC study participants was hypertension. By the diagnostic criterion adopted for this study, 135 men (32.5%) were diagnosed as hypertensive at intake. As our determination of criteria for diagnosis of hypertension was complex and involved comparisons with other studies, a complete discussion of our diagnosis of hypertension among the study sample, comparisons with other populations, and the implications of the findings are presented separately following the discussion of general findings.

The second most prevalent chronic medical problem among these men was hemorrhoids. Approximately 31% of participants suffered from this problem at intake, with the majority of these reports verified by physical examination. Hay fever, reported by almost 23% of the ATCs at intake, was next most common. Hypertension, hemorrhoids, and hay fever were the only specific conditions with an intake prevalence of more than 20%. Taken together, four dermatologic conditions (boils, tinea, pilonidal cyst, and sebaceous cyst) affected almost 39% of the sample.

Chronic bronchitis among our sample of air traffic controllers was more prevalent than we had expected, with 12% of subjects thus diagnosed. Although comparisons of the rates of chronic respiratory diseases among our sample with those of other studies would have been desirable, they are problematic because of the wide variety of diagnostic procedures and criteria used. A review of the epidemiology of chronic respiratory disease by Dr. I.T.T. Higgins (mimeograph, Department of Epidemiology, University of Michigan School of Public Health, December, 1970, p.9), stated, "Epidemiologic studies have indicated that the prevalence of chronic respiratory disease of all degrees of severity varies from under 10% to over 40% of the population, depending on age, sex, and the definitions of chronic respiratory disease which are used."

The earlier Cobb-Rose report (1973) found peptic ulcers to be excessively prevalent in air traffic controllers when compared to a group of licensed airmen. In the present study, gastric and duodenal ulcers active at intake had a combined prevalence of about 6.5%, and an additional 3.1% of ATCs in the group reported ulcers that were no longer active. The combined reported lifetime prevalence at intake was, therefore, just under 10% (96/1,000) for these men aged 25-45 years. Of the 27 currently active ulcers, nine were of the duodenum, and the remaining 18 were of unspecified site (ICDA 533).

These findings suggested an elevated morbidity for these conditions among the air traffic controllers when compared also with prevalence data from the general U.S. population. U.S. National Health Survey data derived from interviews during 1975

indicated a combined gastric and duodena! ulcer prevalence of 23 per thousand males aged 17 to 44 (U.S. DHEW, PHS communication of unpublished data). The prevalence of 65 per 1,000 of currently active peptic ulcer conditions among our study sample appears, therefore, to have been almost triple the national rate. However, the national figure would be expected to be somewhat lower because the national survey included men from 17 to 25 years of age who would be expected to have a considerably lower prevalence of ulcers. Since rigorous diagnostic criteria and cross-examination by the physician were integral to the diagnoses in our study, whereas the national diagnostic data were based on less stringent interview criteria, biases may exist in this comparison. To the extent that survey respondents in the general public may overreport peptic ulcer disease, or include under that label a variety of other gastrointestinal disorders, the likelihood is increased that our ATCs may really have had more than the 3 to 1 relative risk of peptic ulcer disease suggested by the data cited above.

Incidence of Physical Health Changes After Intake

Physical health changes (illnesses and injuries) were monitored for each participant from the date of his entry examination into the ATC HCS until his final examination approximately three years later. The first ATCs entered the study in February, 1974 and the last ones were mustered out in October, 1977. A total of 4,300 health change events were certified in the interim by the study physician. The information from which these diagnostic decisions were made came from a variety of sources. For 94% of the diagnoses, information came in whole or in part from the Monthly Health Review. For 6% of the changes recorded*, the ATC himself was involved in providing information, either by telephone or at the time of his regular examination. Additional sources of information included the physical examination itself, laboratory findings and the participants' physicians. The 4,300 new health changes comprised 3,623 acute illness and injury events (84% of the total) and 433 recurrences or reactivations of previously diagnosed conditions (10% of the total). The remaining 244 events were almost entirely the clinical emergence or discovery of chronic disease problems.

Of the total health changes developing after intake into the study, 61% were cared for by the participant himself without professional assistance. Thirty-seven percent received physician or

*These percentages total more than 100% because some diagnoses were made on the basis of several sources of information.

clinic attention on an outpatient basis, and the remaining 2% (90 events) were treated by admission to a hospital.

The distribution of days of limited activity attributable to these health changes is displayed in Table 103. The median event for which a specific number of restricted days could be ascertained cost the participant between three and six days of disability. For 34% of events, days of restricted activity could not be ascertained from the information received.

The health changes were categorized into broad diagnostic groups representing the anatomic-physiologic system involved and/or its etiologic type. The distribution of health changes after intake among these diagnostic categories is displayed in Table 104. In the ATC HCS, as in most other extended studies of illness experience in normal populations, the most common health problem was respiratory disorders. These accounted for 36% of all health changes. Injuries were second most common, with 12.5% of the total of all diagnoses. Acute gastrointestinal problems, and complaints regarding bones, muscles, and joints were the next most common health changes. The frequencies displayed in this table include all 4,300 recorded health changes, including 1,445 "trivial" (Level 0) changes, 2,523 minor health changes (Level 1), 250 moderate health changes (Level 2), and 82 severe health changes (Level 3). (See Section IIIC, Indexing Health Changes By Levels of Severity, for explanation of criteria used.) It was often difficult to discriminate between complaint behavior and actual physical health changes in those diagnoses classified as trivial. This is documented by the fact that only 72% of Level 0 events were self-treated and 91% were designated as having indeterminate or no days of restricted activity. In addition, there was a profound decrease in the frequency of certification of Level 0 changes as the study progressed. We therefore decided that the Level 0 health changes were not medically important and not consistently reported; hence they were omitted from all calculations of incidence of the various health changes and from predictive analyses.

Examination of the specific diagnoses entering into Level 1, 2, and 3 health changes, and the probabilities of receiving medical care and hospitalization associated with each diagnostic entry for each level of health change revealed that the 2,773 Level 1 and 2 health changes were composed of a similar set of conditions. The main difference between Level 1 and Level 2 was the severity of the episode, particularly in terms of days of disability. In contrast, Level 3 illness events and Level 3 injuries were qualitatively quite different, posing either a threat to a normal life expectancy or a lengthy dis-

TABLE 103

Distribution Of Days Of Restricted
Activity For All Diagnosed Health Changes
In The ATC HCS

<u># of Days</u>	<u># of Events</u>	<u>Percentage</u>
None	879	20%
1-2	807	19%
3-6	760	18%
7-14	232	5%
15-30	107	3%
More than 30	41	1%
Undetermined	1474	34%
	4300	100%

TABLE 104
Distribution Of ATC Health Changes After Intake
Among Diagnostic Categories

<u>Etiological Group</u>	<u>Absolute Frequency</u>	<u>Relative Frequency</u>
RESPIRATORY	1557	36.2%
ACUTE GASTROINTESTINAL	358	8.3%
NON-SPECIFIC VIRUS	236	5.5%
NON-INFECTIOUS GASTROINTESTINAL	100	2.3%
HEMORRHOIDS	79	1.8%
SKIN DISORDERS	194	4.5%
BONES, MUSCLES, JOINTS	317	7.4%
ALLERGIES	172	4.0%
EYE	47	1.1%
EAR	110	2.6%
MENTAL	219	5.1%
INJURIES	536	12.5%
GENITOURINARY	66	1.5%
HYPERTENSION	36	0.8%
OTHER	273	6.3%
	<u>4300</u>	<u>100.0%</u>

ability.

For these and other reasons, it was decided to combine Level 1 and Level 2 health changes into a single series of data analyses for both descriptive and predictive purposes. The 82 Level 3 health changes were treated separately and further divided into three diagnostic groups: hypertension (36 new cases), severe injuries (21 cases), and all other serious somatic illnesses (25 cases).

The basic summary statistic used in analyses of slight and moderate health changes (Levels 1 and 2) was "the average annualized compressed illness rate." This lengthy term describes how this illness index was calculated. Level 1 and Level 2 illnesses and injuries were compressed into a single index by counting 1 point for each Level 1 health change and 2 points for each Level 2 health change. This was done on the basis that the median days of disability associated with Level 1 changes was 3-6 days, whereas the median days of disability for Level 2 changes was 7-14 days, an approximate ratio of 2 to 1. Similarly, Level 1 health changes received medical attention in 39% of cases, whereas Level 2 events received medical attention in 85% of cases, again close to a 2 to 1 ratio.

The intervals between successive medical examinations at Boston University differed considerably across men for the four prospective intervals of follow-up which were terminated by Examinations 2-5, respectively. In order to compare illness rates across men for different periods at risk, each interval's illness experience was adjusted to an annualized rate. Similarly, although the rate of return of Monthly Health Reviews - the basic information source for health change decisions - was 90.35% (more fully described later), we felt that some adjustment was necessary for individuals who returned fewer than the full number of reports, and thus were less at risk for having acute illness events reported and certified. Accordingly, the rate of return of Monthly Health Reviews as well as the period of risk was taken into account in the calculation of annualized illness rates.

Examination of annualized illness rates by each of nine major diagnostic categories plus the total of all fifteen diagnostic categories revealed uniform correlations between illness rates for corresponding diagnostic categories across intervals, for the total annualized illness rate across categories, and for each of these with the grand total of all illnesses for the entire study period (Table 105). This led to the conclusion that each interval of observation (i.e., each period at risk between successive medical examinations) was an unbiased

TABLE 105

Correlations Of Average Annualized Illness Incidence Rates
(Totals For All Diagnostic Categories) For Each Interval With The Average For The
Entire Study Period And The Number Of Intervals Each Man Participated Actively

	Annualized Incidence For:				Number Of Intervals
	Int. 1	Int. 2	Int. 3	Int. 4	
Interval 1	---	(320)*	(284)	(262)	(358)
Interval 2	.372	---	(293)	(272)	(339)
Interval 3	.308	.375	---	(273)	(298)
Interval 4	.319	.415	.348	---	(276)

Average Incidence for Entire Study	.759	.765	.712	.711	---
Number of Intervals of Participation	.085	.034	.087	-.009	.083

*Numbers in parentheses represent sample sizes from which correlation coefficients in lower left triangle were computed.

estimate of the total illness experience for each man. Therefore, the most stable, unbiased estimate of his total illness-proneness by diagnostic category and overall, would be the annualized illness rate averaged for four intervals. This statistic became our major dependent variable for slight and moderate health changes. In addition, it was found that the number of intervals in which a man was active in the study did not correlate with average annualized illness rates. Therefore, no bias was introduced by including men with only one or two scorable intervals in the analyses along with men who were full participants in the study throughout all four inter-examination intervals.

A further word on the completeness of the data is in order. Men were sent Monthly Health Reviews each month that they were active in the study. Mailings continued until participants were promoted, transferred, medically disqualified from ATC work, or until they gave notice of their desire to withdraw from the study for personal reasons. The amount of drop-out was very low, and the reasons for it are described elsewhere. Nearly 90% of all MHRs mailed out were returned to the study. There was no decrement in cooperation as the study progressed (see Table 106). There were, nevertheless, a few men who tended to be remiss in their return of Monthly Health Reviews. We decided that for men with data missing on occasional months, a fair representation of total illness experience could be obtained by prorating the reported illness experience of the reported months. We decided further that at least half the months in an interval had to have data or proration would be subject to too great a possibility of error. Since the average interval between examinations was nine months, we set a lower limit of five returned MHRs to qualify a man as "scorable" for annualized illness rates for a given interval. Men returning fewer than five MHRs in an interval were not scored for that interval.

Thirty-eight of the 416 entrants into the study had no interval in which they returned 5 or more MHRs. They thus had zero scorable intervals and were excluded from all analyses using average annualized illness rates. The remaining 378 men had one or more scorable intervals. Since number of scorable intervals did not correlate with average annualized illness rates for any diagnostic category or for the total of all categories, all of these men were included in these analyses.

The amount of proration that took place for men scored for each interval was very small. Table 106 shows the rate of MHR return, from 94.3% to 95.8%, for all scorable men in each interval. Thus, for the "fully active participants in

Rate of Return of Monthly Health Reviews

Segments of Longitudinal Study	Percentage of MHRs Returned	
	From All Participants Receiving MHRs	From Active Participants Contributing to the Annualized Illness Rates
Interval 1	87.8%	95.8%
Interval 2	88.5%	95.0%
Interval 3	90.8%	95.7%
Interval 4	89.6%	94.3%

the study," - the 378 men who entered into the data analyses for average annualized illness rates - the illness rates are based on 95% complete data from the primary source from which slight and moderate health changes were ascertained.

The Most Common Health Change Diagnoses

The study physician who certified the 4,300 health changes after intake utilized 318 specific diagnostic codes to classify the diagnoses. Many of these marked only one or two events each, and only 16 types of illness or injury occurred more than 50 times among the subjects (including Level 0 health change). These 16 conditions are displayed in Table 107, with number of men affected at each level of severity and total number of diagnoses. The most common diagnoses were upper respiratory infection, accounting for 20% of the total, sprains (all locations collectively), common cold (nasal symptoms only), non-specific viral disease, and gastroenteritis.

As stated before, Level 0 health changes were considered medically unimportant as well as inconsistently reported. Level 3 health changes were of sufficient severity and rarity to warrant separate analysis. We then calculated average annualized compressed illness rates based on the 2,773 diagnoses categorized Level 1 or 2. This became the summary measure of morbidity for minor and moderate illnesses and injuries. The following findings emerged: respiratory disorders were the most common health change, occurring, on the average, 1.33 times per person per year. Eighteen percent of the men reported no respiratory problems at all, while 24% reported an average of two per year or more. Injuries were the next most common, with a rate of 0.40 per man per year, with 60% of the ATCs remaining free of injuries throughout the study while the remaining 40% averaged from 0.2 to 4.3 injuries per man per year. Fourteen percent averaged 1 injury per year, or more. Acute gastrointestinal problems occurred to the average man 0.29 times per year. Sixty-one percent had no gastrointestinal problems during the entire 3 years, while almost 7% averaged at least 1 per year. Non-specific viral disease struck 25% of the men each year on the average. For 6% of the men, one episode of viral disease was recorded for each of the 3 years of participation. For 64%, no events occurred. Allergies, though common among the men at intake, had a tendency to more frequent recurrence and were observed 0.17 times per year for the entire population. This amounted to an average of 0.71 times per year in the 90 men who were subject to any allergy at all during the course of the study. Problems with bones, muscles, or joints of Level 1 or Level 2 severity occurred an average of 0.12

Incidence Of The 16 Most Frequently Diagnosed Physical
Health Changes After Intake Into The ATC Study By
Diagnostic Code And Number Of Men Diagnosed At Each Level Of Severity*

	ICDA Code	Number of Men With Health Change By Level of Severity			Total Number Of Events	
		0	1	2		
<u>RESPIRATORY</u>						
Common Cold	460.0	108	73	4	-	249
Sore Throat	462.0	101	51	-	-	186
Upper Respiratory Infection	465.0	-	296	-	-	866
'Flu-like Syndrome' and Flu	470 - 472	-	138	-	-	207
<u>HYPERTENSION</u>						
	401.0	-	-	-	-	36
<u>ACUTE G I</u>						
Diarrhea	009.1	62	50	2	-	142
Gastroenteritis	009.2	-	141	5	-	213
<u>NON-SPECIFIC VIRAL DISEASE</u>						
	079.9	-	139	13	-	236
<u>HEMORRHOIDS</u>						
	455.0	44	12	2	-	79
<u>BACK PAIN, MUSCLES & JOINTS</u>						
Low Back Pain	728.7	69	8	1	-	104
Back Pain	728.9	34	21	8	-	73
<u>FEVERS</u>						
Day Fever	507.0	-	71	3	-	125
<u>HEADACHE</u>						
Headache	384.9	50	20	-	-	84
<u>NEURALGIA</u>						
Neuralgia	525.9	108	7	-	-	171
<u>WOUNDS & INJURIES</u>						
Wrist Sprains	840 - 848	112	62	52	6	255
Other Superficial Injuries	910 - 918	49	53	4	-	124

*Individual ATC for whom repeated episodes of the same condition were diagnosed at different levels of severity will be represented in the table at each level of severity for which he received a diagnosis.

times per man per year. All other diagnostic categories occurred much less frequently.

When all of these categories are considered together, a total illness incidence rate can be computed for Levels 1 and 2 events compressed and annualized as described. On the average, participants of this study had 2.5 such health changes per year. Only about 6% of participants reported no health changes at all. Complete absence of health changes would be statistically improbable, and we are reassured that the small number of persons in the "no health change category" reflects the honesty and completeness of reporting by our participants. There was great variation in the frequency of reported health changes, ranging from 0.2 per year to 12.3 changes per year. Section V, Predictive Findings, contains a discussion of psychological and social factors associated with varying level frequencies of health change, overall and for various physiologic systems considered separately.

Serious Illnesses And Injuries During The Study: A Summary of Level 3 Physical Health Changes

The most severe of all health changes were labeled Level 3. This diagnostic level required either a sustained period of disability (usually 15 days or more) or the emergence of a disease whose consequences might threaten future ability to work or shorten life expectancy. Although hospitalization was involved in many of the Level 3 illnesses, hospitalization itself without at least seven days of disability did not warrant a Level 3 rating of severity unless an illness of life-shortening potential was involved. Certain illnesses such as hypertension and angina pectoris were always considered Level 3 on the basis of risk of end organ damage, and others, such as ulcers of the stomach and duodenum, gastritis, diabetes mellitus and liver inflammation were rated Level 3 if they involved hospitalization.

All Level 3 health changes were categorized into four types: hypertension, injuries, psychiatric disability (which was graded Level 3 only if it involved disability and hospitalization), and all other physical illnesses considered collectively. Discussions of the incidence of hypertension and psychiatric disorder are presented in other sections. Level 3 injuries and other physical illnesses are described below.

Level 3 Injuries

During the course of the study, 21 severe injuries were incurred by 18 men, three of them having two severe injuries each. In order to qualify for Level 3 severity, an injury had

to result in greater than one month of limited activity with much of this usually involving time lost from work. The complete list of severe injury diagnoses and the number of times each occurred is listed in Table 108.

Ten of the severe injuries resulted in hospitalization, and the remaining 11 were treated on an outpatient basis. These injuries included 9 fractures, 3 dislocations, 6 sprains, 2 cases of internal derangement of joint, and 1 non-specific injury.

Level 3 Physical Illnesses (Excluding Hypertension)

Hypertension, newly diagnosed in 36 men after the study began, was the most commonly occurring serious physical illness. It is discussed separately in a section following. Diagnoses were rendered for 19 other specific conditions affecting ATCs with sufficient severity to be rated Level 3. These 19 conditions affected 23 men at the severe level. As 2 of these men had 2 such diagnoses each, there was a total of 25 diagnoses of Level 3 physical illnesses, excluding those for hypertension.

Twenty of these illnesses required hospitalization and five were treated on an outpatient basis. Examination of the table may raise the question why certain illness of seemingly moderate severity such as cellulitis of the leg, shoulder bursitis, and esophagospasm were considered severe enough to be rated Level 3. In each of these instances, however, the particular illness episode was sufficiently severe or complicated as to warrant hospitalization and, in the case of the shoulder bursitis and the one severe instance of cellulitis, disability for greater than 30 days was also involved. Three of the 13 cases of peptic ulcer disease diagnosed during the course of the study were considered to be severe.

The remaining Level 3 physical illnesses covered a broad gamut which can be considered fairly typical of men aged 25-45. The complete series of diagnoses together with level of care received and days of disability are presented in Table 109.

TABLE 108

Level 3 Injuries Among Air Traffic Controllers During
3 Years Of ATC HCS

<u># Cases</u> ¹	<u>ICDA</u>	<u>Diagnosis</u>	<u>Level of Care</u> ²	<u>Days Restricted</u>
1	724.0	Internal Derangement of Joint ³	3	
1	724.5	Internal Derangement of Joint ³	3	
1	809.0	Multiple Closed Fractures, Trunk	3	
1	812.0	Closed Fracture, Upper Humerus	2	
1	814.0	Carpal Fracture	2	
1	816.0	Finger Fracture ³	3	
2	822.0	Patella Fracture	3	
1	824.0	Ankle Fracture ³	2	All required
1	825.0	Tarsal/Metatarsal Fracture	2	31+
1	825.0	Tarsal/Metatarsal Fracture	3	days down
1	836.0	Knee Dislocation	2	
2	836.0	Knee Dislocation	3	
2	844.0	Sprain Knee/Leg ³	2	
1	845.0	Sprain Ankle ³	2	
1	846.0	Sprain Sacroiliac ³	2	
2	847.0	Sprain Neck ³	2	
1	996.8	Injury, other ³	3	

¹ These 2¹ L3 Injuries were incurred by 18 men, 3 of whom had 2 L3 injuries each.

² Level of Care categories are: 2 = medical ambulatory care and 3 = hospitalization.

³ Only a minority of the injuries in this diagnostic category were of sufficient severity to be rated Level 3.

TABLE 109

Level 3 Physical Illnesses Diagnosed Among
Air-Traffic Controllers During 3 Years of ATC HCS¹

<u># Cases²</u>	<u>ICDA</u>	<u>Diagnosis</u>	<u>Level of Care³</u>	<u>Days of Restricted Activity</u>
1	012.2	Pleurisy with Effusion	3	15-30
1	162.1	Malignant Neoplasm	3	31+
2	410.0	Ischemic Heart Disease w/Hypertension	3	31+
1	410.9	Acute Myocardial Infarction	3	31+
1	413.9	Angina Pectoris	2	31+
1	503.9	Chronic Sinusitis ⁴	3	15-30
1	530.9	Esophagospasm ⁴	3	7-14
1	532.0	Duodenal Ulcer-Bleeding	2	15-30
1	532.0	Duodenal Ulcer-Bleeding	3	31+
1	533.9	Peptic Ulcer ⁴	2	7-14
2	535.0	Gastritis/Duodenitis ⁴	3	7-14
1	540.0	Appendicitis	3	15-30
1	540.0	Appendicitis	3	31+
1	541.0	Appendicitis	3	31+
1	569.9	Intestinal Disease, other	3	15-30
1	574.0	Acute Cholecystitis/Lithiasis	3	15-30
1	574.0	Acute Cholecystitis/Lithiasis	3	31+
1	575.0	Cholecystitis/Cholangitis	3	31+
1	592.0	Calculus-Kidney/Ureter ⁴	2	7-14
1	592.0	Calculus-Kidney/Ureter ⁴	3	7-14
1	682.4	Cellulitis of Leg ⁴	3	31+
1	725.1	Herniated Disc ⁴	2	31+
1	731.1	Shoulder Bursitis ⁴	3	31+
36	401.0	Hypertension	3	0

¹ Level 3 Psychiatric illnesses, all of which involve hospitalization, are reported under Psychological Health Changes.

² There were 25 L3 diagnoses incurred by 23 men, two of whom had two such diagnoses, among illnesses other than hypertension.

³ Level of Care categories are: 2 = medical ambulatory care and 3 = hospitalization.

⁴ Only a minority of cases in diagnostic categories marked thus were of sufficient severity to be rated Level 3.

SUMMARY

Upper Respiratory Infection (URI) and Influenza (Flu)

URI was diagnosed on the basis of self-reports, via the Monthly Health Review, of clusters of symptoms including, as a minimum, sore throat and sneezing, stuffy or runny nose. Other symptoms adding certainty to the diagnosis were: temperature of 100° or more, dry cough or coughing up substances other than thin phlegm.

Flu was diagnosed upon self-report of either of two minimal clusters of symptoms: certain pains and cough and fever, or the pains and cough and nausea/vomiting. Additional symptoms, such as painful or burning eyes, or excess fatigue, added certainty.

Except for the spring months of 1974, the monthly incidence of URI among the ATCs over the three-year study ranged from 1% to 10% for "possible" URI and also for "probable" URI. Monthly incidence rates ranged from 0 to 3% for "possible" and also "probable" flu.

Altogether 866 episodes of URI affecting 296 men, and 207 episodes of flu affecting 138 men were diagnosed. URI and flu together accounted for 25% of all diagnoses during the three year study.

b. Upper Respiratory Infection and Influenza

Respiratory symptoms are commonly reported as the most frequent of all physical complaints. One study of thousands of persons in a prepaid medical care plan found that respiratory diseases among men aged 25-44 years accounted for 28% of all diagnoses, both acute and chronic, a figure more than twice that of the next most common category of diagnoses (Avnet, 1967). National data gathered by continuous sampling surveys of the National Center for Health Statistics provided an estimate that respiratory conditions accounted for 54% of all acute conditions for the total population during the year July, 1975 through June, 1976 (DHEW Publication No. (PHS) 78-1548, January, 1978).

Procedures and Definitions

The data indicating the large contribution of respiratory ailments to any total count of illnesses caused us to pay particular attention in this study both to establishing rigorous criteria for assignment of diagnoses and to the certainty with which the diagnostic label could be applied.

As described in the section on methods of measurement (IIIC), the Monthly Health Review (MHR) mailed each month to the ATCs in the study was the main source of information concerning transient or acute illnesses.

Information on upper respiratory infection (URI) was elicited through five items listed in the MHR: temperature of 100° or more; sore throat; sneezing, stuffy or runny nose; dry cough, more than occasional; coughing up substances other than saliva or thin phlegm (see copy of MHR, Exhibits).

Information on influenza (flu) was elicited through eight items (either alone or in combination with various other symptoms) listed in the MHR: frequent dry cough; productive cough; fever; nausea or vomiting; painful or burning eyes; headache; stomach or abdominal pain; general myalgia ("aches or pains in muscles or joints other than the back").

ATCs were instructed to check whether their symptoms appeared as illness episodes, isolated events or continuing problems.

The symptoms checked were then assigned a diagnosis of URI or influenza on the basis of patterns or clusters conforming to definitions established for these illness as follows:

MHR ITEM REPORTED (see code below)

Possible URI	7 and 8
Probable URI (3-point)	7 and 8 plus one of 1, 9, 10
Probable URI (4-point)	7 and 8 plus two or more of 1, 9, 10

- 1 = Temperature of 100° or more
- 7 = Sore throat
- 8 = Sneezing, stuffy or runny nose
- 9 = Dry cough (more than occasional)
- 10 = Coughing up substances other than thin phlegm.

A definition of influenza was derived after considerable discussion within our medical team and informal consultation with Dr. H. Bruce Dull of the USPHS Center for Disease Control and Dr. Neil Blacklow, then of the Adult Infectious Disease Section, Department of Preventive Medicine and Epidemiology, Boston University School of Medicine. Although positive diagnosis of influenza can only be made by laboratory studies, this procedure is infrequently followed in clinical practice. In lieu of laboratory diagnosis, therefore, the following definitions of influenza were accepted:

Possible flu

- a) Pain (any of the following: headache, stomach pain/abdominal cramps, aches and pains in muscles and joints), AND cough (either of two: dry cough - more than occasional, or any productive cough), AND fever.

- or -

- b) Pain (as defined above) AND cough (as defined above), AND nausea/vomiting.

Probable flu

- a) Either triad above plus either the remaining major symptoms (fever, nausea/vomiting), OR painful or burning eyes, OR excess fatigue.

Accuracy of Reporting and Validity of Definitions

The reliability of using the MHR to obtain health change information was demonstrated by Dr. Bernard Kreger's telephone interviews which checked the accuracy of the reporting (see IIIC). In addition, a further analysis was made of three months' MHRs (February, March, and April, 1975) to determine whether or not the patterns of symptoms reported were reasonable reflections of the clinical observations of these illnesses and whether or not the procedure and definitions used produced overreporting or underreporting of illness.

The analysis showed a strong pattern of clustering among the five URI symptoms listed, and indicated that the combination of nasal symptoms with sore throat in effect defined "possible" URI. The additional presence of fever or frequent (dry or productive) cough gave the diagnosis greater certainty ("probable URI").

The three-month analysis also helped to resolve the question whether the symptoms selected as defining the flu really had a greater-than-chance association with one another.* Statistical tests of the probabilities of defining "flu pattern" by chance in the ATCs' MHRs revealed that the triads of symptoms occurred more frequently than would be expected by chance. Other internal analyses of the data were performed. All results suggested that the definitions established for a flu diagnosis appeared to be valid indicators of genuine illness among the study subjects.

Additional information regarding the three-month analysis of respiratory symptoms reported in the MHR can be found in a

*If the definitions used adequately mirrored the natural clustering of symptoms of these illnesses, one would expect the clusters to occur more frequently than they would by chance. The probability of the occurrence of clusters by chance are calculated as the product of the occurrence of the individual symptoms in the population. Thus, if headaches are reported by 20% and athlete's foot by 10% of the population, the headache-athlete's foot combination could be expected to occur in 2% of the population by chance alone. This type of analysis was applied to various triads of symptoms defined as flu. All of the triads tested occurred from 2.5 to 3.5 times as often as would be expected by chance. These ratios were usually, but not always, statistically significant, the expected number of events being sometimes as small as one and the observed number around five (thus creating violations of the statistical assumptions for most tests of significance).

paper prepared for publication, "Use of a Monthly Health Review to Ascertain Illness and Injuries in the Air Traffic Controller Health Change Study," included in Appendix II.

Incidence of URI

A monthly incidence of URI was calculated for the period from March, 1974 (at which time 60 men had been entered into the study) through February, 1977 (at which time 269 men returned MHRs). This period included the full recruitment phase when a peak of 372 participants (January, 1975) returned MHRs.

Over this 36-month period, a total of 10,549 MHRs were returned, or an average of 293 per month. Monthly incidence was calculated on the basis of the specific number of returns each month.

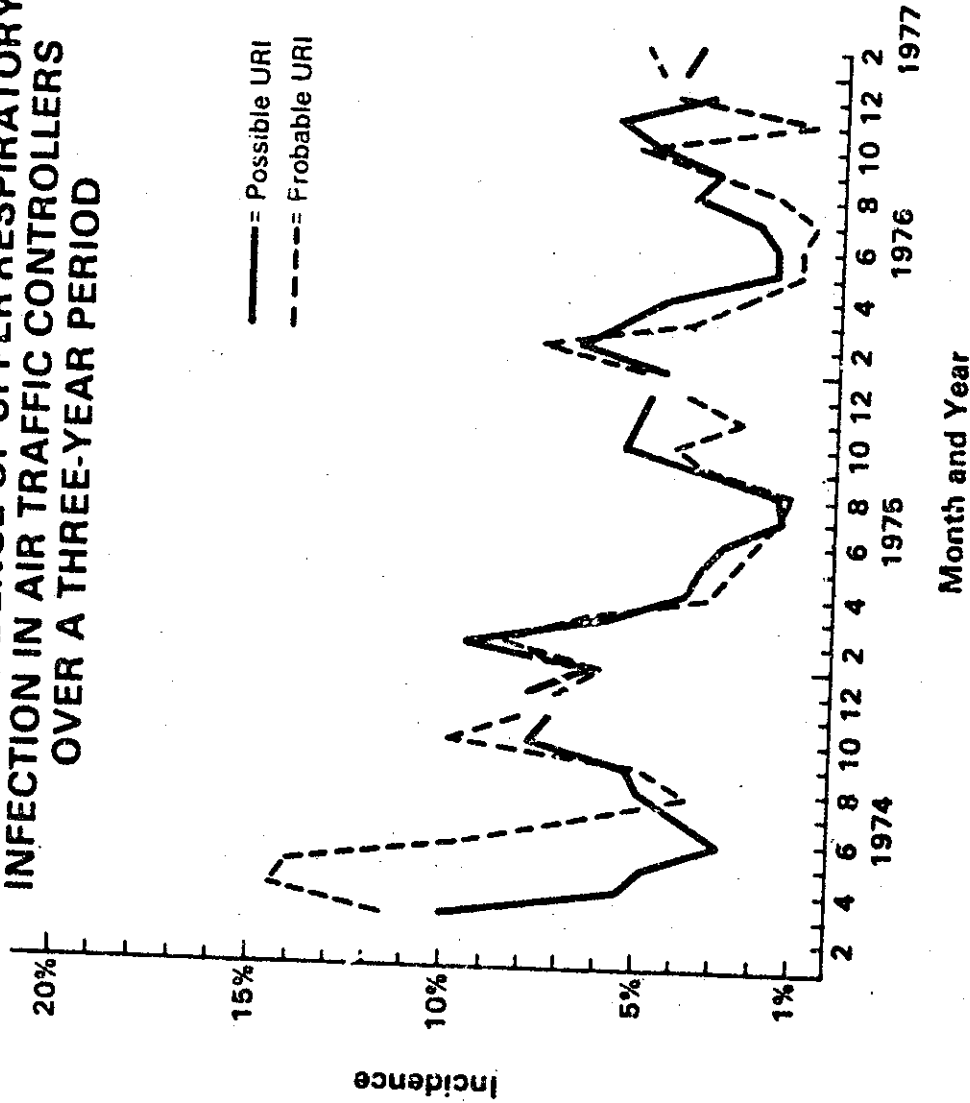
Figure V displays the monthly frequency of "possible" and "probable" URI. Except for the spring months of 1974, the incidences of "possible" and "probable" URI each ranged between 1% and 10%.

The three-month data on days of restricted activity and frequency of medical care, gathered for our earlier analysis, suggest that the definitions of "possible" and "probable" URI relate not only to degree of certainty of the diagnosis, but also to degree of severity of the illness.

Figure V shows that the relative frequencies of "possible" and "probable" URI follow one another quite closely with peaks in the fall and winter. The spring and early summer of 1974 present certain exceptions to these generalizations. First of all, the rates of illness are considerably higher than during the rest of the three-year period. Secondly, the relative frequency of "probable" URI is much greater than that of "possible" URI; and finally, a seasonal shift to high frequencies in late spring is noted. There are four possible explanations for this variant pattern. The first is that inasmuch as these data were gathered at the beginning of the study, the respondents may have had a tendency to overreport their symptoms. If overreporting were responsible for this apparent peak, one would expect to find overreporting of symptoms in other physiological systems as well. A number of analyses were done separately for a variety of diagnoses and for a variety of symptoms on the Monthly Health Review. As overreporting of other symptoms tended to be minimal, we concluded that the high rate of reported URI symptoms was primarily attributable to other factors. A second possible explanation was that the MHR used during the first eleven months of 1974 was different from the re-

MONTHLY INCIDENCE OF UPPER RESPIRATORY INFECTION IN AIR TRAFFIC CONTROLLERS OVER A THREE-YEAR PERIOD

FIGURE V



vised form used during the remainder of the study and presented in the Exhibits appended. Although the same symptoms were included in both forms of the MHR, the format was different in the 1974 early version. This may have influenced the frequency of URI, and as we shall note later, of influenza, during the spring. A third possibility is that the few men who entered the study in the first two months may either have been more prone to respiratory problems than other ATCs, or that the small numbers provided an extremely unstable basis for multiplying percentage rates and hence a very few URI events would project into a high rate. A fourth possible influence on the high rates was what appears from clinical anecdotes to have been a genuine epidemic of URI and influenza during the late winter and spring of 1974 in the Northeastern U.S.

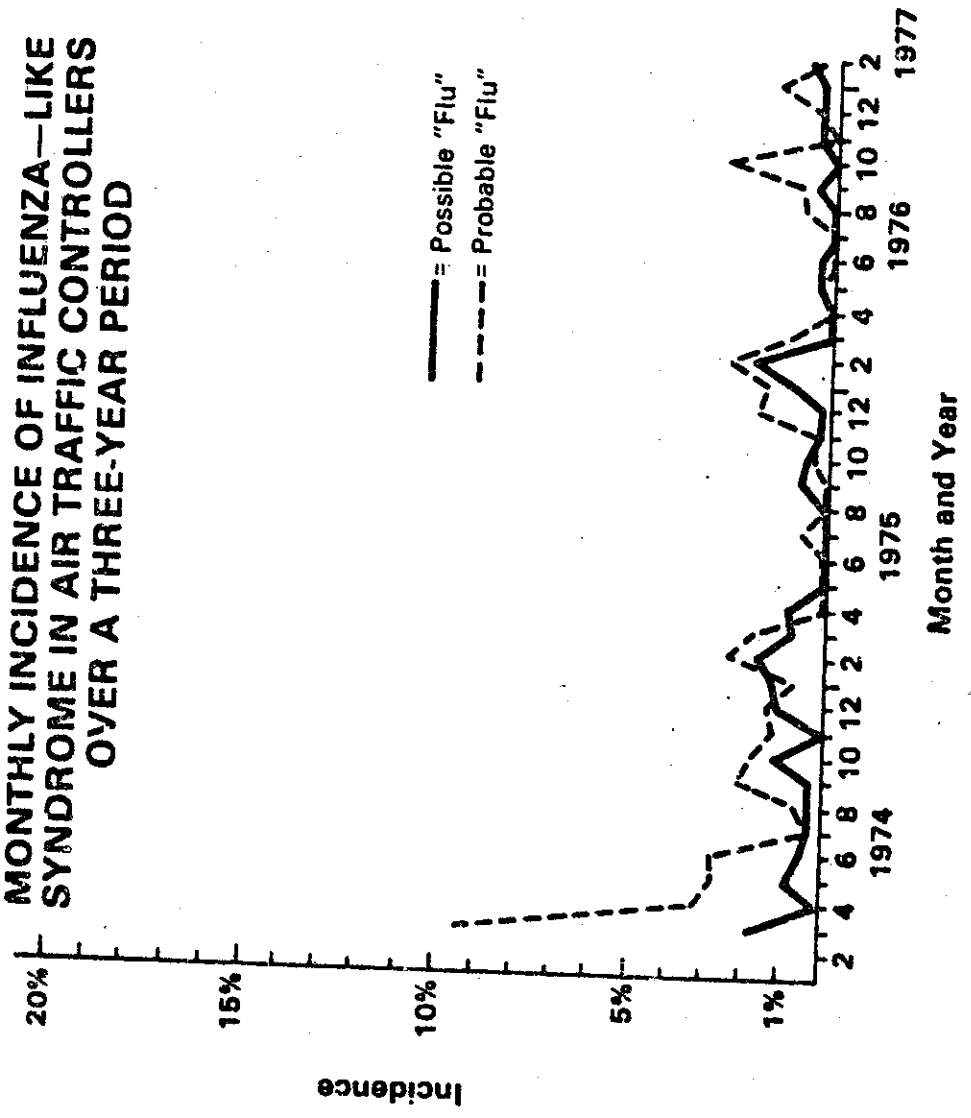
Incidence of Influenza

The frequency of flu, relatively small in this healthy male population, over these 36 months is displayed in Figure W. "Possible" and "probable" flu each had monthly incidence rates ranging from 0 in the summers of 1975 and 1976 to 3% in the course of each winter. Again, the spring of 1974 appeared to be an exception, with monthly rates of 9.5% for "probable" flu and 2% for "possible" flu. The four possible contributing explanations discussed above for URI also apply to these data. The format of the original MHR form, the small sample participating in the first few months of the study, and a possible genuine excess of influenza during the early spring of 1974 appear to have contributed in unknown proportions to the high rate observed. From the summer of 1974 onward, however, the graph (Figure W) shows a consistent rhythm with "possible" and "probable" flu occurring in similar frequencies, and higher incidences occurring in winters with virtually no disease occurring in summers.

Altogether 866 episodes of URI affecting 296 men, and 207 episodes of flu affecting 138 men, were diagnosed during the three-year study. URI alone accounted for 20% of all diagnoses rendered after intake, and together with flu, accounted for 25% of all diagnoses during the three years of surveillance.

MONTHLY INCIDENCE OF INFLUENZA-LIKE SYNDROME IN AIR TRAFFIC CONTROLLERS OVER A THREE-YEAR PERIOD

FIGURE 4



SUMMARY

Injuries

Information regarding injuries was gathered from the monthly self-reports (Monthly Health Review), the examinations at Boston University Medical Center and outside medical reports.

A total of 325 injuries, mostly mild or moderate, were diagnosed over the three years, producing an incidence of 34.4 injuries per 100 man-years and accounting for 11.4% of all mild, moderate and severe conditions diagnosed after intake. Injuries contributed disproportionately to the most severe conditions, comprising 25.3% of all Level 3 diagnoses.

Sprains were the most frequent type of injury, followed by contusions and superficial injuries, fractures and dislocations, other injuries including burns and concussion, and, finally, wounds and lacerations. There were only 21 injuries designated severe, and the majority of these were fractures or dislocations.

Among the 416 men, 30 (7%) had three or more injuries each, 53 had two injuries each, and 89 had one injury each.

Generally, the ATCs had a slightly lower rate of injury than males in the general U.S. population, and a somewhat longer recovery period.

c. Injuries

Along with our efforts to determine the extent and severity of illnesses, we also monitored injuries that occurred during the three years of the study. We were interested in learning whether the ATCs incurred more or less injury than others in the general population, what types of injuries they suffered, and whether or not proneness to injury was associated with, or predictable by, any of the psychosocial, biographical or physical factors that we were investigating.

Data Collection and Recording

Information concerning injuries was gathered primarily from self-reports of the controllers on the Monthly Health Review. Additional information was obtained at the Periodic Examinations (approximately 9 months apart) at Boston University Medical Center and through outside medical reports.

Injury diagnoses were recorded by International Classification of Diseases, Adapted N code, and by level of severity (see Section IIIC for explanation of the development of severity levels).

Incidence

A total of 325 injuries, Levels 1, 2 and 3 (mild, moderate and severe), were sustained during the 36-month surveillance period, producing an incidence of 34.4 injuries per 100 man-years. As with the analyses of illnesses reported in the previous sections, the trivial, Level 0 injuries were excluded from all analyses.

The 325 injuries accounted for 11.4% of all Level 1, 2 and 3 conditions diagnosed after intake into the study. However, injuries contributed disproportionately to the most severe conditions, accounting for 25.3% of all Level 3 diagnoses. The number of injuries and the number per 100 man-years in each category of injury is displayed in Table 110.

Although exact comparisons with injury data for the general population are not possible because of differences in age grouping and criteria for inclusion in the injury count, it is apparent that the incidence of injuries among the ATCs in our study was somewhat lower than the estimated 39.4 injuries (not age specific) per 100 males per year in the U.S. When the ATC rate was adjusted to reflect the same inclusion criteria as that of the government data, the adjusted ATC rate of 37.5 injuries per

by Type and Severity

Type of Injury	36-Month Total Number of Injury Events	Number Per 100 Man-Years ¹	Level of Severity (No. of Injuries)			Percent of Total Injuries
			1	2	3	
Fractures, Dislocations (ICD 802-838)	41	4.3	15	14	12	12.6%
Sprains (ICD 840-848)	131	13.9	70	55	6	40.5%
Lacerations and Wounds (ICD 870-907)	20	2.1	16	4	0	6.2%
Contusions and Superficial Injuries (ICD 910-929)	102	10.8	89	13	0	31.4%
Other (ICD 374, 724, 724.5, 738.3, 850, 944-949, 996-996.8)	31	3.3	19	9	3	9.5%
Total Injuries	325	34.4	209	96	21	100.0%

¹ Man-years = average number of Monthly Health Reviews received over 36-month surveillance, or $11,336 \div 12 = 944.67$

100 man-years approached the general U.S. male population rate even more closely.*

Employed males in the U.S. sustained a higher rate of injury (44.5 injuries per 100 employed males) reflecting the fact that work-related accidents are an important source of injuries among the general male population. The air traffic control environment, however, is not particularly conducive to accidental injury, and one would therefore expect a somewhat lower incidence among this occupational group.

Type and Severity of Injuries

As shown in Table 110, the most frequent type of injury was sprains, accounting for 40.3% of the total. Contusions and superficial injuries were next most frequent (31.4%), and the remaining types were fractures and dislocations (12.6%), other injuries, including burns and concussion, etc. (9.5%) and wounds and lacerations (6.2%).

Predictably, the largest number of injuries were relatively mild, with only 21 (6.5%) designated Level 3 (severe). A majority (57.1%) of these were fractures or dislocations, and the largest number of the remaining severe injuries were sprains. Sprains accounted for 57.3% of the moderate, and 33.5% of the mild injuries, which were mostly contusions and superficial injuries.

Injury Repeaters

The number of ATCs reporting repeated injury, and the number of injuries reported per man is shown in Table 111. Of the 416 men in the study, 89 sustained one injury each, 53 had two injuries each, and 30 men (7%) sustained 3 or more injuries each.

Factors predictive of injuries are discussed in Section V.

Days of Restricted Activity

The total days of restricted activity for all injuries was found to be 3,198, or 338.4 days per 100 man-years. In comparison, the estimated number of days of restricted activity caused by injuries for males aged 17-44 years in the general U.S. population (July 1974 - June 1975) was 298.7 per 100.

* (DHEW Publication No. (HRA) 77-1541, February 1977, pp. 9 and 17.

TABLE III

Number Of Men Incurring Repetitive Injuries And
Proportion Participating In ATC HCS Until Completion

Number of Injuries Per man	No. Men Repeating	No. Men Repeating and Participating in Study Until End	Percent Participating Until End
0	244	131	54%
1	89	62	70%
2	53	39	74%
3	14	12	86%
4	7	5	71%
5	2	1	50%
6	3	2	67%
7	1	1	100%
8	2	2	100%
9	1	0	-

Since the rate of injury for our ATC group was somewhat lower than that estimated for U.S. males of reasonably comparable age, the higher rate of "days down" for the ATC group could indicate more serious injuries or slower recovery from injury. The fact that a larger proportion of the injuries among the ATCs involved the more serious categories of fractures and sprains also helps to explain the greater number of days down.

Table 112 shows the level of care involved in the injuries. Slightly more than a quarter (27.7%) received no medical attention, approximately two-thirds (67.7%) received doctor's care, and 4.6% required hospitalization.

ATC Injuries by Level of Care and Type of Injury

Level of Care	Number of Injuries					
	Fractures and Dislocations	Sprains	Lacerations and Wounds	Contusions and Superficial Injuries	Other	Total
Self	3	49	3	27	8	90
Medical Ambulatory	31	81	15	75	18	220
Hospital Inpatient	7	1	2	0	5	15
All Levels	41	131	20	102	31	325

SUMMARY

Hypertension

After examination of criteria for determination of hypertension used in several other studies, it was decided to adopt criteria more suitable for this study. Prevalence cases of hypertension were those whose systolic blood pressure was equal to or exceeded 140 mm Hg or whose diastolic pressure was equal to or exceeded 90 mm Hg at both the intake and the next examination, normally 9 months apart. At each examination, two readings of the blood pressure were averaged to produce the recorded pressure for that examination. Incidence cases were new cases developing from among the pool of those free of symptoms at intake, using the same requirement that the elevated blood pressure be shown at two successive examinations.

By applying the criteria of other studies to the ATC HCS data, comparisons could be made of prevalence and incidence in the differing population groups.

Using the ATC HCS criteria, 135 men, or 32.5% were found to have hypertension at intake. Thirty-six additional men (5.7% annualized rate) developed hypertension over the course of the study.

Applying the criteria for determining the condition used in each comparative study to ATC data, the following comparisons of prevalence and incidence emerged:

- 1) By HANES (U.S. Health and Nutrition Examination Survey, 1971-74) criteria, 55% of the ATCs were hypertensive (both borderline and definite) at intake, a rate 1.5 times that of the white U.S. males of the HANES population.
- 2) By Framingham Heart Study criteria, 64% of the ATCs were hypertensive at intake; for the category of definite hypertension alone, this was a rate 1.5 times that of males of comparable age in Framingham, Massachusetts. Under the same criteria, 64% became hypertensive over the 3 years of the study (all categories of hypertension) producing a rate 4 times that of the Framingham males.
- 3) By FAA criteria, which allowed higher blood pressures with increasing age and measured the blood pressure with the person in a supine position after rest, only 11% of the ATCs were hypertensive at intake.
- 4) Comparisons with the Western Collaborative Group Study, 1964, applying the Framingham criteria for definite hypertension, showed that the ATCs prevalence of hypertension may be 2 to 4 times that of the Western Collaborative population of middle class men working in above average jobs.

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The various comparisons led to the conclusion that air traffic controllers have a substantially elevated risk of hypertension.

d. Hypertension

Hypertension is known to be a condition having the potential for future very serious end-organ damage and even the shortening of life expectancy. Its prevalence* was previously reported to be considerably higher among air traffic controllers than among second-class airmen (Cobb and Rose, 1973). We therefore selected our methodology carefully, utilizing the experience of our project physician who had been, and is still, a medical examiner for the Framingham Heart Study. We selected several criteria for the diagnosis of hypertension in order to enable us to compare our findings with those of two major epidemiological investigations of blood pressure levels and hypertension: the 1971 - 1974 Health and Nutrition Examination Survey (HANES) conducted by the U.S. Public Health Service using a nationwide probability sample of the population (DHEW Publication No. (HRA) 78-1648, Sept. 1977, pp. 2-4, 18) and the Framingham Heart Study (Kannel and Gordon, 1974, Dec. 30, pp. 31-32), a longitudinal surveillance of a sample of the adult residents of Framingham, Massachusetts. We also utilized, for comparison purposes, the diagnostic criteria for hypertension established by the FAA for recertification of ATCs at their annual medical examination. In addition to these three sets of diagnostic criteria from other groups, we developed our own diagnostic criteria for the ATC HCS. As described later, these criteria gave us a more stable diagnostic decision based on brief and well specified examination procedures which are equivalent at all ages. The methods of examination and rules for making of diagnoses according to these four different criteria are detailed in Table 113.

Some comments on the strengths and weaknesses of the various diagnostic criteria are in order. The HANES criteria relies on a single reading of blood pressure at a single examination for the determination of hypertensive status. It therefore would be expected to generate the highest percentage of prevalence cases if, as is usually assumed, first reading of blood pressure tends to be higher than subsequent readings. On the other hand, when more than one reading is used and the elevation of any reading can result in the diagnosis of hypertensive status, such as obtains for the Framingham Heart Study criteria, lability of blood pressure would produce a large enough number of borderline prevalence cases.

* Any study participant who had experienced the conditions listed in Table 102 at any time before entry into the study, or for whom the condition was diagnosed at entry, was considered a prevalence case.

TABLE 113

Four Sets Of Criteria For Determination Of Hypertension

Readings (Syst. & Diast.)	Definite HT	Borderline HT	Normotensive
Framingham ¹ 2 Seated, left arm, or 1 if second reading not available, at one exam.	Either syst. \geq 160mm Hg or diast. \geq 95mm Hg on both readings	Any combination of two readings other than those meeting criteria for definite hypertensive or normotensive	Both syst. $<$ 140mm Hg and diast. $<$ 90mm Hg on both readings
HANES ² 1 seated, right arm, at one exam	Either syst. \geq 160mm Hg or diast. \geq 95mm Hg.	syst. $<$ 160mm Hg and diast. $<$ 95mm Hg but not both $<$ 140mm Hg syst. and 90mm Hg diastolic	Both syst. $<$ 140mm Hg and diast. $<$ 90mm Hg
FAA ³ # Not specified, reclining BP used	Must require no medication for control of blood pressure and must demonstrate BP levels no greater than the following maximum reclining values: Systolic Diastolic Age 20-29 140mm Hg 90mm Hg 30-39 150mm Hg 90mm Hg 40-49 150mm Hg 100mm Hg 50-over 160mm Hg 100mm Hg		
ATC HCS Average of 2 seated right arm readings at each of 2 successive examinations	Eithersystolic \geq 140mm Hg or diastolic \geq 90mm Hg on two successive visits approximately 9 months apart		Any ATC who does not meet the criteria for diagnosis of Hypertension.

¹ Kannel and Gordon, Feb., 1974, Section 30, pp. 31-32.

² OHEM Publication No. (HRA) 78-1648 Sept. 1977, pp. 2,3,4,18.

³ Air Traffic Control Specialist Health Program, Dept. of Transportation, FAA, Order 3930.3, May 3, 1977, Appendix 1, p.5-6.

Blood pressures taken of persons lying down are systematically lower than those taken in the sitting position. Extending the time of recumbent rest before taking the blood pressure would also lower the readings further. For these reasons, the FAA criteria would tend to generate fewer cases. In addition, the usually observed increase in hypertension prevalence by age would be negated, if not reversed, by the different blood pressure elevations required at different ages for the diagnosis of hypertension by FAA criteria. In general, FAA criteria would designate fewer people as hypertensive than either of the other criteria described above.

The ATC HCS criteria developed by the investigators of this study calls for the averaging of two readings of the blood pressure, thus reducing the likelihood that novelty effect or lability will falsely lead to the diagnosis of hypertension. The observation in this study and elsewhere that blood pressure shows variability from day-to-day also led us to set the requirement that blood pressure must be elevated at two successive examinations in order for a diagnosis of hypertension to be made. All these provisions of the ATC HCS diagnostic criteria tend to reduce the frequency with which hypertension is diagnosed and hence, for the same group of blood pressure readings, the rates of prevalence and incidence of this condition would be lower than obtained from either the HANES or the Framingham criteria.

For all of these diagnostic criteria, the incidence rates for hypertension would be expected to be influenced by the prevalence rate in that the number of normotensives remaining at risk for the determination of incidence would be reduced by the number of prevalence cases designated at intake. In addition, criteria like the HANES, which tend to designate persons with normal but higher and more labile blood pressures as "borderline hypertensives" remove these high risk people from the group to be followed and hence, may tend artificially to reduce future incidence rates.

The comparative findings regarding the prevalence of hypertension in the ATC HCS using the four diagnostic criteria described are displayed in Table 114. The high prevalence rates of hypertension as judged by the HANES and the Framingham criteria were very striking. By the HANES criteria, 27% of the men were borderline hypertensive and an additional 28% are definite hypertensives for a total prevalence of 55%. The Framingham criteria developed an even higher prevalence of hypertension but two-thirds of it was in the borderline category. Forty-four percent of men received this diagnosis and nearly 20% additional were considered definite hypertensives for a total of nearly 64% prevalence by this system. Neither the FAA criteria nor the ATC HCS criteria distinguish between borderline and definite hypertension (see

TABLE 114

Comparative Prevalence of Hypertension Among Air Traffic Controller
Sample at Intake to ATC HCS by Four Alternative Sets of Criteria

Criteria Applied to ATC HCS blood pressure data	Prevalence among ATCs in Sample					
	Borderline Hypertensive		Definite Hypertensive		Total Hypertensive at Intake	
	#Men	%	#Men	%	# Men	%
HANES	113	27.2%	117	28.1%	230	55.3%
FRAMINGHAM HEART STUDY	184	44.3%	81	19.5%	265	63.8%
FAA	N/A		N/A		47	11.3%
ATC HCS	N/A		N/A		135	32.5%

Table 115). By the FAA criteria, only 11% of men were hypertensive, but by the ATC HCS criteria 32% received this diagnosis.

Further studies of blood pressures and of different criteria for diagnosing hypertension were done using blood pressure determinations from the second through fifth medical examinations conducted at BUSM. This provided the means for checking the stability of the diagnoses made by different criteria. Application of the HANES and Framingham criteria to our data demonstrated the instability of prevalence and incidence rates for borderline hypertension generated by the use of only one blood pressure reading or the higher of two such readings at a single examination. Use of the first reading alone produced many "hypertensives" who were responding to the novelty of the examination procedure with an elevation of pressure and whose blood pressures at ensuing examinations were normal. Two readings of blood pressure at a single exam and application of the Framingham criteria, produced many cases of "borderline hypertension" on the basis that one of the readings was above the normal cut-off, even though the other was clearly in normotensive range. Examinations on later dates showed a consistent return to normal pressures in most of these men. Definite hypertension diagnosed on the basis of systolic pressures 160 mm Hg or greater or diastolic pressure of 95 mm Hg or greater was identified a great deal more consistently under any of the diagnostic criteria.

Because we intended to perform additional predictive studies of those who became hypertensive during the course of the ATC HCS, we sought a more stable and conservative indicator of hypertensive status. Hence, we adopted the ATC HCS criterion which specified that hypertension would be diagnosed only upon elevated blood pressure (the average of two readings while sitting: sbp equal to 140 mm Hg or greater or dbp equal to 90 mm Hg or greater) at two consecutive examinations, which normally occurred approximately nine months apart. Additional grounds for the diagnosis of hypertension at intake were the determination by our study physician that the participant (1) had a history of being diagnosed as hypertensive by a physician and at intake had elevated blood pressure (140/90 as defined above); or (2) had a history of being diagnosed as hypertensive by a physician and was currently adhering to a regimen of anti-hypertensive medication. Our ATC HCS criteria for diagnosis of hypertension were therefore considerably more stringent than either the HANES or the Framingham Study. In addition, they differed qualitatively from the criteria designated by FAA regulations.

We decided not to adopt, for our research purposes, the FAA criteria used for recertification of controllers upon annual examination. Our decision was based partially on the fact that the FAA

acceptance of elevated blood pressures as normotensive among older controllers was not appropriate to our study goal, which was to identify those controllers whose blood pressure levels became elevated during the course of the study and to discover the antecedents of this process. Another reason for not using this criteria was that the use of supine blood pressures and the lowest of an unspecified number of readings made comparisons with other studies difficult and the resemblance to daily blood pressures at work too remote.

The incidence of new cases of hypertension developing among men judged normotensive at intake into the ATC HCS is displayed in Table 115. In view of the very high prevalence rate of hypertension judged to be present when the Framingham criteria were applied, only 150 of the 415 men for whom complete diagnostic data at intake was available were considered normotensive and at risk for new disease. Of these, 14 developed definite hypertension and 83 developed borderline hypertension over the course of the next four examinations utilizing the Framingham criteria. This represented a combined incidence of 65% over a three-year risk period. This seems definitely out of keeping with clinical experience even with presumably high risk groups. It must be remembered, however, that "borderline hypertension" would be diagnosed by these criteria if either of two readings at any of the four subsequent examinations ventured above 140 or 90 respectively. But this diagnostic criterion does not seem appropriate for clinical or administrative guidance regarding what is clearly a serious problem. Still, these data do provide the basis for comparison with other groups of men who were examined repeatedly using the same methodology and decision rules.

Use of the ATC HCS criteria yielded 36 new cases of hypertension over the ensuing four examinations. When one considers that a man must have been normotensive at the intake examination and hypertensive at two successive examinations to qualify under this criterion, it becomes apparent that the actual period at risk was not three years, but rather about 2.25 years. This is true because hypertension would have to be first diagnosed at exam 4 in order to be confirmed by the time of the last examination of the study. This generates an annualized incidence rate of 5.7% per year which is still quite substantial considering the stringency of the diagnostic criteria.

Comparisons of Prevalence of Hypertension with Other Populations

Although many studies have been published with data on prevalence of hypertension among different community and industrial groups, the differences in diagnostic criteria and the age, sex and race distributions of the study population (or lack of speci-

Comparison Of Incidence Of Hypertension
ATC HCS Study Vs Men Of Comparable Age
Framingham Study

	<u>Framingham Study</u>	<u>ATC Study</u>	
Age Range in This Analysis	30-39 years	Mean age: 36 years	
Total Men Examined	N/A	415	
Hypertensive at Intake			<u>Prevalence</u>
Framingham Criteria			
"Definite"		81	19.5%
"Borderline"		184	44.3%
Normotensive at Intake	362	150	
	<u>Status after 6 years Biennial Exams</u>	<u>Status after 3 years Nine monthly exams</u>	
Normotensive	253	53	
Borderline hypertensive	100	83	
Definite Hypertensive	9	14	
<u>Annualized Incidence Rates/100</u>			
Borderline Hypertension	4.6	18.4	
Definite Hypertension	.4	3.1	
Total Hypertension	5.0	21.5	

fication thereof) make it very difficult to derive comparisons that would be even partially satisfactory. The most adequate sources for comparison remained the DHEW's Health and Nutrition Examination Survey (HANES) of 1971 to 1974 and the Framingham Heart Study. In view of the fact that we had recorded separately each of the several blood pressure readings at each examination, we were able to make rather precise comparisons of our findings using diagnostic criteria to fit the comparison study. Inasmuch as our sample consisted totally of males, 99% of whom were white, we could make comparisons with sex-race specific data from these epidemiologic studies. Comparisons of hypertension prevalence in the ATC HCS with that of white males in other populations by different diagnostic criteria are presented in Table 116. These data reveal a considerably greater prevalence of hypertension among our ATC sample whenever similar criteria are used to determine cases. This is true no matter which criteria are applied. The ATC prevalence of hypertension (both definite and borderline) was 1.5 times that of white males in the U.S. (HANES data). The prevalence of definite hypertension, the more severe segment of the total hypertensive group, by HANES criteria was 1.6 times higher among ATCs than men in the general population. Use of the Framingham version of "definite hypertension" yielded a 1.5 times excess among ATCs as compared with the population of that Massachusetts town.

The Western Collaborative Group Study (Rosenman et al., 1964) also measured blood pressure levels in 3,524 men employed in white collar, engineering and managerial positions in ten large industries in California. The WCGS population was similar in occupational prestige, but somewhat higher on the average in education as compared to the ATC study group. The WCGS men, however, were considerably older than these ATCs. Using the Framingham criteria for definite hypertension, WCGS men aged 50 - 59 years at intake (average age 53.7 years) had a hypertensive prevalence of 13.9% and men ages 40 - 49 years at intake (average age 43.2 years) had a hypertensive prevalence of 8.4%. If one then makes a linear extrapolation to the average age of 36.2 years (which was the average for our ATC group) one can estimate by graphic extrapolation what the prevalence rate of hypertension would have been in the WCGS if their younger group had averaged 36.2 years rather than 43.2 years. The rate derived by this estimation is a prevalence of 4.8%. The observed prevalence in the ATC study using comparable diagnostic criteria, was 19.5% or 4.0 times the age specific estimate derived from the very large WCGS study. Even if linear extrapolation is not an accurate procedure, it should be noted that prevalence of definite hypertension in the ATC study is still more than twice the rate of that observed for the WCGS men ages 40 - 49 years even though the latter group averages 7 years older than the ATC group. This set of comparisons suggests

TABLE 116

Comparison Of Prevalence Of Hypertension Among ATC HCS Sample
At Entry To Study, Male Residents Of Framingham And
White Males In The United States

Age	% with Definite by Framingham Criteria (Syst. \geq 160mm Hg or diast. \geq 95mm Hg)	% with Definite HT by HANES criteria (Syst. \geq 160mm Hg or diast. \geq 95mm Hg)	% with Hyper- tension by HANES criteria (Syst. \geq 140mm Hg or diast. \geq 90mm Hg)	% with Hypertension by ATC HCS criteria (Syst. \geq 140mm Hg or diast. \geq 90mm Hg)
Framingham Males (1948)	35-39	13.3% ¹		
HANES white males (1971-74)	35-44		17.3% ²	35.9% ³
ATC HCS Males	25-48 (av. 36)	19.5%	28.1%	55.4%
Relative Risk (ATC/other)		1.47	1.62	1.54

¹ Kannel, William B., M.D. and Gordon, Tavia, editors. The Framingham Study, An Epidemiological Investigation of Cardiovascular Disease, Section 29. Means at each examination and interexamination variation of specified characteristics: Framingham Study, Exam 1 to Exam 10. Tavia Gordon and Dewey Shurtliff. December, 1973, Table A-22. (DHEW Publ. No. (NIH) 74-478).

² Blood Pressure Levels of Persons 6-74 years, United States, 1971-1974, U.S. Dept. Of Health, Education, and Welfare, Public Health Service, Hyattsville, Md., September 1977, Table 40, p. 72 (DHEW Publ. No. (HRA) 78-1648).

³ DHEW Publ. No. (HRA) 78-1648, Tables 40 and 42, pp 72,74.

that the prevalence of hypertension in the ATC may be 2 to 4 times that of middle class men working in above average jobs.

Comparisons of Hypertension Incidence Data

There is very little information on incidence of hypertension in the U.S. Repeated measures of the same population at annual intervals are a prerequisite for such data. Rough estimates of the incidence of hypertension, however, have been offered by experts in the field on the basis of their reviews of published epidemiologic data (Stamler, 1968, p. 152; Julius and Schork, 1971). Incidence was estimated to be within the range of approximately 1% to 4% per year among persons approximately 30 to 60 years of age.

In order to obtain a more precise estimate of incidence of hypertension in a comparable population, the ATC HCS investigators obtained access to printouts of hypertension data from the Framingham Heart Study. We are indebted to Dr. H. Emerson Thomas, Co-principal Investigator; Mrs. Pat McNamara, Research Associate; and to Dr. Bernard E. Kreger, Examining Physician, for making these computer printouts available to us for this specific purpose. The printouts contained a listing of all normotensive entrants into the Framingham Heart Study by secret I.D. number, age, sex, hypertension status at intake and hypertension status at each of the next several biennial examinations. By re-checked hand counting we determined that there were 362 normotensive males, ages 30 - 39 years entering the Framingham Study. After 3 biennial examinations (six years of follow up) 253 remained normotensive throughout the period, 100 showed borderline hypertension on one or more occasions (but not definite hypertension), and 9 showed definite hypertension. This yielded annualized incidence rates per 100 men of 4.6 for borderline, 0.4 for definite, and 5.0 for total hypertension. These data are presented in Table 115. By comparison, applying the same Framingham criteria to our ATC men and making appropriate adjustments for the differential time at risk, the annualized incidence rates per 100 men in the ATC HCS were 18.4 for borderline hypertension, 3.1 for definite hypertension, and 21.5 for total hypertension. For all categories of hypertension, ATC men showed at least a four-fold increased risk as compared to Framingham men.

Even when the more stringent diagnostic criterion developed in our own study was used for the diagnosis of hypertension incidence, an annualized rate of 5.7 per 100 per year is generated. Despite the stringency of the criterion, this is approximately 3 times the incidence estimated for the general population by reviewers of the epidemiologic literature.

Our general conclusion, then, is that air traffic controllers have a substantially elevated risk of hypertension and this is observed both when a cross-sectional measure is taken at intake or when incidence figures are calculated in longitudinal study. We estimate that the prevalence of hypertension among ATCs is between 1.5 to 2 times that of the general population, but that incidence rates are from 3 to 4 times that of comparable men in other lines of work or in an average community. Hypertension is thus the most serious health problem among air traffic controllers, and high priority should be placed on discovering the circumstances responsible for it and types of persons most susceptible to these circumstances.

SUMMARY

Hearing Impairment

Air conduction audiograms and speech discrimination tests performed by a professional audiologist at Boston University Medical Center revealed the following:

- 1) ATC mean thresholds at 4,000 and 6,000 Hz were 7.2 dB poorer at 25-29 years of age than non-noise exposed males and the differences increased with age;
- 2) High frequency hearing loss observed in the ATCs is consistent with the audiometric pattern associated with noise exposure;
- 3) The hearing loss was associated with age, but not with years of experience as a controller;
- 4) High frequency loss was particularly marked in men over 40 years of age;
- 5) 98.6% of the ATCs passed word tests in which they were required to repeat pairs of two syllable words, one presented in each ear, in a partially overlapped manner;
- 6) No psychosocial predictor variables were found to be associated with hearing outcomes;
- 7) No association was found between hearing impairment in the "good" ear and measures of job-related stress;
- 8) Men who were hypertensive at intake were significantly more often among those found to have severe hearing losses at Round 3.

e. Hearing Impairment

Air conduction audiograms were done at Daniels Hearing Center of University Hospital, Boston, Massachusetts on 351 subjects enrolled at Round 3 of the ATC study. Bone conduction thresholds were obtained when air conduction was abnormal. Speech discrimination ability was tested at 40 dB above the pure tone average using Northwestern University Auditory Test No. 6. All testing was administered with 50 dB of speech noise in the non-test ear. The Staggered Spondaic Word Test was administered at 50 dB HTL or 40 dB above the pure tone average if thresholds were greater than 25 dB.

The air traffic controllers' mean thresholds at 4,000 and 6,000 Hz were 7.2 dB poorer at 25-29 years of age than non-noise exposed males. The difference between controllers' thresholds and the NIOSH data increases with each age group, falling 16.5 dB below the norms at age 45-49. Many of the controllers have a history of military service and employment in various aspects of aviation. Our data has not yet been analyzed to compare the hearing thresholds of controllers with other occupation or recreation-related noise exposure to those with no history of exposure prior to work experience in this field. However, our test results indicate that the air traffic controllers had significantly poorer thresholds at 4,000 and 6,000 Hz than non-noise exposed males of the same age. The configuration of controllers' composite audiograms shows the greatest loss at 6,000 Hz for all age groups with a mean recovery of 4 dB at 8,000 Hz. A high frequency hearing loss of this type is consistent with the audiometric pattern associated with noise-induced hearing loss.

The mean air conduction threshold for all 702 ears was compared with NIOSH median hearing threshold for non-noise exposed males by frequency. These data are presented in Table 117.

Hearing loss at each frequency was studied in relation to the ATCs' ages and years of experience in the FAA. These two variables are, of course, highly correlated. When years of experience in the FAA was controlled for age, it was not significantly associated with hearing loss. However, when age was studied, with experience controlled, age remained strongly associated with hearing loss. High frequency loss was particularly marked in men over 40 years of age, more so than one would have predicted by extrapolating from younger ATCs. There is reason to suspect that many of this older cohort had exposure to intense noise early in their working

TABLE 117

Mean Air Conduction Threshold Of
351 ATCs And A Group Of Non-Noise Exposed Males

<u>FREQUENCY</u>	<u>Hz</u>		<u>500</u>	<u>1000</u>	<u>2000</u>	<u>3000</u>	<u>4000</u>	<u>6000</u>
<u>Age Group</u>								
25-29	NIOSH ATC	Data*	11.0	5.4	3.8	5.6	7.4	10.8
		Mean	8.1	6.6	7.0	8.6	14.3	18.2
30-34	NIOSH ATC	Mean	11.8	6.0	4.6	7.0	9.8	13.6
			9.2	7.3	7.6	12.9	18.0	20.8
35-39	NIOSH ATC	Mean	12.6	7.0	5.6	9.0	12.4	16.6
			8.4	7.2	7.9	13.1	21.8	24.2
40-44	NIOSH ATC	Mean	13.6	7.6	6.6	11.2	15.6	20.4
			10.6	10.2	12.2	20.5	29.6	33.0
45-49	NIOSH ATC	Mean	14.4	8.4	8.0	13.8	19.4	24.4
			13.3	14.0	14.0	23.3	35.8	41.0

*
NIOSH Median Hearing Levels for non-noise exposed males published in Criteria
for a Recommended Standard...Occupational Exposure to Noise, U.S. Dept. HEW, 1972.

lives (perhaps before entering the FAA) to a degree not experienced by the younger men.

An audiologic test of particular interest is the Staggered Spondaic Word Test. This test involves verbal repetition of 2 two-syllable words, one presented to each ear in an overlapping manner. This task is particularly relevant to the competing noise and messages encountered daily in rapid sequence by ATCs. It is encouraging to note that 98.6% of our ATC participants passed this test.

The audiometric results for the worse of the two ears for each man were considered to be an index of the full extent of the pathology of hearing loss and was utilized as a health outcome measure. None of the psychosocial predictors from Rounds 1 and 2 were associated with this outcome.

The result for the better ear for each man was considered a predictor. It was hypothesized that a man who had severe hearing loss in his "good ear" would encounter more job-related stress because of this limitation. Statistical analyses of the psychosocial stress measure did not reveal significant associations.

One finding of interest was the relation of hypertension to hearing loss. This may have been influenced in part by age. Men who were hypertensive at intake into the study were significantly more often among the men found to have more severe hearing losses at the Round 3 audiologic exam. This association held both for the better and worse ear for the men. One possible implication of the finding is that if it is administratively unwieldy to provide full audiologic examinations to all ATCs, these should at least be provided for men with higher blood pressures.

The audiology examinations were performed by Nancy J. Miller, M.A., CCC. in Audiology, Director of the Daniels Hearing Center.

SUMMARY

Frequent Complaints: Sleep Problems and Headaches

Headaches were the most common health complaints of the ATCs, and sleep problems were second most common. Thirty-five percent of the men reported that they had sleep problems four or more times a month. When all sleep problems were considered, the two most frequent explanations offered were: "Too many ideas spinning through my mind" (given by 70%) and "changes in sleeping schedule such as changes in work shifts" (given by 69%).

Responses to an inquiry as to their best and their worst time of day indicated that the ATCs varied greatly in the time of day when they considered themselves to function best.

In response to a questionnaire, 48% of the men reported headaches during one month lasting more than 1 hour, and 33% of these had headaches so severe as to stop their normal activity. However, only 6% had the more severe headaches on three or more days per month. Although headaches were a common problem among the ATCs, they were, for the most part, not disabling.

f. Frequent Complaints: Sleep Problems and Headaches

Sleep Problems

Trouble getting to sleep, or staying asleep until the desired time for awakening, was the second most common health complaint reported monthly by participants in the study, exceeded only by the frequency of prolonged headaches. Sleep problems were reported as occasional difficulties by 15% of the men each month and as a continuing problem occurring more than half the time by another 10% of the participants. No systematic seasonal changes in the prevalence of sleep problems were noted over a two-year period. The substantial prevalence of sleep problems and their implications for health and effective functioning as an air traffic controller led us to a more detailed study of this problem in February, 1977.

The Sleep Questionnaire

A one-page questionnaire regarding sleep problems and their presumed causes was added to the monthly mailings sent to 315 ATCs active in the study at that date. Two hundred sixty questionnaires were returned with sufficiently complete data for analysis. This represented an 83% completion rate.

Respondents were asked to indicate how often during the past month they experienced each of four kinds of sleep problems:

- a. trouble falling asleep,
- b. trouble staying asleep (awaking far too soon and not being able to get back to sleep),
- c. waking up several times per night,
- d. waking up after their usual amount of sleep feeling tired and worn out.

Findings

The response distributions to each of these four questions were remarkably similar. About one-third of the men reported that they had not encountered the problem at all. Another third indicated they had had sleep problems only from one to three times during the month; about one-fourth reported that they had these troubles on four to fourteen occasions; and about 10% reported that they had them fifteen or more days during the month. These data are displayed in Table 118.

TABLE 118

Frequency Of Reported Sleep Problems
Among 260 Air Traffic Controllers

<u>Type of Problem</u>	<u>How often occurring this month?</u>				<u>Total</u>
	<u>Not at all</u>	<u>1-3 days</u>	<u>4-14 days</u>	<u>15+ days</u>	
trouble falling asleep	32.4%	31.3	26.2	10.2	100%
trouble staying asleep including "early waking"	37.0	26.3	26.7	10.0	100%
wake up several times per night	34.1	31.4	22.4	12.2	100%
wake up feeling tired and burn out	27.8	32.1	31.4	8.8	100%

Concurrence of Different Sleep Problems

Analysis was undertaken to see whether the four different types of sleep problems occurred independently of each other or in combination in the same individuals. The number of nights a participant was troubled by each problem in the reported month was stratified into four levels: not at all, 1-3 days, 4-14 days, and 15 or more days. Cross-tabulations of the frequencies of sleep problems by each other revealed a strong degree of association. The chi squares generated amongst the six possible pairs of these four variables ranged from 38 to 200 (with nine degrees of freedom)--all highly significant. The gamma statistic, a measure of association, ranged from +.38 to +.77. These data are presented in Table 119.

The association is illustrated, for example, by the 79 ATCs who had trouble falling asleep only 1-3 days in the past month, and of whom only two (2.5%) reported trouble staying asleep throughout the night on 15 or more occasions. In contrast, of the 27 men who had trouble falling asleep on 15 or more nights of the month, 13 (50%) also had trouble staying asleep during the same number of nights. As one might suspect, the strongest association was between waking far too early and waking up several times during the night. The lowest associations--though still highly significant--were between waking up after the usual amount of time feeling tired and worn out and the three other forms of insomnia.

ATC Explanations of Their Sleep Problems

Considering all sleep difficulties collectively, the most frequent cause stated by respondents to the questionnaire was: "too many ideas spinning through my mind." Seventy percent of men offered this explanation. "Changes in sleeping schedule such as changes in work shifts," was offered as an explanation by 69%. Fifty-five percent thought worries or problems contributed to sleep difficulties, and the remaining suggested causes were all endorsed much less frequently.

It would seem reasonable to expect that different manifestations of sleep problems would be associated with different beliefs as to their causes. Similarly, it seemed quite likely that presumption of cause might differ systematically between people who rarely had a sleep problem and those who had one very often. To answer these questions, cross-tabulations were made between the monthly frequency of the problem and the reported causes, separately for each type of sleep problem.

Respondents who had trouble falling asleep four or more days

TABLE 119

Intercorrelations of Four Types of Sleep Problems
in a Specified Month for 256 Air Traffic Controllers*

	(2)	(3)	(4)
1) Trouble Falling Asleep	.69	.50	.44
χ^2	146.5	73.5	57.2
2) Trouble Staying Asleep (including waking too early)		.77	.43
		200.7	50.3
3) Wake up Several Times per Night			.38
			38.0
4) Wake up After Usual Amount Feeling Tired and Worn Out.			

* Of 260 men, only the 256 who gave some answer (ranging from "not at all" "22-31 days") to each of the four questions involving sleep problems are included in this analysis.

during the month were more likely than men with lesser frequencies of this problem to attribute it to changes in schedule or worries or problems. Men who reported trouble falling asleep 4-14 days in the past month more often attributed the problem to "things eaten or drunk" before retiring than did men who had this problem only rarely or those who had it 15 or more days per month. Persons who reported waking up feeling particularly tired and worn out four or more days in the previous month more often attributed their excess fatigue to worries or problems than did persons who experienced this problem only rarely. It should be noted that persons were permitted to endorse as many possible causes for their sleep problems as they felt might apply and that only a minority of those having such problems reported that they had no ideas as to the causes. Nevertheless, there was an association between high frequencies of problems and perplexity as to their cause. Respondents who reported trouble staying asleep, waking up several times per night, or waking up feeling tired or worn out on 15 or more days in the past month more often had no ideas about the cause of these problems than did persons who reported these problems less frequently (Tables 120 - 123).

The hypothesis that different types of sleep problems would be associated with different explanations of cause was not supported. For these analyses, we considered only those respondents who reported a given problem four or more times per month. For all four sleep problems, the most common causes cited were: changes in schedule, too many ideas spinning through one's mind, and worries or problems. Change in schedule was the most frequently cited reason for trouble falling asleep, trouble staying asleep, and waking up after rest feeling worn out. Ninety-one percent of persons who woke up feeling fatigued 15 or more days in the reported month believed changes in schedule to be the primary reason for their problem. "Too many ideas spinning through my mind" was most frequently cited by those who woke up frequently during the night. "Worries or problems" was, for most groups and most types of sleep difficulty, the third most frequently cited cause.

Best and Worst Time of Day for ATCs

At the same time that sleep problems were inquired about, participants were asked to indicate which time of day was best for them and which time of day they found most difficult. The task was introduced as follows:

"Some people feel far better--more alert, competent, and happy--at one time of day,

TABLE 120

Reported Causes Of Sleep Problem
By Type And Frequency Of Problem

"Trouble Falling Asleep"

	Monthly Frequency of Problem			signif- icance*
	N=78 1-3 days	N=65 4-14 days	N=25 15+ days	
Things eaten or drunk	15/76 .20	27/63 .43	6/22 .27	.01
Repeated use of the bathroom	13/76 .17	12/61 .20	3/22 .14	---
Too many ideas spinning through head	58/78 .74	55/65 .85	21/26 .81	---
Worries or problems	36/75 .48	44/62 .71	21/25 .84	.002
Changes in schedule	59/79 .75	57/66 .86	21/25 .84	.004
Not allowing enough time	25/76 .33	28/61 .46	8/22 .36	---
Ideas about cause	5/61 .07	8/33 .13	7/20 .32	.01

*Indicates probability by chi square that the group with different frequencies of sleep problem differ in rates of endorsing this "cause."

TABLE 121
Reported Causes Of Sleep Problem
By Type And Frequency Of Problem
"Trouble Staying Asleep"

	Monthly Frequency of Problem			signif- icance*
	N=62 1-3 days	N=60 4-11 days	N=25 15+ days	
Things eaten or drunk	19/62 .31	25/60 .42	5/25 .20	---
Repeated use of the bathroom	18/62 .29	9/58 .16	3/25 .60	---
Too many ideas spinning through head	52/66 .79	54/64 .69	18/25 .72	---
Worries or problems	36/62 .58	44/62 .71	17/24 .71	---
Changes in schedule	46/66 .70	52/64 .81	19/25 .76	---
Not allowing enough time	24/62 .39	25/60 .42	7/23 .30	---
No idea about causes	5/44 .11	7/37 .19	8/20 .40	.03

*
 Indicates probability by chi square that the group with different frequencies of sleep problem differ in rates of endorsing this "cause."

TABLE 122

Reported Causes Of Sleep ProblemBy Type And Frequency Of Problem"Wake Up Several Times Per Night"

	Monthly Frequency of Problem			signif- icance*
	N=75 1-3 days	N=53 4-14 days	N=29 15+ days	
Things eaten or drunk	29/75 .39	18/53 .34	8/29 .28	---
Repeated use of the bathroom	14/72 .19	15/54 .28	8/30 .27	---
Too many ideas spinning through head	61/79 .77	46/56 .82	23/30 .77	---
Worries or problems	48/76 .63	35/54 .65	18/28 .64	---
Change in schedule	56/80 .70	41/55 .75	20/30 .67	---
Not allowing enough time	28/74 .38	26/54 .48	7/26 .27	---
No idea about cause	3/53 .06	8/37 .22	10/21 .48	.000

* Indicates probability by chi square that the groups with different frequencies of sleep problem differ in rates of endorsing this "cause."

TABLE 123

Reported Causes Of Sleep ProblemBy Type And Frequency Of Problem"Wake up After Usual Amount Feeling Tired"

	Monthly Frequency of Problem			signif- icance*
	N=77 1-3 days	N=74 4-14 days	N=19 15+ days	
Things eaten or drunk	25/77 .32	25/74 .34	4/19 .21	---
Repeated use of the bathroom	17/75 .23	16/74 .22	7/19 .37	---
too many ideas spinning through head	54/78 .69	60/78 .77	18/22 .82	---
Worries or problems	36/74 .49	55/74 .74	15/22 .68	.005
Change in schedule	55/79 .70	58/77 .75	20/22 .91	---
Not allowing enough time	32/76 .42	29/73 .40	13/20 .65	---
No idea about causes	3/51 .06	10/52 .19	4/15 .27	.05

* Indicates probability by chi square that the group with different frequencies of sleep problem differ in rates of endorsing this "cause."

but noticeably below that level at other times. You hear someone saying; 'I'm a morning person' and another: 'I'm a night owl.'

For each description, please check the one set of hours which best fits."

The following choices of hours were provided to be checked as the best time of day or the most difficult time of day: 7 a.m.-12 noon, 12 noon-5 p.m., 5 p.m.-10 p.m., 10 p.m.-7 a.m., and "all times are the same."

There was a surprising spread of nominations for the best time of day and the most difficult time of day. Morning hours were most commonly picked in both of these categories (see Table 124). Thirty-six percent of the men felt morning was best for them, about one quarter of respondents picked afternoon, and another quarter picked evening hours, while only 5% perceived the midnight hours as their best time.

With respect to the most difficult time of day, nearly 30% picked morning, 25% picked the midnight hours, about 19% picked afternoon and the same percent picked evening. About 10% of the men said that all times of day were about the same for them. Editing of these data suggested that the questionnaires were answered thoughtfully and meaningfully. None of the 244 respondents to this series of questions checked the same time of day as being both best and worst. Cross-tabulations of answers to these two questions revealed that men for whom the morning hours were best tended more often than the total respondent sample to pick afternoons and evenings as their worst time of day. People for whom evenings (5 p.m.-10 p.m.) and midnight hours (10 p.m.-7 a.m.) were best times of day tended rather strikingly to say that morning was the most difficult and clumsy time for them.

Conclusions

These findings suggest that not all people are equally comfortable or equally capable of working the several shifts which ATC work requires. It would be worth investigating the benefits to be gained from assigning persons wherever possible to work at the times of day when they are more energetic, alert, and capable and not assigning them to the times when they feel tired, irritable, or inept. This suggestion is further supported by the analysis of the sleep problems data earlier in this section. Here it was found that changes in sleeping schedule, such as caused by changes in work shifts, were among the most common reasons given for frequent problems in falling

TABLE 124

Preferred And Most Difficult Time Of Day
For 244 Air Traffic Controllers In February, 1977

	All the same	7am-12pm	12pm-5pm	5pm-10pm	10pm-7am
Best time of day	8.6%	36.5	27.5	27.5	4.9
Worst time of day	9.4%	28.7	18.9	18.9	24.2

If the Best Time was:

7am-12pm

12pm-5pm

5pm-10pm

10pm-7am

The most frequently selected Worst Time was:

12pm-5pm and 5pm-10pm

10pm-7am

7am-12pm

7am-12pm

asleep, staying asleep, and waking up refreshed. It would be important to determine what relationship, if any, these verbal reports may have to differences in the quality of work and the percent time actually spent on the boards during morning, afternoon, and night shifts by men who are working preferred vs. disliked time schedules.

The presence of sleep problems was cross-tabulated by most preferred and least preferred time of day. No significant relationships were found. A few trends were noted which further supported the internal consistency of the data but did not provide a basis for further programmatic suggestions.

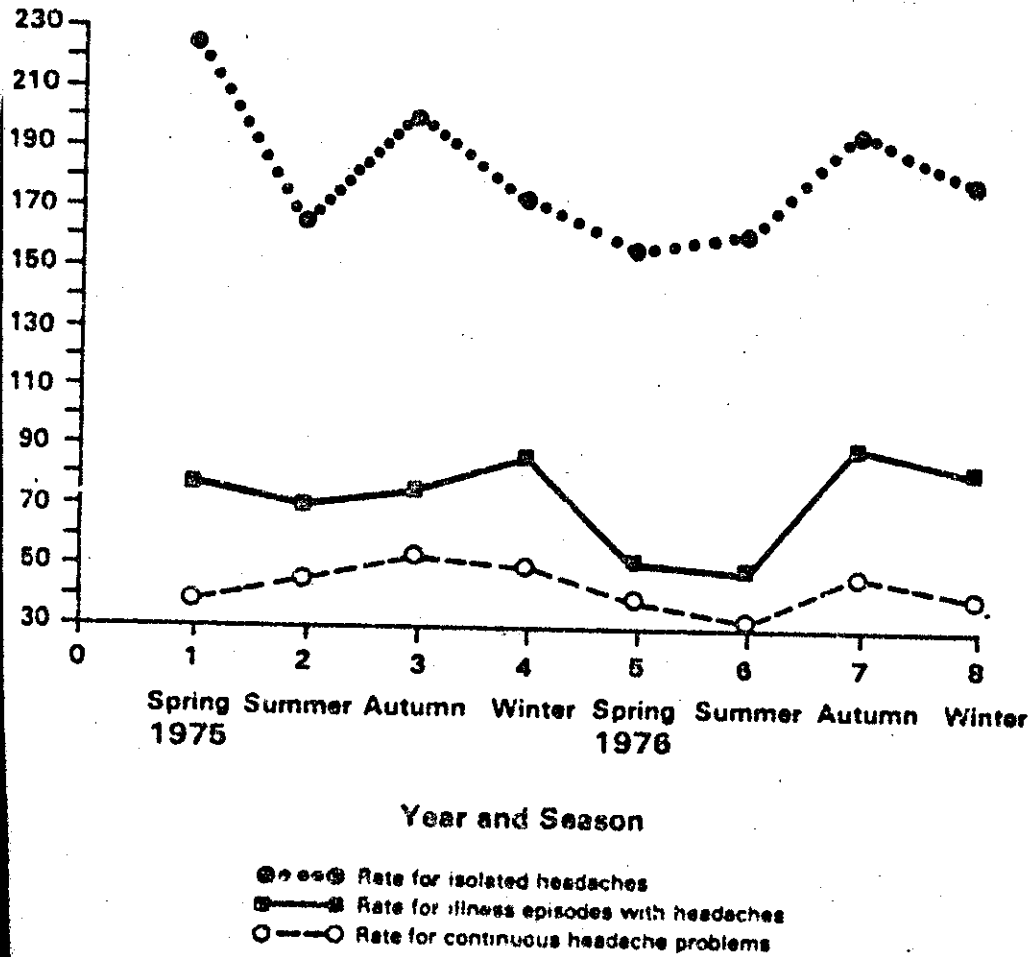
Headaches

Headaches were the physical health problem most commonly reported on the Monthly Health Reviews returned throughout the study by our ATC participants. In the average month, about 18% of the men reported headaches that lasted more than one hour and were not part of illness episodes. In addition, 4% of the men reported such headaches for at least half the days of the month. There was no regular cycling of headache prevalence by the seasons although there was a tendency for fewer reports of headaches in summers than in autumns. The seasonal prevalence of headaches for 1975 and 1976 is shown in Figure X. These data suggested that headache was quite a problem among the ATCs, but comparison with other occupational groups was impossible because none have been as thoroughly or repeatedly monitored for this symptom as the participants in the ATC HCS.

Because of the high prevalence of headaches, it was deemed advisable to obtain a more detailed picture of the frequency, severity, duration and other physical properties of this common problem. A headache questionnaire was developed after a review of the clinical and epidemiological studies of headaches which have been published in the medical literature. This questionnaire was pilot-tested, revised and then circulated to the entire study group in February, 1977, accompanying the mailing of the Monthly Health Review. The data which follow were derived from the 264 completed questionnaires that were returned. They represent a detailed picture of the frequency, severity and physical properties of headaches experienced during February, 1977.

One or more headaches were reported during the study month by 69% of the 264 respondents. However, only 48% of the men had headaches lasting for more than one hour and only 33% reported headaches so severe that "they made you stop what you were doing." Forty percent of the men reported headaches on three to ten days of the month and 4% reported such symptoms more than 10 days of the month. Prolonged or severe headaches were much less frequent

FIGURE X
**SEASONAL PREVALENCE OF
 HEADACHE (LASTING MORE THAN 1 HOUR)**



with only 23% of the men reporting headaches extending more than one hour on three or more days of the month, and only 6% reporting severity sufficient to force a cessation of activities on three or more days per month.

We were interested in determining which among these headaches could be considered migraine, muscle tension, or other types. Considerable work on computer diagnosis of headache type from self-reported symptoms has been performed at a number of medical centers. We were particularly guided by the work of Stead and colleagues (Stead, et al., 1972), and aided by the epidemiologic studies of A.M. Ostfeld (1962) and by another study of computer diagnosis which used criteria similar to those derived by Ostfeld (Freemon, 1968). The diagnostic criteria for various types of headaches used by Stead and his group were based on criteria suggested by the Public Health Service Committee on Classification of Headache. Using these criteria and the scoring cut-offs presented in the paper by Stead, et al., it was determined that 27 of the 264 respondents (10%) were susceptible to migraine headaches, 10 men (4%) were subject to classical muscle tension headaches, 15 men (6%) were susceptible to cluster headaches.

The symptom series and computer logic of the Freemon System for Diagnosing Headaches could not be duplicated exactly. Nevertheless, there was fairly close agreement between the Freemon and the Stead systems with 24 of the 27 migraine cases diagnosed by the Stead system also so classified according to Freemon. Many of the headaches reported by ATCs were not classifiable into strictly defined diagnostic groups. This is probably also the case for headaches presented for diagnosis at Neurology Clinics. The following description of the characteristics of headaches and their circumstances of occurrence is based on all respondents who either had headaches lasting for more than one hour or had such severe ones that they forced cessation of activity. About 112 men gave detailed descriptions of such headache experiences during the month studied.

Just before the headache:

1. 30% of men with at least occasional prolonged or severe headaches reported that the muscles of their head or neck felt tight.
2. 26% said their eyes became sensitive to light, but 27% said that usually they had no prodromal symptoms at all.

Starting location:

1. For 42% with headaches, starting location was around or behind the eyes.

2. For 30%, the headaches usually started at the back of the head or neck.
3. For only 16% was the headache initiated unilaterally.

Usual time of occurrence

1. For over 30% of the men, periods of intense concentration, or periods of worry or emotional tension surrounded the headaches.

Type of pain:

1. Half of the men reported that they usually had a dull steady ache or pain.
2. Thirty percent reported a steady pressure and 27% reported throbbing or pounding.
3. Thirty-one percent reported that bright lights made the headache worse.

Duration of headaches:

1. Since headaches lasting less than one hour were not reported unless severe, the distribution of remaining headaches by duration was truncated. Nevertheless, it was interesting that seven of the men reported that their headaches usually lasted more than eight hours and 20 additional men reported that they occasionally lasted that long. Thus 10% of the total men reporting (with or without headaches) had headaches of eight hours or greater duration, at least occasionally.

Severity

1. As expected, most headaches most of the time did not interfere with ongoing activities. However, 3 men reported that they usually had pain of sufficient severity to force them to stop whatever they were doing, and 37 men reported that they occasionally had such pain. This represented 3% and 14%, respectively, of the total group of respondents.

Relief of Headaches

1. Of the 112 men reporting either prolonged or severe headaches, 58% got adequate relief from aspirin. Twenty-four percent needed stronger non-prescription pain relievers,

while 44% got relief without drugs, through relaxation, massaging the head or neck or other procedures.

It was not possible for us to compare the prevalence and severity of headaches among ATCs with the experience of other groups because published data are derived from patients who presented themselves at general medical or headaches clinics. Although headaches seemed to be quite common among the ATCs, they were, for the most part, of short duration and not disabling. It would be useful to do a more extensive analysis of the 23% of men with prolonged headaches and the 6% of men with very severe headaches, to determine psychosocial and physical characteristics associated with these problems. This type of analysis was not possible in the time available for the present study.

D. Psychological Health Outcomes

While it was as important to assess psychological health outcomes as it was to evaluate physical health outcomes, the methodology for determining psychological health change was neither as standardized as that for diagnosing physical health change, nor was the severity of psychological problems as consistently definable. Nonetheless, we sought a methodology that would provide both objective assessments by psychology professionals and subjective reports by the ATCs themselves of various aspects of psychological functioning both at entry into the study and throughout the 3-year surveillance period. We were interested in determining the prevalence and incidence of psychological problems to gain some understanding of the general level of psychological functioning of men involved in this unique occupation, and we were equally interested in ascertaining whether or not it was possible to identify those who would later develop psychological problems by any predictive measures. We weighed carefully the numerous options available for assessing psychological health - such as clinical interviews, clinical psychological testing, self-report personality inventories, structured interviews, symptom inventories and behavioral indices - and eventually selected an approach that would yield both objective assessments in depth at less frequent intervals and self-reports on symptom check-lists at more frequent intervals. The objective assessments were accomplished by use of the Psychiatric Status Schedule, a standardized structured interview, and the self-reports were transmitted via the Zung Anxiety and Depression Scales accompanying the Monthly Health Review. These instruments and their use are described in the first section below. A description of the criteria for indexing psychological health changes by levels of severity follows in the second section; and the findings of prevalence and incidence of psychological problems are presented next. The findings and discussion concerning early identification of persons prone to psychological problems are presented in Section V, Predictive Findings.

SUMMARY

Methods of Measurement of Psychological
Health Outcomes

Psychological health outcomes were assessed in two ways. First, the major psychological health outcomes were evaluated by trained psychologists using the Psychiatric Status Schedule (PSS), a structured clinical interview procedure. The PSS was selected because it had been devised to yield highly reliable assessments of psychopathology and because considerable data from other populations were available for comparative purposes.

Five criterion areas of psychological status were evaluated: subjective distress, impulse control disturbances, work role disturbances, mate role disturbances and alcohol abuse.

Symptomatic cut-off scores were established for each of the five criterion areas of psychological health according to statistical and clinical standards for significance. The cut-off scores for identifying systematic levels of disturbance were set from 1 to 3 standard deviations above the means observed for a normal urban community sample. The cut-off levels were substantially below the means observed for pre-treatment psychiatric outpatients for the subjective distress scale, were approximately equal to pre-treatment outpatients for impulse control and work role scales, and were higher than pre-treatment outpatients for the alcohol abuse and mate role disturbance scales.

The second set of psychological health outcomes were evaluated on a monthly basis using the Zung Self-Rating Depression Scale (SDS) and the Zung Self-Rating Anxiety Scale (SAS). These self-report instruments assessed clinically significant depression and anxiety respectively and had been found reliable and valid for this purpose in several studies.

Over 90% of the men in the study completed the SDS and SAS for each month they were sent a form.

1. Methods of Measurement

Psychological health was monitored along with physical health at the examination visits to Boston University Medical Center, made at approximate 9-month intervals. At these visits the Psychiatric Status Schedule (PSS), a structured psychiatric interview procedure, was used by doctoral-level psychologists to evaluate the ATCs.

The PSS was selected because it allowed assessment of psychopathology in depth, because comprehensive data were available on normative psychiatric populations and because of the instrument's accepted reliability and validity (Spitzer, Endicott and Fleiss, 1967; Spitzer, Endicott, Fleiss and Cohen, 1970; Strupp, 1972; Luborsky, 1972; Weissman, 1975).

In addition to the pre-existing data on other populations and the recommendations of other researchers, the use of the PSS meant that we were assessing psychological health not only systematically, but also through the eyes and experience of a clinician.

The psychologist administering the Psychiatric Status Schedule used the standard press board booklet, 32 pages in length, with a precoded answer sheet for recording the presence or absence of 321 symptoms. The Schedule presented primary questions to elicit information about symptoms, and also provided follow up questions in the event that the first answers were insufficient to judge the presence or absence of a symptom.

Questions were grouped to cover symptoms in the areas of somatic complaints, moods, fears, interpersonal relations, identity, cognitive processing, suicidal tendencies, drug use, alcohol use, delusions, hallucinations, behavior in the interview situation, and role functioning as a wage earner, housekeeper, student, mate, parent, and patient, as applicable for a given subject. A computerized program then scored the symptoms using item weights of 0, 1, 2 or 3, and converted the raw scores into T-scores (mean = 50, S.D. = 10) based on the results from the standardization study of 770 psychiatric patients.

A total of 50 T-scores were possible. Four scores, called macro-scales because they subsumed 16 symptom scale scores, assessed subjective distress, behavioral disturbances, impulse control disturbances, and reality testing disturbances. An alcohol abuse symptom scale was scored independently. Of seven role scales assessing impairment due to psychiatric disturbances in wage earner, housekeeper, student, mate, parent and patient (denial of illness) roles, and in addition, an overall average of the six scale scores, we used only the wage earner and mate role scales.

We focused primarily on the four macro-scales, the independent symptom scale of alcohol abuse and the three role scales named. The other symptom scales were not utilized because they were subsumed by the macro-scales. The housekeeper role, parent role, and the student role scales were not used because they were not applicable to all subjects. Our findings then led us to concentrate on only five outcomes: subjective distress, impulse control disturbances, work role disturbances, mate role disturbances and alcohol abuse.

Training and Reliability of Interviewers

Three doctoral-level psychologists and one master's-level psychologist were trained to use the PSS. All had previous clinical experience in the assessment of psychopathology in both normal and psychiatrically ill populations. Initial training consisted of familiarization with the instrument and the use of the training manual and tapes available from Spitzer, Endicott, and Cohen (Spitzer, Endicott, and Cohen, 1968; Spitzer, Endicott, and Cohen, 1968b). After reaching the criterion level suggested in the training manual (less than 2 false positives and less than 4 false negatives out of 321 possible answers for each of the standard tapes and four special tapes that we produced), a minimum of 20 subjects were interviewed by pairs of psychologists. In interviews, the interviewers alternated the active interview task, with the inactive member of the pair observing and independently filling out the PSS answer sheet. This procedure was undertaken to standardize the interviewers' interpretation of responses and scoring among themselves.

A computer program for scoring the entire PSS protocol was obtained from Dr. Endicott. Twenty-five test cases were provided to check the accuracy of the transplanted program. Scoring by the computer program was initiated after its absolute accuracy was established.

Pearson product moment correlations were calculated for the scale scores produced by the interviewer pairs for each subject. With the exception of three scales, the interviewers demonstrated a high degree of consistency with reliability coefficients ranging from .83 to 1.00. The behavior disturbance, speech disorganization, and social isolation scales had lower reliability.

The low interviewer reliability for those three particular scales primarily was due to variance and a difference in scoring in only one item in each case. Despite the high inter-rater correlations for the other scales, it was possible that there could have been significant mean differences between the pairs of interviewers. A series of t-tests were performed and the results

indicated no significant differences between the interviewers in any pair. The scale means and standard deviations indicated that the high rater reliability primarily was due to a complete agreement on the lack of pathology for most subjects at any given examination. For scales with variability, inter-rater reliability was at least equivalent to that reported by Spitzer et al. (Spitzer, Endicott, Fleiss and Cohen, 1970).

We also examined whether or not the scale scores were affected by the role (observing or interviewing) of the interviewer. No significant difference was found between the scores generated in the observer role and in the interviewer role.

The above procedures were carried out each time a new psychologist was hired for the study. A new interviewer's scores were not accepted as data of record until the inter-rater reliability was above .8 with the current interviewer and until there was no mean difference in the scores obtained by the two individuals. Since we also required the interviewer to surpass the criterion level for training suggested in the manual for the PSS, we were confident that our interview results were highly reliable.

Internal Consistency of PSS Criterion Scales

Spitzer et al. reported the internal consistency of the PSS scales in their standardization study of 770 newly-admitted psychiatric inpatients (Spitzer, Endicott, Fleiss, and Cohen, 1970). Table 125 presents the internal consistency figures derived from the intake interviews with the air traffic controllers, and for comparison, those of the inpatient standardization sample. The table shows that high internal consistency reliability was obtained for less severe and more prevalent areas of psychiatric dysfunction (subjective distress, alcohol abuse, and mate role). The low internal consistency for behavioral disturbances, impulse control disturbances, reality testing disturbances, and several of the role scales seemed reasonable and appropriate since one would not expect such symptoms to be common or consistent in a highly selected non-patient group such as the air traffic controllers. In the standardization sample the internal consistency was much higher, as would be expected with a sample of patients whose symptoms were clustered more at the extremes.

Overall Psychiatric Status Profile at Intake

Table 126 presents the means and standard deviations of scores on the PSS for our sample of air traffic controllers, a large group of psychiatric inpatients, and a group of 130 urban community residents. The absolute zero point for each scale, indicative of no pathology, also is presented in the

Internal Consistency Of PSS Scales For Air Traffic Controllers¹
At Intake Compared To Standardization Group Of Patients

<u>Macro-Scales</u>	<u>Number of Items</u>	<u>Air Traffic Controllers</u>	<u>Patient Standardization Sample²</u>
Subjective distress	80	.82	.89
Behavioral disturbances	72	.47	.80
Impulse control disturbances	33	.52	.86
Reality testing disturbances	24	.38	.86
<u>Role Scales</u>			
Wage-earner	13	.28	.68
Mate	10	.72	.76
Parent	12	.19	.65

¹
N = 416

²
Kuder-Richardson Formula 20 internal consistency, $r = \frac{k}{k-1} (1 - \frac{\sum p q}{S_y^2})$

TABLE 126

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Means and Standard Deviations Of Scores On Psychiatric
Status Schedule For Air Traffic Controllers At
Intake, A Community Sample, And A Psychiatric
Inpatient Sample

	Air Traffic Controllers N=416 Mean (s.d.)	Community Sample N=130 Mean (s.d.)	Inpatient Sample ¹ N=603 Mean (s.d.)	Score for no pathology (zero point)
<u>Macro-scales</u>				
Subjective distress	34.1 (3.8)	33.8(4.6)	49.7(10.3)	31
Behavioral disturbance	42.8 (2.9)	42.1(2.6)	50.7(10.4)	41
Impulse control	46.7 (3.0)	45.6(1.3)	50.7(11.0)	45
Reality testing disturbance	44.2 (.8)	44.5(1.4)	50.9(10.9)	44
<u>Role Scales</u>				
Wage earner (416, 93, 142) ²	41.2 (2.9)	40.7(2.0)	51.4(11.5)	40
Mate (384,82,144) ²	43.1 (6.3)	42.4(5.5)	50.8(10.0)	39
Parent (356,58,116) ²	44.0 (2.8)	45.4(4.0)	51.4(12.1)	43
<u>Symptom Scales</u>				
Alcohol abuse	47.2 (3.1)	46.4(2.1)	50.7(10.5)	46

¹ Spitzer, Endicott, Fleiss and Cohen (1970).

² Number of subjects for all male, non-patient sample; community sample; and inpatient samples respectively.

last column.

The table indicates that the psychiatric profile of air traffic controllers and of the urban community sample were relatively similar to one another and quite different from the inpatient sample. However, the air traffic controllers scored statistically higher than the urban community sample on the impulse control disturbance ($t = 5.9, p .001$), and wage-earner role ($t = 3.4, p .001$). On the other hand, the controllers scored significantly lower than the urban community sample on the parent role scale ($t = 2.6, p .01$). The air traffic controllers and the community sample were significantly lower than the inpatients on all scales, as one might expect.

Some of the differences between the urban community sample and our sample were statistically significant, but of unknown practical or clinical significance, whereas the large absolute differences between these two groups and the inpatients were both statistically and clinically meaningful. Furthermore, some of the difference between air traffic controllers and the urban community sample may have been due to the difference in sex composition of the groups. Our sample was all male, while the community sample was 58% female. Each of the scales on which there was a significant difference between these two groups may have reflected personality and symptom reporting differences between males and females.

Classification of Significant Psychiatric Symptomatology

The Psychiatric Status Schedule provided scale scores for the various areas of psychiatric symptomatology. However, for the purpose of this study we needed to establish the levels at which we would consider an individual to have significant psychiatric symptomatology in each area. These cut-off scores were established to have statistical as well as clinical meaning.

To achieve both statistical and clinical meaning, we compared the air traffic controllers with five other groups reported in the literature. Table 127 displays comparative statistics for inpatients, former inpatients, pre-treatment outpatients, an urban community sample, urban community leaders and the air traffic controllers at intake into the health change study.

Each set of three rows in Table 127 gives the mean, standard deviation, and number of subjects in each group who were scored when this number was different from the total number of subjects in a group. It is apparent that the three non-

TABLE 127

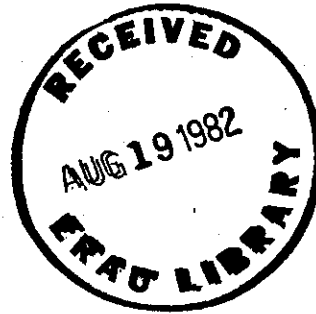
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Comparative Statistics for PSS Samples¹

Means and standard deviations of PSS scales											
	Number of Subjects	% Male	Subjective Distress	Behavioral Disturbance	Impulse Control Disturbance	Reality Testing Disturbance	Alcohol Abuse	Wage-Earner Role	Marital Role	Parent Role	Student Role
Inpatients	603	27.2	49.67 10.25	50.67 10.37	50.70 10.98	50.91 10.85	50.73 10.54	51.43 11.47 (142)	50.78 10.04 (144)	51.37 12.07 (116)	49.78 9.76 (83)
Former Inpatients	97	26.8	41.91 7.22	54.26 10.19	46.05 3.17	47.02 4.96	47.05 3.51	45.00 4.47 (6)	50.20 8.16 (25)	48.53 2.32 (17)	N/A
Pre-treatment Outpatients	91	62.6	48.82 10.36	46.00 7.99	50.23 8.00	46.53 6.05	47.42 6.00	46.77 9.14 (44)	50.14 9.15 (37)	51.41 10.76 (29)	49.09 9.14 (45)
Urban community Sample	130	42.3	35.75 4.61	42.12 2.55	45.56 1.31	44.48 1.36	46.39 2.07	40.65 1.98 (93)	42.41 5.52 (82)	45.36 4.09 (58)	39.90 2.02 (10)
Urban community Leaders	26	84.6	33.69 3.65	42.38 4.51	45.85 1.43	44.15 .54	46.85 2.99	40.58 2.16 (26)	43.36 5.22 (22)	44.30 4.11 (10)	42.00 4.24 (2)
Air traffic controllers (ATCs)	416	100.0	34.11 3.77	42.84 2.88	46.69 2.98	44.22 .84	47.16 3.09	41.20 2.86 (416)	43.01 6.50 (384)	44.00 2.82 (356)	40.92 3.08 (113)
Raw Zero Score			31.00	41.00	45.00	44.00	46.00	40.00	39.00	43.00	39.00
Symptomatic Cut-off			41.00	51.00	49.00	46.00	52.00	45.00	53.00	52.00	50.00
% ATCs above Cut-off			6.0	2.6	12.7	2.6	7.5	4.1	7.6	2.2	1.8
% Urban community Above Cut-off			9.9	1.5	3.1	6.1	2.3	2.1	6.1	8.5	0.0

1. Data for all samples except air traffic controllers were supplied by Jean Endicott, Ph.D. of the Evaluation Section, Biometrics, NY State Dept. of Mental Hygiene
 NOTE: The figures in parentheses for the role scale results give the number of subjects for whom the role scale was appropriate and scored.

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patient samples were most similar to one another and most dissimilar from the three patient groups across all nine scales.

For comparison purposes the scale scores which corresponded to a complete lack of symptoms on any given scale are listed in the seventh row of Table 127. Immediately below this row is the symptomatic cut-off score designated by this study team.

The symptomatic cut-off score was established as being greater than or equal to one standard deviation above the urban community sample, or two standard deviations above the urban community leaders sample, whichever was greater. The cut-off score was rounded off to the next highest integer when it was below 50; cut-off scores above 50 were rounded down to the next full integer. This procedure was followed because the score of 50, in and of itself, was the mean of psychiatric inpatients on each scale in the original standardization study. As can be seen, the symptomatic cut-off scores established for the air traffic controllers were almost identical to and sometimes higher than the scores of former inpatients. The scores used to establish significant symptomatology also were equal to or greater than the average scores of pre-treatment outpatients. Finally, and perhaps most dramatically, with the exception of subjective distress, and perhaps wage-earner rate, the cut-off scores also were equivalent to the mean scores achieved by psychiatric inpatients. Consequently, when we report that an air traffic controller had significant symptomatology in an area, it is usually equivalent to saying that the controller was at least as symptomatic as outpatients and inpatients receiving or about to receive treatment.

Thus the symptomatic cut-off scores had both statistical and clinical meaning in that they were equivalent to the mean for inpatients and outpatients, were one full standard deviation or more above the scores of an urban community sample, and represented a level of symptomatology found in persons involved with psychiatric treatment.

Monthly Self-Reports Of Anxiety and Depression

In addition to the evaluation of psychiatric status by means of the structured clinical interview conducted at Boston University, we were interested in obtaining more frequent estimates of the psychological functioning of the subjects. After the intake evaluations at Boston University, it became clear that the most common psychological problems were anxiety and depression. Consequently, we searched the literature for self-report inventories that would be easy to administer, simple to score, and clinically

relevant.

With the valuable assistance of James Barrett, M.D., a psychiatric epidemiologist, our research led to the work and instruments of William Zung, M.D. Zung had developed a special scale for the assessment of clinically significant depression, and a scale for the assessment of clinically significant anxiety (Zung, 1965; Zung, 1971). In both instances Zung used clinical diagnostic criteria to select the self-report items in such a way that a high score on his scales would represent a higher intensity of either anxiety or depression. Both instruments were reported to be reliable and valid for the quantitative assessment of clinically significant anxiety and depression (Zung, 1965, 1967a, 1967b, 1969, 1971a, 1971b).

In addition, both the Self-rating Anxiety Scale (SAS) and the Self-rating Depression Scale (SDS) were self-report measures with established degrees of subject acceptability and were practical to use as repeated measures. They were short, only twenty items, and easy to score. Finally, and of particular relevance for our selection of these instruments, they both had received wide use in various patient groups and in normals, making available considerable validation data as well as a large number of comparison groups to aid us in the interpretation of results.

We decided to use these instruments, but we needed to decide on the optimum frequency of self-report. The length of time between interval examinations averaged nine months, and the PSS evaluation at each examination was made on the basis of the previous month's symptomatic behavior. Hence, between PSS evaluations we would have no knowledge of a man's general psychiatric status for eight of every nine months.

Although there were reasons why more frequent or less frequent self-reports might be useful, we felt that a monthly report of the two prominent syndromes of depression and anxiety symptomatology would be most useful. Therefore, after the second examination visit to Boston University, we began to include the SAS and the SDA as part of the monthly self-report package mailed to each subject at the end of each month to be filled out and returned with information relating to that particular month.

Over 90% of the men cooperated by completing the SAS and SDA each month along with their Monthly Health Review (see Section IIIC). The SAS and SDS continued to be sent each month until an ATC became ineligible for the study by virtue of promotion, transfer, or discharge from

the agency.

Table 128 displays the form of the SDS as we used it on a monthly basis. Table 129 displays the SAS as we used it. The directions were slightly different from those originally used by Zung because a nurse or other person was not available (as Zung would have it) to explain how to answer the questions. At the top of each form we noted the month for which the SAS or the SDS was to be completed. Both instruments have positively worded items and negatively worded items so that a response tendency to say "yes" or "no" would not lead to an artificially inflated or deflated score.

The first month's returns were carefully scrutinized to ascertain whether or not the air traffic controllers understood the directions. Any responses which suggested a misunderstanding of directions or unusual response tendencies were followed up by a call to the controller to determine and correct the difficulty. Examination of the next month's forms showed that all such difficulties had been resolved.

Self-Rating Depression Scale

PLEASE CHECK THE APPROPRIATE ANSWER FOR THE MONTH OF: _____

DIRECTIONS: Please read each question very carefully. Although some questions may be difficult to answer, please give your best answer by making a check in the appropriate answer column. Also, please note that the answers change meaning depending on the question. For example, "none" does not always mean no difficulty.

	NONE OR A LITTLE OF THE TIME	SOME OF THE TIME	GOOD PART OF THE TIME	MOST OR ALL OF THE TIME
1. I feel down-hearted and blue	_____	_____	_____	_____
2. Morning is when I feel the best	_____	_____	_____	_____
3. I have crying spells or feel like it	_____	_____	_____	_____
4. I have trouble sleeping at night	_____	_____	_____	_____
5. I eat as much as I use to	_____	_____	_____	_____
6. I still enjoy sex	_____	_____	_____	_____
7. I notice that I am losing weight	_____	_____	_____	_____
8. I have trouble with constipation	_____	_____	_____	_____
9. My heart beats faster than usual	_____	_____	_____	_____
10. I get tired for no reason	_____	_____	_____	_____
11. My mind is as clear as it used to be	_____	_____	_____	_____
12. I find it easy to do the things I use to do	_____	_____	_____	_____
13. I am restless and can't keep still	_____	_____	_____	_____
14. I feel hopeful about the future	_____	_____	_____	_____
15. I am more irritable than usual	_____	_____	_____	_____
16. I find it easy to make decisions	_____	_____	_____	_____
17. I feel that I am useful and needed	_____	_____	_____	_____
18. My life is pretty full	_____	_____	_____	_____
19. I feel that others would be better off if I were dead	_____	_____	_____	_____
20. I still enjoy the things I used to do	_____	_____	_____	_____

TABLE 129

Self-Rating Anxiety Scale

PLEASE CHECK THE APPROPRIATE ANSWER FOR THE MONTH OF: _____

	<u>NONE OR A LITTLE OF THE TIME</u>	<u>SOME OF THE TIME</u>	<u>GOOD PART OF THE TIME</u>	<u>MOST OR ALL OF THE TIME</u>
1. I feel more nervous and anxious than usual	_____	_____	_____	_____
2. I feel afraid for no reason at all	_____	_____	_____	_____
3. I get upset easily or feel panicky	_____	_____	_____	_____
4. I feel like I'm falling apart and going to pieces	_____	_____	_____	_____
5. I feel that everything is all right and nothing bad will happen	_____	_____	_____	_____
6. My arms and legs shake and tremble	_____	_____	_____	_____
7. I am bothered by headaches, neck and back pains	_____	_____	_____	_____
8. I feel weak and get tired easily	_____	_____	_____	_____
9. I feel calm and can sit still easily	_____	_____	_____	_____
10. I can feel my heart beating fast	_____	_____	_____	_____
11. I am bothered by dizzy spells	_____	_____	_____	_____
12. I have fainting spells or feel like it	_____	_____	_____	_____
13. I can breathe in and out easily	_____	_____	_____	_____
14. I get feelings of numbness and tingling in my fingers, toes	_____	_____	_____	_____
15. I am bothered by stomach aches or indigestion	_____	_____	_____	_____
16. I have to empty my bladder often	_____	_____	_____	_____
17. My hands are usually dry and warm	_____	_____	_____	_____
18. My face gets hot and blushed	_____	_____	_____	_____
19. I fall asleep easily and get a good night's rest	_____	_____	_____	_____
20. I have night mares	_____	_____	_____	_____

SUMMARY

Indexing Psychological Health Change By
Levels of Severity

Two tasks were accomplished to index the levels of severity for psychological health change. First, severity levels were established for each criterion symptom scale of the PSS, SDS and SAS. Second, severity levels were established for psychological health change across symptoms and over time.

Several indices of severity were investigated for the PSS criterion scales. Results indicated that a dichotomous, asymptomatic versus symptomatic, classification was most appropriate.

The final determination of psychiatric status and severity was made two ways. Susceptibility to psychiatric problems was defined by three groupings.

- 1) Incidence cases were defined as those men who on any of the five PSS criterion scales were classified symptomatic after, but not at, intake.
- 2) Prevalence cases were defined as those men who had any of the five PSS criterion scales classified symptomatic at intake.
- 3) Asymptomatic controls were defined as those men who never had a symptomatic PSS criterion score in five evaluations.

The second overall psychiatric status assessment classified men into four groups according to the extent of psychiatric problems.

- 1) Asymptomatic controls never had a symptomatic PSS criterion scale in five evaluations.
- 2) Acute cases had only a single symptomatic criterion score at only one evaluation of the five.
- 3) Intermittent cases had one or more symptomatic criteria at 2 or 3 of five evaluations.
- 4) Chronic cases had one or more symptomatic criteria at 4 or 5 of five evaluations.

Severity for the monthly evaluation of depression and anxiety also was evaluated two ways.

For a given month, the severity was classified according to the level of symptomatology reflected by a score.

- 1) Level 0 was established at a range indicative of no or insignificant symptomatology.

- 2) Level 1 reflected definite depression or anxiety at the symptom level.
- 3) Level 2 was established at a syndrome level equivalent to outpatients with a diagnosis of depression or anxiety.
- 4) Level 3 was established as the highest level, representing a severe depressive or anxiety neurosis needing clinical treatment.

Men were classified into four groups representing their characteristic psychiatric morbidity over their time in the study using annualized rates of Level 1, 2 or 3 episodes. A minimum of one interval between examinations with at least five returned questionnaires was needed to make these classifications. The four groups were:

- 1) Asymptomatic controls had an average annual rate of episodes of less than .5 per year.
- 2) Acute cases had an average annualized rate of episodes between .6 and 2.9 per year.
- 3) Intermittent cases had an average annualized rate of episodes between 3 and 8.9 per year.
- 4) Chronic cases had an average annualized rate of episodes of 9 or more per year.

2. Indexing Psychological Health Change By Severity
Elimination of Levels of Severity for Scores on Specific PSS Scales

Two issues in classifying the severity of psychological health problems had to be considered. First, we had to consider the use of severity levels for each of the symptom scales; and second, we had to consider the use of severity levels to classify overall psychiatric health or illness. The first task was to consider the use of severity levels on the individual symptom scales.

Table 130 displays the two major methods that we examined for classifying Psychiatric Status Schedule severity on a given criterion scale. The first method produced ordinal categories so that a "Level 0" on a criterion scale represented an asymptomatic assessment. Even though symptoms may have been present, they would not be sufficient to exceed the cut-off score established for significant symptomatology. As previously mentioned, these cut-off scores were established by comparison with a number of clinical groups (see Table 127). A Level 1 psychiatric symptom was established as one in which the PSS score was above the cut-off criterion but less than one standard deviation above the psychiatric inpatient group. Hence a Level 1 psychiatric health outcome was derived from significant but clinically mild symptomatology. A Level 2 psychiatric health change was established as one in which the PSS criterion score was greater than one standard deviation above the psychiatric inpatient average. Finally a Level 3 health change required a PSS criterion score of more than one standard deviation above the psychiatric inpatient average and in addition required hospitalization for the psychological condition.

This method of establishing levels of symptomatology attempted to include the absolute level of symptomatology involved in the dysfunctional status. However, we conducted a large number of analyses that compared individuals classified at the various levels on each of the PSS criterion scales and found that there was very little difference between the three symptomatic groups on measures of personality, attitudes toward work, life change, laboratory or personal history variables. This rather surprising finding suggested that the concept of level was not a useful one since there were few, if any, distinguishing characteristics between people at the three upper levels. We determined, therefore, that it was most feasible simply to classify individuals as asymptomatic or symptomatic.

Our eventual method of classification according to the Psychiatric Status Schedule criterion scales was, therefore, dichotomous. If an individual scored above the cut-off for a

TABLE 130

Methods For Classifying PSS
Severity On Criterion Scales

- Method 1 Level of symptomatology
- A. Level 0 - asymptomatic, below cut-off score for significant symptomatology
 - B. Level 1 - above cut-off score but less than one standard deviation above psychiatric inpatient average
 - C. Level 2 - more than one standard deviation above psychiatric inpatient average
 - D. Level 3 - Level 2 plus hospitalization
- Method 2: Asymptomatic vs symptomatic
- A. Level 0 - equal to or less than cut-off score
 - B. Level 1 - above cut-off score

criterion scale, he was classified as symptomatic. If an individual scored at or below the cut-off level, he was considered asymptomatic. This method had the obvious drawback that some individuals could score exceedingly close to the cut-off on one or more criterion scales without being considered symptomatic. This was a problem common to categorical measurement of any kind.

We investigated the problem of cut-off score boundaries by examining the actual symptoms that contributed to the classification of our subjects as symptomatic on a given scale. Conversely, we examined the specific symptoms for individuals scoring at or just a few points below the criterion cut-off score. We found that the combinations of symptoms that actually occurred to symptomatic individuals were clinically significant, i.e., the symptoms resulting in a classification of symptomatic for an individual were reflected by clinically diagnosable conditions.

On the other hand, those scoring just below the criterion cut-off tended to have somewhat unrelated symptoms that reflected either a pre-clinical state or a non-diagnosable series of scattered symptoms.

Throughout this report we have used only a classification of symptomatic or asymptomatic to describe or group subjects on specific Psychiatric Status Schedule criterion scales. Clinical psychiatric diagnoses were not made in this study, nor were levels of severity assigned to scores on the specific PSS scales.

Levels of Severity for Overall PSS Assessment

We needed then to consider establishing severity levels to categorize the men's overall psychiatric status. Table 131 displays a number of methods that were possible for classifying an individual's overall psychiatric status in a particular examination by levels of severity.

Methods 2, 3 and 4 were usable only if classification by levels were used on the individual scales. We investigated the predictive differences between the groups using all five methods. We found that there were very few differences between the groups distinguished by level (as in the investigation of the usefulness of levels of severity for classifying individuals on the individual scales), whereas the number of scales on which the individual was classified symptomatic seemed to be the more powerful discriminator between persons.

TABLE 131

Methods For Classifying Levels of
Overall Psychiatric Status
At A Given Examination

Method 1: Number of Symptomatic Criterion Scales

- A. None
- B. One
- C. Two
- D. Three or more of eight

Method 2: Number and Level of Symptomatic Criterion Scales

- A. None
- B. One level 1, all others normal
- C. Multiple level 1's, no level 2's or 3's
- D. At least one level 2
- E. At least one level 3

Method 3: Number and Level of Symptomatic Criterion Scales

- A. None
- B. One level 1; all others normal
- C. One level 2 or 3; all others normal

Method 4: Number and Level of Symptomatic Criterion Scales

- A. None
- B. One level 1; all others normal
- C. One level 2 or 3; all others normal
- D. Two at any level, 1-3, all others normal
- E. Three or more at any level, 1-3

Method 5: Number of Symptomatic Criterion Scales

- A. None
- B. One
- C. Two or more

We decided, therefore, to use Method 5, with three categories for the number of symptomatic criterion scales at a given examination to classify an individual's overall level of psychiatric status. These three categories were: 1) none of the criterion scales were symptomatic; 2) a single criterion scale was symptomatic; or 3) two or more scales were at symptomatic levels. Individuals with no symptomatic criterion scales were considered asymptomatic with respect to their overall psychiatric status at a given examination. Individuals with only one criterion scale at a symptomatic level were considered to have a mild psychiatric disorder, and individuals with two or more symptomatic scales were considered to have a moderate psychiatric disorder.

Severe psychiatric disorders characterized by hospitalizations, suicide attempts, or psychosis were very infrequent as one would expect. These few cases are discussed with the descriptive findings.

Psychiatric Status Schedule: Classification of Severity Over Time

Finally, we investigated a number of methods for classifying an individual's psychiatric status across examinations; that is, an individual's psychiatric status over his entire period of enrollment in the study. We finally were satisfied with four different classifications, the first two of which applied to single criterion scales, the second two of which applied to an individual's overall psychiatric status.

Table 132 displays the final methods we used for classifying psychiatric status across the examinations. With respect to individual criterion scales such as subjective distress or alcohol abuse, we determined that two major issues were of paramount importance to the purposes of this contract. First, one would want to know the variables that could predictively distinguish between people who first developed their problem during the study, and those who remained asymptomatic. Secondly, one would want to know what the significant predictors were for people with varying frequencies of occurrence for a given problem.

The problem of determining the significant predictors of the first onset of psychiatric problems was one which had not been developed particularly well in the literature in the area. Consequently, we devised a method labeled a "sliding interval" onset analysis.

The primary purpose of this design was to discover the predictors of the first onset of a psychiatric difficulty. Cases were defined as men with the first occurrence of a problem after

Methods For Classifying
Psychiatric Status Across
Examinations

Criterion Scales

1. First occurrence of a problem - sliding interval onset analysis
 - A. Cases - men with the first occurrence of a problem after intake
 1. Exclude men with problem at intake
 2. Exclude men with unremitting problems
 - B. Controls - men who never had any problem
 1. Sample in same proportion from each round as those who were cases
 - C. Predictors - selected from examination preceding onset examination, e.g., when cases were asymptomatic
2. Frequency of occurrence of a problem
 - A. Categories
 1. Never
 2. Once only
 3. Twice or more
 - B. Exclude drop-outs-true frequency unknown
 - C. Predictors - intake and background variables

Overall Status

1. Susceptibility to psychiatric problems
 - A. Incidence Cases - anyone who had any PSS symptomatic score after intake, but not at intake, including drop-outs
 - B. Prevalence cases - anyone who had any PSS symptomatic score at intake, including drop-outs
 - C. Controls - those who never had a symptomatic score, exclude drop-outs
2. Extent of psychiatric problems - exclude drop-outs
 - A. Mild - a single occurrence of a single symptomatic score
 - B. Moderate - one or more symptomatic criteria at two or three examinations
 - C. Severe - one or more symptomatic criteria at four or five examinations
 - D. Controls - those who never had a symptomatic criterion score

intake. Men with either problems at intake or unremitting problems were excluded from the case group. Both of these exclusions were necessary so that we would avoid predicting psychiatric problems from pre-existing psychiatric problems. Controls were defined as men who never had any symptomatic psychiatric criterion scale throughout the entire period of enrollment in the study. Because predictors could vary from round to round due to historical events and maturation of individuals, the predictor data on the controls was taken from specific rounds of examinations to match the cases with predictor data from specific rounds. Predictor data were selected from an examination preceding the onset examination; that is, from a time when the ATC was asymptomatic. Our design compared predictor data from cases before they became asymptomatic with predictor data from those who never developed a problem on a particular criterion scale. Therefore, for each sliding interval onset analysis, individuals were simply classified as having developed a problem or not. There was no further differentiation in the level of their difficulty.

The second method for classifying status across examinations on a given scale was to categorize individuals in terms of the frequency with which they experienced a problem. We established these categories as: (1) never having had the problem over the course of the study; (2) having had a problem on a particular criterion scale only once; and (3) having had a particular problem two or more times out of the five examinations. For these analyses, men who dropped out and did not have complete Psychiatric Status Schedule examinations were excluded from the analysis since the true frequency for which they may have had problems was not determinable. Predictors for this type of analysis were drawn from intake, personality and background data looking forward over the course of this study to determine if there were significant differences between people who experienced particular problems at different rates.

There were also two methods for classifying an individual's overall psychiatric status across all examinations. The first method was concerned with the problem of determining the characteristics of individuals who were susceptible to psychiatric problems. This method classified individuals according to three criteria. First, incidence cases were defined as those men who had any PSS symptomatic criterion score after intake, but who did not have any PSS symptomatic scores at intake. Men who later dropped out, but who had developed a problem prior to dropping out were considered as incidence cases, assuming they also did not have a problem at intake. Secondly, prevalence cases were defined as those men who had any PSS symptomatic criterion score at intake. Prevalence cases could include drop-outs, since even

drop-outs had intake evaluations. Prevalence cases remained classified as prevalence cases even if new or different problems developed after intake. Third, control cases were defined as those who never had a PSS symptomatic criterion score. For the control group, drop-outs had to be excluded since the presence or absence of symptomatic scores could not be determined after they left the study.

Since any problem was sufficient to result in either a prevalence or incidence classification, the comparison of cases and controls resulted in a study of susceptibility to psychiatric problems. Intake psychological characteristics, sociodemographic characteristics, personality, physiological responsivity to work, and other data were used to differentiate between asymptomatic controls, prevalence cases and incidence cases.

The second overall psychiatric status assessment was made according to the extent of psychiatric problems. For this classification scheme drop-outs had to be excluded since they would not have full data on which to classify their status. Four groups were defined for these analyses. Acute cases were those who had a single occurrence of a single symptomatic criterion score on the PSS. Intermittent cases were defined as those men who had one or more symptomatic criteria at two or three of the five examinations. Chronic cases were defined as those men who had one or more symptomatic criteria at four or five out of the five examinations. Controls were defined as those who never had a PSS symptomatic criterion score. Again, these groups were compared by their intake psychological tests, their sociodemographic background data, their responsivity to work, and their physical health symptoms.

Levels of Monthly Depression And Anxiety

Table 133 displays the criteria by which we established levels of monthly depression and anxiety episodes. Level 0 was established at a range indicative of no or insignificant symptomatology. Although a person could have a number of symptoms and be classified at Level 0, one would not consider him to have had a significant problem.

Levels 1, 2, 3 were established to discriminate between people with symptoms of varying intensity and medical significance. Level 1 represented definite symptoms of depression (or anxiety). Scores in this range reflected significant depression or anxiety at the symptom level, but one would not necessarily expect persons scoring at this level to obtain treatment.

Having established these levels for the scores obtained in

Levels Of Monthly Depression
and Anxiety

<u>Level</u>	<u>Standard Score Range</u>		<u>Descriptive Meaning for Depression (Anxiety)</u>
	<u>Depression</u>	<u>Anxiety</u>	
0	25-49	25-44	No or insignificant symptomatology
1	50-59	45-54	Definite symptoms of depression (anxiety). Scores in this range should reflect the presence of significant depression (anxiety) at the symptom level, but below that which would ordinarily result in referral for treatment.
2	60-69	55-64	Depressive (anxiety) symptomatology present at a level which might be seen in actual patients who present with depression (anxiety) as the main problem. Level 2 represents the syndrome level of an out-patient group with a diagnosis of depressive (anxiety) neurosis.
3	70+	65+	Depressive (anxiety) symptomatology present to a marked degree, dominating the clinical picture. This range should be equivalent to that seen in patients either hospitalized for depression (anxiety) or experiencing a severe depressive (anxiety) neurosis.

any given month, we considered how many monthly responses we should require to assign a level for a given interval. Table 134 displays the monthly response rates during the second interval of the study. The monthly questionnaires were not sent until a man completed his second examination at Boston University. Not only had 24 men become ineligible between the first and second examinations, but an additional 20 were becoming ineligible at the time of their second evaluation. Consequently, 44 individuals were not sent any monthly questionnaires during the second interval as can be seen in the first row of Table 134.

Table 134 was organized in ascending order of the number of questionnaires returned because it is only on the basis of returned questionnaires that diagnostic assessments would be made. Clearly the more questionnaires a man returned, the higher his average response rate. In fact, the overall response rate during this interval was 95.6%. However, response rates for people who returned few questionnaires were much lower.

Since it was possible that the response rates were a function of the number of questionnaires men were sent between their second and third evaluations, we needed to determine a reasonable response rate and to establish a minimum number of returned questionnaires for an individual to be given a valid assessment for the interval.

There was a major change in the response rate between those who returned four or fewer questionnaires and those who returned five or more. If an individual returned four or fewer questionnaires, the response rate was at least 66%. Furthermore, five questionnaires represented at least half of the average interval length of 9 months. In addition, there were very few people who were on the borderline level of five returned questionnaires. Consequently, for the purpose of classifying individuals according to their depression and anxiety between examinations, we established a minimum standard of at least five returned questionnaires. In all cases, returning five or more questionnaires meant that an individual returned at least two out of the three sent to him during an interval.

For the great majority of men who returned six or more questionnaires, the response rate was much higher. We felt confident that our minimum criterion of five questionnaires per interval provided a reliable and valid data base on which to evaluate a man's episodic experience of depression and anxiety.

Finally, we had to consider how to classify the levels of

Response Rates During
Second Interval For Monthly
Depression And Anxiety Questionnaires

<u>Number of</u> <u>Questionnaires</u> <u>Returned</u>	<u>Number of</u> <u>Individuals</u>	<u>Total Number of</u> <u>Questionnaires</u> <u>Returned</u>	<u>Total Number of</u> <u>Questionnaires</u> <u>Sent</u>	<u>Average</u> <u>Response</u> <u>Rate</u>
N/A*	(44)	N/A	0	N/A
0**	2	0	0	0
1	3	3	26	11.5%
2	5	10	36	27.8%
3	4	12	32	37.5%
4	3	12	29	41.4%
5	5	25	36	69.4%
6	27	162	178	91.0%
7	58	406	424	95.8%
8+	265	2439	2450	99.6%
Totals	372 +(44) Ineligible	3069	3211	95.6%
416 Total at intake				

* Ineligible because of changed status by the time questionnaires were sent out

** These 2 subjects exercised their right to refuse to complete these questionnaires even though they remained as study participants.

depression and anxiety episodes over time. Having established levels for classifying the monthly self-reports, we needed to establish the characteristic psychiatric morbidity of our subjects during the interval between examinations. Table 135 displays our definitions and criteria for levels of annualized rates of depression and anxiety episodes. An episode was defined as a month in which a controller had a Level 1 or above score. If a man had at least one interval in which he returned a minimum of five questionnaires, then he was classified into one of four groups based on this average rate of episodes calculated across all intervals for which the minimum criterion of five questionnaires was met.

An individual was classified as asymptomatic if his average annual rate of episodes was less than 1 month per year. An individual was classified as having acute episodes if his average annualized rate was greater than 1 month but less than 3 months per year. Intermittent classifications were made if the average annual rate was greater than 3 months but less than 9 months per year. An individual was classified as having chronic anxiety or depression if the average annualized rate of episodes was equal to or greater than 9 months per year.

These classifications of chronicity were based purely on numbers of episodes without consideration of the levels of severity. We did examine the combined influence of both the level of severity and the number of episodes. These results are shown in Table 136.

Table 136 displays the number of months out of 36 that individuals were asymptomatic, acute, intermittent, or chronic at each of the defined levels of depression or anxiety. For example, those subjects classified asymptomatic had no Level 1, Level 2, or Level 3 episodes over the three intervals in the study. The sum of months do not total 36 exactly because of rounding error in the annualization calculations for each interval.

Clearly the overall classification based on number of episodes was associated also with severity of episodes. For example the chronic group had seven times the annual rate of Level 2 depressive episodes as the intermittent group, and the intermittent group had twice the annual rate of Level 2 episodes as the acute group. On the other hand, the Level 3 episodes of depression were experienced about equally by the three clinical groups.

The same picture held true for anxiety. The chronic group (as expected by definition) had the highest annual rate

Levels Of Annualized Rates Of
Depression And Anxiety Episodes From
Second Through Fifth (Exit) Examinations

Episodes: defined as Level 1 or above for a given month.

Annualized rate: defined as the average number of months per year an individual experienced episodes of depression or anxiety calculated for each between - examination interval.

Subjects: an individual received an interval annualized rate only if he returned at least five monthly questionnaires in an interval.

Levels: Asymptomatic - average annualized rate of episodes less than one month per year

Acute - average annualized rate of episodes equal to or greater than one month but less than three months per year

Intermittent - average annualized rate of episodes equal to or greater than three months but less than nine months per year

Chronic - average annualized rate of episodes equal to or greater than nine months per year

NOTE: The average annualized rates were rounded off according to the following algorithm:

<u>Actual average</u>	<u>Rounded to</u>	<u>Descriptive label</u>
0.00-0.55	0.0-0.5	Less than one month per year
0.56-2.95	0.6-2.9	Greater than one but less than 3 months per year
2.96-8.95	3.0-8.9	Greater than 3 but less than 9 months per year
8.96-12.00	9.0-12.0	Greater than or equal to 9 months per year.

TABLE 136
 Overall Annualized Rates*
 Of Depression And Anxiety Episodes As
 A Function Of The Level Of Episodes

Overall Level Classification of Average Annual Rate	Depression						Anxiety		
	Level 0	Level 1	Level 2	Level 3	Level 0	Level 1	Level 2	Level 3	
Asymptomatic ¹	35.14	N/A	N/A	N/A	35.16	N/R	N/A	N/A	
Acute ²	32.06	2.30	.53	.22	32.44	2.39	.23	.11	
Intermittent ³	20.33	13.84	.98	.33	17.63	16.11	.76	.25	
Chronic ⁴	4.82	23.46	6.67	.43	4.37	26.99	3.99	.00	

* Based on the sum of three intervals of calculable annualized rates to yield figures representing the number of months out of 36 that an individual had episodes of the particular level; total N with 3 intervals = 271; N/A=not applicable by definition

- 1 Depression, N=178; Anxiety, N=187
- 2 Depression, N=66; Anxiety, N=57
- 3 Depression, N=18; Anxiety, N=18
- 4 Depression, N=9; Anxiety, N=9

of Level 1 anxiety episodes. In addition, they had more than four times the rate of Level 2 anxiety episodes compared to the intermittents who themselves had three times the anxiety episode rate of the acute group. The results for Level 3 anxiety episodes were not clear. For some reason the chronic anxiety group had no Level 3 episodes of anxiety. The intermittent anxiety group experienced Level 3 episodes at a rate of 1 in 12 years. The acute group experienced a Level 3 anxiety episode at a rate of only one in approximately 30 years. Thus Level 3 anxiety episodes were extremely rare on the whole and were not particularly associated with the overall level classification based on the average annual rates.

These results indicated generally that subjects classified as chronic according to their average annual rate of episodes had not only more episodes but also more severe episodes than those classified as intermittent or acute. This finding was true for both anxiety and depression. As a consequence of this finding we were able to simplify our overall classification of levels to that based simply on the annual average rate.

Before making this decision we checked to see how well the annualized rate in each interval was correlated with the overall annual rate across all intervals. We also checked how well the rates calculated for each of the three intervals correlated with one another, and finally we examined whether or not the number of intervals influenced the average annual rate that was calculated.

Table 137 displays these final checks. As can be seen in Part A. of this table, the annual rate calculated for any given interval was very highly related to the average annualized rate across all intervals. The correlations were above .9 and approximately equal.

Part B of Table 137 shows that the annual rates calculated for each interval were highly correlated with one another for both depression and anxiety. That is, the assessment of an annual rate of episodes during one interval was quite comparable to the annual rate calculated for another interval. These correlations, however, were not as high as the correlations between the intervals and the overall annualization rates, which suggested that a given interval could not be used to represent the entire experience of depression and anxiety episodes. On the other hand, the overall average annualized rate well represented the experience of anxiety and depression episodes by individual controllers.

Part C of Table 137 displays the correlations between the number of valid intervals and the rates calculated for them. There were no significant relationships between the number of valid intervals and the annual rates either over all intervals or for any given interval. Consequently we were assured that the number of intervals did not influence the annual rates.

After making these various checks, we were confident about using our overall level classification based on the average annual rate for depression and anxiety episodes. In the remainder of this study the classification of individuals based on monthly psychiatric morbidity is reported in two ways--first, in terms of the overall average annualized rates of episodes, and, secondly, in terms of the asymptomatic, acute, intermittent, and chronic groupings.

SUMMARY

Prevalence and Incidence of Psychological
Health Change

Over the three years in the study, 32.5% of the controllers remained symptom free in our five criterion areas of psychiatric status. About one quarter (23.8%) of the men had some significant symptomatology at intake and an additional 28.1% manifested significant problems after, but not at, intake. A few men (15.6%) were asymptomatic up to the point they dropped out but their later status was not known.

The prevalence of significant symptomatology was 12.7% for impulse control disturbances, 7.6% for mate role problems, 7.5% for alcohol abuse, 6.0% for subjective distress, and 4.1% for work role disturbances.

Alcohol use and abuse were investigated further. Using a standard protocol, 42-61% of the controllers were classified as heavy drinkers compared to 28-31% of a national sample of men, depending on the age group but controlling for race and socioeconomic status. On the other hand, we found that 7.5% were classified as alcohol abusers using behavioral and psychiatric criteria and less than 1% were alcoholics using strict physiological criteria. Other data indicated that most drinking was used as a coping mechanism by the men.

In terms of the overall extent and severity of psychiatric problems for three years, 2.9% of the men were hospitalized for psychiatric reasons, 12% had chronic problems, 22.4% had intermittent problems, 14.9% had an acute problem, 32.5% never had a criterion problem in five evaluations, and 15.4% had no problem by the time they became ineligible for further evaluation.

Evaluations of the average monthly morbidity due to depression revealed that 4.2% had chronic depression (nine or more months with an episode of depression in a year), 6.8% had intermittent depression (3-8.9 months in a year with an episode), 22% had acute depression (.6-2.9 months in a year with an episode) and 66.8% had no, or very infrequent depressive episodes.

The monthly morbidity of anxiety was quite similar with 2.8% experiencing chronic anxiety, 6.8% having intermittent anxiety, 20.5% having acute anxiety episodes and 69.9% having very infrequent or no anxiety episodes over two and a half years.

The monthly morbidity rate of depression was not significantly different from that of other non-patient groups while the monthly morbidity of anxiety was less than that of general non-patient populations.

3. Prevalence of Significant Psychiatric Symptomatology and Morbidity of Depression and Anxiety

Table 138 displays our findings of significant psychiatric symptomatology in the PSS examinations at Boston University over the three years of controller participation. These findings relate to the individual symptom criterion scales. At intake, 6% of the controllers were experiencing significant subjective distress, representing primarily depression and anxiety. By the end of the study, 12.5% had experienced significant subjective distress problems at least once in the three years. The prevalence figure of 6% at intake was somewhat below the prevalence figure of 9.9% in an urban community sample, calculated from data provided by Dr. Jean Endicott of the Evaluation Section, New York State Department of Mental Hygiene and originally collected by Dr. Bruce Dohrenwend (see Table 127). Thus the controllers experienced 39% less significant subjective distress than did the urban community sample. However, as 58% of the community sample were women, the data are not fully comparable. No better comparisons were found.

Impulse control disorders as assessed by the PSS primarily reflect the inability to control anger, drug abuse, and anti-social behaviors. As seen in Table 138 the air traffic controllers experienced a relatively high proportion of impulse control disturbances compared to the urban community sample noted above. In fact, the controllers had four times the prevalence of impulse control disturbances compared to this group. By the end of the study, almost one-third of the controllers had manifested some problem with impulse control. This result was confirmed by our findings on the California Psychological Inventory (see Section IIIB3). In that section we noted that controllers scored very low on their responsibility and socialization scales of the CPI, which reflect dimensions of impulse control problems.

The work role disturbance scale of the PSS assesses whether or not the psychiatric status of an individual interferes significantly with his job performance according to a number of criteria. For this dimension of psychiatric dysfunction, the controllers had a prevalence of 4.1% compared to 2.1% of the urban community sample. The high rate of work-related disturbances was understandable in light of the high level of impulse control disturbances experienced by the controllers, since one would have to have other psychiatric problems before one could find disruptive functioning in the occupational role.

The mate role scale of the PSS assesses whether or not there is dysfunction in the mate relationship of the individual in terms of activities, sexual functioning, communication pat-

TABLE 130
Prevalence Of Significant
Psychiatric Symptomatology
By PSS Examination

<u>Symptom</u> <u>Criterion</u>	<u>Total</u> <u>Number</u> <u>of</u> <u>ATCs</u>	<u>Percent</u> <u>Asymptomatic</u> <u>at</u> <u>Intake</u>	<u>Percent ATCs</u> <u>Symptomatic</u> <u>at</u> <u>Intake</u> <u>(Prevalence)</u>	<u>Percent of</u> <u>Urban Community</u> <u>Sample Symptomatic</u> <u>at First</u> <u>Evaluation</u>	<u>Percent ATCs Who</u> <u>Had or Developed</u> <u>the Problem</u> <u>at Least Once</u> <u>in Three Years</u>
Subjective Distress	416	94.0%	6.0%	9.9%	12.5%
Impulse Control	416	87.3%	12.7%	3.1%	30.3%
Work Role	416	95.9%	4.1%	2.1%	23.8%
Mate Role	384 ²	92.4%	7.6%	6.1%	21.6%
Alcohol Abuse	416	92.5%	7.5%	2.3%	19.0%

¹ See Table III.D.1-3 for complete comparison data.

² 384 of 416 were married or had a cohabitation mate.

terns with the mate or social patterns of the couple. The prevalence for controllers with this problem was 7.6% compared with 6.1% for the urban community sample, essentially the same rate. Approximately one in five controllers had a disturbance in mate role functioning at some time over the three years of the study.

Finally, the symptom criterion of alcohol abuse was evaluated and the controllers experienced a prevalence of 7.5% at intake, compared with a prevalence of 2.3% among the urban community sample. One needs to exercise restraint in interpreting this comparison because of the sex differences in alcohol use and abuse, and the majority of women in the community sample. In addition, it is quite likely that the urban sample was under-reporting their use of alcohol.

Since alcohol abuse was mentioned very frequently by the air traffic controllers and by the facility administrators as a problem area, we undertook a particularly intense and detailed examination of alcohol use and abuse problems among air traffic controllers. These results are presented separately following the other findings, but generally, the 7.5% prevalence of alcohol abuse problems among the controllers at intake is similar to Northeastern USA prevalence of persons defined as problem drinkers and alcoholics (Chafetz, 1974), but is lower than prevalence figures for a similar occupational group (Cahalan, Gisin, Gardner, Smith, 1972). Hence although the prevalence of alcohol abuse was higher than that of the urban community sample, it was comparable to, or even slightly lower than, a more appropriate comparison group.

Table 139 displays the frequency of occurrence of significant psychiatric symptomatology for those men who were studied all five times by PSS examination at Boston University. These results differ from the preceding in that any man who did not have all five evaluations was not included and hence the total percentage of men experiencing a problem is slightly, but not greatly, different.

The frequency of occurrence of significant psychiatric symptomatology was notable primarily because of the relatively low rates of occurrence of problems two or more times during the three years. The single exception to this observation was impulse control disturbances, which occurred in approximately 15% of the men two or more times.

Table 140 addresses the final overall psychiatric status accorded each man as a result of his examinations at Boston University. The table displays the results using our two methods for describing a man's overall psychiatric status. Part A of

TABLE 139

Frequency Of Occurrence
Of Significant Psychiatric
Symptomatology In Those Studied
All 5 Times By PSS Examination

<u>Symptom Criterion</u>	<u>Total Number of ATCs¹</u>	<u>% Experiencing</u>		
		<u>Never</u>	<u>Once</u>	<u>Twice or More</u>
Subjective Distress	307	87.9%	7.2%	4.9%
Impulse Control	307	74.3%	11.1%	14.7%
Work Role	305 ²	80.3%	14.4%	5.2%
Mate Role	271 ³	30.1%	11.4%	8.5%
Alcohol Abuse	307	81.1%	9.4%	9.4%

1

Only those evaluated all 5 times are included, including men who were disqualified from the study.

2

Two men had not worked due to physical illness for an entire interval between examinations.

3

113 men changed their mate (not just spouse) status at different examinations and therefore did not have 5 evaluations.

Overall Psychiatric StatusA. Susceptibility to Psychiatric Problems in Three Years

	<u>No Problems- Incomplete*</u>	<u>No Problems</u>	<u>Any Problems at Intake</u>	<u>Any New Problems After Intake</u>	<u>Total Who Had or Developed A Problem</u>
Number of ATCs	65	135	99	117	216
% of 416	15.6%	32.5%	23.8%	28.1%	51.9%

B. Extent of Psychiatric Problems in Three Years

	<u>No Problems- Incomplete*</u>	<u>No Problems</u>	<u>Acute</u>	<u>Inter- mittent</u>	<u>Chronic</u>	
Number of ATCs	65	135	65	99	52	
% of 416	15.6	32.5	15.6	23.8	12.5	

	<u>No Problems- Incomplete*</u>	<u>No Problems</u>	<u>Acute</u>	<u>Inter- mittent</u>	<u>Chronic</u>	<u>Psychiatric Hospitalization</u>
Number of ATCs	64	135	62	93	50	12
% of 416	15.4	32.5	14.9	22.4	12.0	2.9

* These subjects had no problems before dropping out and their later status was not fully assessed.

Table 140 displays the prevalence of problems according to susceptibility categories discussed earlier. Sixty-five men were classified as having no problems, but this was a result of their having incomplete data. We classified them separately since we felt it was unjustified to consider them the same as those who had no problems at all.

Over the three years in the study 32.5% of the men, or 135 individuals, had no problems on any of the five PSS symptom criterion scales. They were completely asymptomatic. Ninety-nine men, or 23.8%, had one or more significant problems at intake.

One hundred and seventeen men, or 28.1%, developed at least one problem after intake into the study. This group of men did not have any problems at intake, but developed them later.

Finally, Table 140 shows that 216 men either had a problem at intake or developed a problem subsequent to intake. Slightly over half of the men initially enrolled in the study manifested some psychiatric problem either at intake or during the three years. Thus, the susceptibility of air traffic controllers to psychiatric problems was quite high when one considers that by the end of the study, half of the men had at least some psychiatric problem or psychological dysfunction. Unfortunately, there is no comparison group to help interpret whether this figure is particularly high relative to any other occupational groups. However, the magnitude of this value certainly suggests a high prevalence of psychological difficulty.

Part B of Table 140 displays the results of our assessment of the extent of psychiatric problems in three years as opposed to the susceptibility to different problems. Part B of the table is split into two parts, the first including psychiatric hospitalizations in the general statistics, the second displaying hospitalizations separately.

Again, sixty-five men had no problems by the time they dropped out of the study, but since they did not have full assessments, it was impossible to describe accurately the extent of psychiatric problems they may have had throughout the three years. Consequently, their data was considered incomplete. The group with no problems is exactly the same group as in Part A of Table 140. Sixty-five men, or 15.6%, had an acute psychiatric problem, which by definition meant that they had only one significant evaluation of one psychiatric problem over the entire three years. Another 99 men had one or more problems at two or three psychiatric evaluations. These men were defined as having intermittenc

psychiatric problems, and they comprised 23.8% of the original group of 416 men enrolled in the study. Men who had one or more problems at four or five of the evaluations were defined as having chronic problems. There were 52 such men or 12.5% of the original study group.

The second half of Table 140, Part B, groups those men who had psychiatric hospitalization into a special category. Three men who were hospitalized for psychiatric reasons had been defined as having acute problems. Six had intermittent problems, and two had chronic problems according to our assessments. Thus a total of 12 men were hospitalized for psychiatric reasons, or 2.9% of the original group. Since these special cases would seemingly indicate particularly significant psychiatric difficulty, we examined their data somewhat more closely across other variables.

Table 141 displays the reported diagnosis, the assessment of psychopathology at intake or later in the study, the extent of psychiatric problems, the burnout category and the FAA award category for these men. The reported diagnoses were obtained either from the medical records of the hospital or were reported directly by the subject on either a Monthly Health Review or during a psychiatric examination. Five of the twelve men had been hospitalized twice during the study.

The reported diagnoses were all psychoneuroses or alcoholism. Alcoholism accounted for 33% of the psychiatric hospitalizations. The remaining diagnoses were basically anxiety or depressive neuroses.

With the exception of one man, the hospitalized subjects were found to have had at least one psychiatric problem on the Psychiatric Status Schedule evaluation. The single man who did not manifest problems on the Psychiatric Status Schedule also was found to have no problems in terms of the extent of psychiatric problems. He was not classifiable according to our burnout category because of incomplete data, and he fell in the high average category for FAA awards for performance. This man would seem to be somewhat of an anomaly since we had no data substantiating his difficulties sufficient to require hospitalization.

Eleven of the 12 men were found to have some psychiatric difficulty on their Psychiatric Status Schedule evaluations. In addition, our burnout classification of men (which used work role pathology as one of four indices) had defined two men as cases of definite burnout, 7 men as preclinical, and

TABLE 141
Psychiatric Hospitalizations

N = 12 Men ¹

<u>Reported Diagnosis</u> ²	<u>Problem at Intake or Later</u>	<u>Extent of Psychiatric Problems on PSS Exams</u>	<u>Burnout Category</u>	<u>FAA Award Category</u>
Anxiety Neurosis*	None	None	N/A	High Average
Depressive Neurosis	Later	Intermittent	Preclinical	Low Average
Psychoneurosis*	Later	Acute	Preclinical	High Average
Alcoholism	Later	Intermittent	Definite	N/A
Alcoholism	Later	Chronic	Preclinical	Low
Alcoholism	Later	Acute	Preclinical	High
Anxiety Neurosis*	Intake	Intermittent	N/A	Low
Anxiety Neurosis	Later	Acute	Preclinical	Low
Character Disorder	Intake	Intermittent	Mixed	Low
Alcoholism	Intake	Chronic	Preclinical	Low
Anxiety Neurosis*	Later	Intermittent	Definite	High
Psychoneurosis*	Later	Intermittent	Preclinical	High Average

¹
 From medical record or reported by subject

²
 5 of the 12 were hospitalized twice. These are marked with an asterisk (*).

one man as a mixed case of positive and negative signs. Hence, 75% of these men were classified as being pre-clinical or definite cases of burnout (See Section III E for a more complete description of the meaning and significance of these burnout outcomes).

We also had collected data on a number of different awards men received from the FAA for their occupational performance (see Section III E). Table 141 shows that five of the twelve hospitalized men were in the very lowest category of FAA performance awards. On the other hand, another five men fell in the highest category of FAA awards for performance. And finally, one man received a low average number of awards. One man could not return for the fifth evaluation during which this information was collected and therefore could not be classified in terms of FAA performance. These data are important to note because they certainly suggest that psychiatric hospitalizations were not related to performance in terms of the awards the FAA would make for such performance. Because of the nature of the data, we were not able to determine whether the awards were made before or after psychiatric hospitalization, but regardless of that fact, it is important for two reasons: If men received their performance award before hospitalization, then clearly their performance was not particularly associated with later hospitalization. On the other hand, if awards were made after psychiatric hospitalization, then the significance of their psychiatric problem did not necessarily interfere with their performance on the job. Hence, although our descriptive results have indicated that certain particular problems such as impulse control disturbances were quite prevalent among controllers, and that psychiatric problems as a whole were experienced by approximately 50% of the men over three years, psychiatric difficulties may not necessarily affect or be related to work performance of air traffic controllers. Findings presented later in this report on the predictive association between certain variables such as the amount of work done, the amount of time spent working, and other of the job measures provided additional support for this suggestion.

As previously described, we also evaluated the monthly morbidity of depression and anxiety. Table 142 displays the prevalence of monthly depression by interval and by the overall average annual levels as previously defined. During the intervals between examinations, only 3.1% to 5.9% of the men experienced chronic depression; 2.6-7.0% experienced intermittent problems; and 7.9-11.8% experienced acute problems during the intervals. During any given interval 76.3% to 80.3% of the men experienced no significant depressive symptomatology.

TABLE 142
Prevalence Of Monthly
 Depression By
 Interval And Overall Average
 Annual Level

Level	Interval 2		Interval 3		Interval 4		Overall Average Annual Level*	
	N	%	N	%	N	%	N	%
Asymptomatic	271	76.3	245	80.3	218	79.0	235	66.8
Acute	42	11.8	24	7.9	34	8.2	79	22.2
Intermittent	25	7.0	18	5.9	11	2.6	24	6.8
Chronic	17	4.8	18	5.9	13	3.1	15	4.2
Totals	355		305		276		353	

*Based on the average annualized rate over the three intervals for the
 353 men who had one or more interval rates

With respect to the overall average annual level of the depressive episodes experienced by men over the three years, 66.8% were asymptomatic the entire time, 22.2% had acute episodes, 6.8% had intermittent episodes, and 4.2% had chronic difficulties. If one considers the intermittent and chronic groups to have the more severe episodes of depression, as was shown in Table 136 then approximately 11% of the men experienced significant depressive episodes at a level certainly suggesting a need for treatment. This 11% figure is very similar to that found in psychiatric epidemiological studies of depressive disorders in the general population (Barrett, Hurst, DiScala, Rose, 1978).

Table 143 displays our results on the extent of monthly anxiety by intervals and according to the overall average annual level. It can be seen that 3.9 - 4.8% of the men experienced chronic anxiety during the three intervals between Examinations 2-5. In addition, 5.9% to 6.9% of the men experienced intermittent anxiety episodes, and 6.9% to 13% of the men experienced acute episodes of significant anxiety. Seventy-six percent to 83.3% of the men experienced no anxiety at all during these intervals between examinations.

Considering the overall extent of monthly anxiety over the three years, we found that 2.8% experienced chronic anxiety episodes, 6.8% experienced intermittent episodes, 20.5% experienced acute episodes, and the remaining 69.9% were asymptomatic over the entire period of the study.

The extent of anxiety and depression on a monthly basis was very similar, and in fact, it was quite common for men with depressive problems also to have anxiety problems. The important point is that the more severe intermittent and chronic levels were experienced by only 9.6% of the men with respect to anxiety and 11.0% with respect to depression. As previously noted, these figures are very similar to those found for other populations of non-psychiatric patients.

Psychological problems, including some psychiatric syndromes, were quite prevalent among the men in the study. Slightly more than half had at least one psychiatric difficulty. The most prevalent psychiatric difficulty was impulse control disturbances which reflected a relatively high number of men who had an inability to control overt anger, anti-social impulses, and illicit drug use. Alcohol use was quite high, but alcohol abuse was about the same as in comparable groups of subjects. Anxiety and depression were experienced at levels equal to or less than that experienced in general populations of non-patients. The experience of psychiatric problems was not particularly

TABLE 143

Prevalence Of Monthly
Anxiety By Interval And
Overall Average Annual Level

<u>Level</u>	<u>Interval 2</u>		<u>Interval 3</u>		<u>Interval 4</u>		<u>Overall Average Annual Level*</u>	
	<u>N</u>	<u>%</u>	<u>N</u>	<u>%</u>	<u>N</u>	<u>%</u>	<u>N</u>	<u>%</u>
Asymptomatic	270	76.0	254	83.3	227	82.2	246	69.9
Acute	46	13.0	21	6.9	19	6.9	73	20.5
Intermittent	22	6.2	18	5.9	19	6.9	24	6.8
Chronic	17	4.8	12	3.9	11	4.0	10	2.8
Totals	355		305		276		353	

* Based on the average annualized rate over the three intervals for the 353 men who had one or more interval rates.

related to FAA performance criteria, but on the other hand, these problems in turn affected the men's work role performance. Psychiatric problems in mate role relationships were experienced at approximately the same rate as among the urban community group, and therefore, we would conclude that mate role difficulties were not more frequent among air traffic controllers than among others. Finally, since alcohol use and abuse were problem areas of great concern to both the air traffic controllers and management, we made an especially detailed evaluation of this problem area which is presented in the next section.

4. Alcohol Abuse

Information for the assessment of alcohol use and abuse, drinking behavior and consumption patterns was collected by use of the 16-item alcohol abuse scale of the Psychiatric Status Schedule, by an eight-item scale generated by factor analysis which assessed the ATCs' use of alcohol as a coping mechanism, and by a set of questions relative to frequency, amount, variability and volume of alcoholic beverage consumption.

Problems with Alcohol Revealed By The PSS

The symptoms reported most frequently were the following: they keep drinking at times even though they feel they should stop; they admit to becoming regularly intoxicated; they report periods in which they cannot recall what occurred the night before, and while alone, they have three or more drinks. The symptoms reported least often were those associated with physiological functioning and generally indicative of the symptom cluster labeled "alcoholism." The distribution and ranking of symptoms indicated that the type of problem experienced by the ATCs was generally a psychological dependence rather than physiological addiction.

The relationships between other psychiatric difficulties and alcohol abuse are displayed in Table 144. From 69% to 85% of the sample experienced neither psychiatric problems nor alcohol problems at a given evaluation. In two-thirds of the cases in which problems related to alcohol did occur, they appeared in conjunction with other psychiatric difficulties such as impulse control, mate role impairment and work role impairment. These findings indicated that difficulties with alcohol were associated with difficulties in other areas as well.

Coping By Drinking

The Coping by Drinking Factor of the ATC Questionnaire assessed alcohol usage as a means of unwinding from work-related tensions, and the effectiveness of drinking as a means of coping with work-related difficulties. High scores were indicative of relatively frequent usage of alcohol as a means of coping with stress or tension. This scale revealed that drinking as a means of unwinding after work was a fairly regular occurrence for controllers. Approximately 50% were inclined to drink as a means of unwinding on 15 of 20 working days. Sixty to 70% found that when they did drink, it was effective in helping them to unwind and relax. The results shown in Table 145

TABLE 144

Overlap Between Psychiatric Problems And Alcohol Abuse At Each PSS Evaluation:

<u>Exam</u>	<u>No Problem</u> <u>N(%)</u>	<u>Psychiatric Problem without Alcohol Abuse</u> <u>N(%)</u>	<u>Psychiatric Problem and Alcohol Abuse</u> <u>N(%)</u>	<u>Alcohol Abuse Only</u> <u>N(%)</u>
1	305(73.3)	80(19.2)	20(4.8)	11(2.6)
2	273(69.6)	95(22.8)	17(4.1)	7(1.8)
3	251(71.9)	61(17.5)	21(6.0)	16(4.6)
4	216(69.0)	65(15.6)	21(6.7)	11(3.5)
5	280(72.2)	76(18.3)	23(5.9)	9(2.3)

TABLE 145

Correlation Matrix: Exam One Through Five
For Coping By Drinking Scale

	<u>Exam 1</u>	<u>Exam 2</u>	<u>Exam 3</u>	<u>Exam 4</u>
Exam 1	-			
Exam 2	.80			
Exam 3	.77	.84		
Exam 4	.71	.78	.84	
Exam 5	.71	.76	.79	.91

All correlation coefficients are significant beyond the .001 level.

also indicated that the ATCs exhibited a high degree of stability in their use of drinking to cope.

Categorizing the men into low, moderately low, and moderately high and high users of alcohol for coping purposes and then cross-tabulating the classifications at the different examinations resulted in the finding that between 57% and 60% of the controllers remained in the same category from exam to exam. About 10% of the men consistently relied on heavy alcohol usage every day of the month to cope with tension from the job.

Alcohol Use As Revealed By Quantity-Frequency-Variability Measures

Frequency of drinking:

A special interview questionnaire about alcohol use was devised for the fourth and fifth examination visits. A systematic evaluation of the frequency, amount, variability and kind of alcohol usage was conducted. The different types of alcoholic beverages were combined by using pure ethanol equivalents. The frequency of drinking represents the number of times that the individual drank in the course of a week, month or year. Table 146 indicates that about 36% of the controllers drank nearly every day and another 20% drank three or four times a week. Cumulatively, about 56% drank at least three or more times a week; only 7% did not drink at all (abstainers).

Quantity of Alcohol Consumed:

Data on the amount of alcohol consumed is presented in Table 147 in terms of the number of ounces consumed per week. About 31% drank between 1 and 7 ounces; 21% drank between 8 and 14; and the remaining 41% drank 15 or more ounces per week. The mean consumption for Examination 4 was 16 ounces per week, while for Examination 5 it was 14 ounces. The correlation between reported alcohol consumption at Examinations 4 and 5 was .64.

Quantity-Frequency-Variability:

Table 148 indicates that approximately half of the ATCs were heavy drinkers (between 47% and 54%) while about a third were light or infrequent drinkers, or abstainers (32% to 39%).

Drinking Occasions:

The controllers were asked if they drank more on their days off or their workdays after work, or if it did not make a difference. Most controllers indicated that their drinking practices were the same for workdays after work and days off.

TABLE 146

Frequency Of Drinking Alcoholic Beverages Among ATC Study Sample

<u>Frequency</u>	<u>Exam* 4</u> <u>N(%)</u>	<u>Exam 5</u> <u>N(%)</u>
1. Two times a day	2(.7)	2(.7)
2. Nearly every day	107(35.2)	107(35.2)
3. 3-4 times a week	62(20.4)	58(19.1)
4. 1-3 times a week	74(24.3)	78(25.9)
5. 2-3 times a month	17(5.6)	20(6.6)
6. About once a month	15(4.9)	11(3.6)
7. Less than once a month/ at least once a year	4(1.3)	7(2.3)
8. Never	23(7.6)	21(6.9)

*Figures are adjusted to include those ATCs present at both exam 4 and exam 5 and include only journeyman controllers (N=304).

TABLE 147

Quantity Of Alcohol Consumed By ATC Study Sample
in Ounces Per Week, As Reported in Rounds 4 And 5

Total Consumption: Exams 4 and 5

<u>Ethanol Equivalent Ounces Per Week</u>	<u>Exam 4*</u> N(%)	<u>Exam 5*</u> N(%)
0	23(7.4)	26(6.7)
1-7	92(29.8)	131(6.7)
8-14	67(21.7)	83(21.4)
15-21	37(12.0)	56(14.5)
22-28	34(11.0)	36(9.3)
29-35	21(6.8)	25(6.5)
<u>Over 35</u>	<u>35(11.3)</u>	<u>30(7.8)</u>
Mean	16.37	14.20
S.D.	16.45	14.2
N	309	387
Range	0-140	0-120

* All men who were evaluated were included.

TABLE 148

Quantity-Frequency-Variability Classification

<u>Classification</u>	<u>Exam 4^a</u>		<u>Exam 5[*]</u>	
	<u>N</u>	<u>%</u>	<u>N</u>	<u>%</u>
Heavy Drinker	164	54.1	144	47.5
Moderate Drinker	42	13.9	40	13.2
Light Drinker	70	23.1	91	30.0
Infrequent Drinker	4	1.3	7	2.3
Abstainers	<u>23</u>	<u>7.6</u>	<u>21</u>	<u>6.9</u>
Totals	304	100.0	304	99.9

^aFigures are adjusted to include those ATCs present at exam four and five
^{*}include only journeyman controllers.

Type of Beverage:

For those controllers who drank, the beverages most frequently consumed were hard liquor and beer, while wine represented the least frequent beverage.

Comparison of Controllers to National Survey Samples on Quantity-Frequency-Variability

The special alcohol questionnaire given at the fourth and fifth examinations enabled us to compare the controllers to adult males of similar demographic characteristics. National survey data using the same questionnaire was available for comparison.

Compared to the national survey results, ATCs were heavy drinkers about four times more often than those in the national survey. Both samples had similar prevalences of light and moderate drinkers. Controllers were also 4 times less likely to fall within the abstainer group (Table 149).

Age was a possible influence on the difference between national and ATC drinking prevalences. Table 150 indicates less drinking as age increases for the national survey as well as for controllers. In terms of heavy drinking, the national survey results were unaffected by age while heavy drinking tended to decrease with age among controllers. Overall, controllers had a higher percentage of drinkers and heavy drinkers.

Medical Diagnoses of Alcoholism

We declined to make psychiatric diagnoses in order to avoid the pejorative implications and the unreliability associated with these diagnoses. However, in the medical sphere, the internist for the study rendered diagnoses based on medical history, physical examination, serology, urology, radiology, monthly self-reports, and hospital records. Diagnoses rendered on the basis of these data were considered more reliable and subject to specific physical findings and symptoms. Thus, diagnoses of alcoholism made by the internist represented physiological addiction with substantive physical findings present.

The internist diagnosed alcoholism for one man at intake and three men after intake. Thus, the total number of men receiving diagnoses of alcoholism on physiological grounds was four, or 0.97%. These men had findings of liver disease, tremors, peripheral neuropathy, blackouts, and other physiological symptoms of addiction to alcohol in association with a history of heavy, prolonged intake of alcoholic beverages. All four were hospitalized at least once

A Comparison Of Quantity-Frequency-Variability Classification
Between A National Survey Sample And The ATC Sample At Exam Four And Five

	<u>National Survey N</u>	<u>Exam Four* N</u>	<u>Exam Five* N</u>
Heavy Drinkers	324	168	185
Moderate Drinkers	354	42	49
Light Drinkers	766	72	118
Infrequent Drinkers	404	4	9
Abstainers	893	23	26
Total		309	387

*All men who were evaluated were included for these comparisons.

TABLE 150

A Comparison Of Drinkers And Non-Drinkers In A National Survey Sample And The ATC Study Sample At Exams Four And Five Analyzed By Age And Controlling For Socioeconomic Status¹

Age Categories	Percent Drinkers			Percent Heavy Drinkers		
	National Sample	ATCs Fourth Exam	ATCs Fifth Exam	National Sample	ATCs Fourth Exam	ATCs Fifth Exam
21-29	84	94	96	28	61	56
30-39	86	92	91	30	52	48
40-49	79	90	88	31	56	42

¹ All ATCs from the fourth (N=309) and fifth (N=387) were included. The data for the national sample was drawn from results for white males, high school to college level education, in the same income bracket as ATCs.

because of their condition.

The incidence of alcoholism according to this stringent criterion was about 0.25% per year, a figure nearly identical to the prevalence at intake of 0.24% (1/416). Hence, a strict physiologically based diagnosis of alcoholism was quite rare.

In summary, slightly over 50% of the air traffic controllers were heavy drinkers. At intake into the study, 7.5% had alcohol abuse problems according to psychiatric and behavioral criteria. Nineteen percent experienced an alcohol abuse problem at some point during the three years. According to physiological criteria, less than 1% suffered from alcoholism during the three years. Alcoholism was newly diagnosed at a rate of about 0.25% per year, a figure nearly identical to the prevalence of physiological alcoholism at intake (0.24%).

It is important to recognize that we examined alcohol-related behavior from a variety of perspectives. We did not wish to enter the highly controversial issue surrounding the diagnosis and definition of alcoholism and therefore used several definitional aspects of "alcoholism." From all perspectives, the controllers drank a great deal but relatively few had physiological disorders as consequences.

SUMMARY

JOB OUTCOMES

Certain job outcomes were measured and analyzed as an adjunct to the health outcomes: burnout, promotion, medical disqualification, amount of work performed and special recognition.

Definite burnout was defined as a decline during the course of the study in two or more of four variables: work satisfaction, competence ratings of peers, bounceback/burnout and work role pathology. Partial burnout was defined as a decline in one of these variables.

Using the definition decided upon, 35 men were found to have developed definite burnout after intake into the study. Forty-nine men were promoted to supervisor; 11 men received medical discharges for psychiatric reasons, and 12 men received medical discharges for physical problems.

The men who were promoted received more awards, on the average, than others, and the men who were disqualified for psychiatric reasons had, on the average, fewer awards than those disqualified for physical health reasons, and all other men.

E. Job Outcomes

In addition to the health outcomes in the previous sections, we measured and analyzed certain job outcomes that we considered important adjuncts to our health change data or that were of particular importance to the FAA.

These job outcomes were:

1. Burnout
2. Promotion
3. Medical disqualification
4. Amount of work performed
5. Special recognition awards

The definition, method of measurement, and frequency of occurrence of these outcomes among the study population are reported in this section.

Methods of Measurement

1) Burnout

The phenomenon of burnout has been of great interest both to the controllers and to the FAA. However, no accepted definition of burnout exists; and its importance, if it is an actual phenomenon, has been a matter of controversy. After considerable discussion with participating controllers, the members of the research team decided upon a definition of burnout that might capture the meaning of the term to controllers. We defined burnout as the occurrence in individuals of a significant negative change, over the three years of the study, in two or more of the following four variables: Work satisfaction, bounceback-burnout factor on the ATC Questionnaire, number of times chosen for competence by peers on the sociometric questionnaire, and the presence of significant work role pathology on the Psychiatric Status Schedule. We designated individuals who showed a significant decline in scores on two or more of these variables as a definite case of burnout, and those who declined one of four variables as a case of partial burnout. In order to make this determination, we calculated the average of the scores for each of these variables in Rounds 1 and 2 and again on Rounds 4 and 5. We then examined the differences in these two average scores, subtracting the average of Rounds 1 and 2 from that of Rounds 4 and 5. For the burnout-bounceback factor, the competence ratings and work satisfaction,

those individuals who had the largest declines (in the lowest one-quarter to one-third of the distribution) were designated as having had a significant change in the particular factor. For the work role pathology, individuals who developed work role pathology after not having it at intake were designated as having significant change in this variable. We also eliminated from all groups individuals who were consistently low from intake onward on two or more of the four factors. We wished to discriminate between men who developed burnout during the time they were in the study and those who were already manifesting burnout at intake into the study.

In general there were three selection criteria for determining cases of burnout, potential burnout, and comparison groups.

1. Individuals had to have completed all five rounds of examinations at B.U. They could not have dropped, have been promoted, or have been disqualified. This was necessary because we were measuring change and had to have the data for all times for the necessary calculation. (Medical drop-outs are covered in a separate job outcome variable).

2. Men had to experience significant decline in scores of two or more of the four variables to be labeled a case of burnout.

3. If individuals showed scores in the lowest quartile at Rounds 1 and 2 on two or more of the four defining variables, they were excluded from the analysis (17 cases were found).

These criteria yielded the following grouping of men:

97 men -- comparison group, no significant fall on any of the variables

115 men -- partial burnout cases, fall in only one of the criterion factors

35 men -- burnout cases, fall in two or more of the criterion factors

246 men able to be classified.

The bounceback-burnout factor consisted of scores on four questions in the Air Traffic Controller Questionnaire. As described in a previous section these were found to intercorrelate highly enough to form a single scale. Men who scored high on burnout and hence low on bounceback on this bipolar dimension answered the following questions as indicated:

1. "In the past six months it has been becoming more difficult for me to bounceback to peak performance when I've been away from the boards"
(Answer: Positively)
2. "In the past six months, it's been harder to shift between peak and slow periods."
(Answer: Positively)
3. "How often do you find yourself worrying about your own burnout?"
(High burnout answers: very often or constantly)
4. "At the present time, how close to burnout do you feel?"
(Answer: extremely close or very close)

A second defining criterion for burnout was the score on work satisfaction taken from the Job Description Index (Smith). This scale is answered by the individual indicating his agreement from "completely true" to "completely false" for a list of 19 adverbs describing work such as good, fascinating, routine, satisfying, etc.

The third score used was the number of competence ratings an individual received from co-workers on the first two rounds compared to the fourth and fifth round. Individuals were scored in the direction of burnout when there was a major decline in the number of men who rated them as among the most competent.

The fourth criterion was work role pathology on the PSS for which individuals received a positive (burned out) score if they were found by the interviewer to have significant interference in their ability to work because of psychological problems.

Table 151 lists the number of cases of burnout over the course of the study in terms of the combinations of the four variables used to define the concept. Of 35 cases of burnout, 29 showed a combination of two of the four factors declining seriously, 5 men showed changes on three of the four, and one man showed all four variables changing in a negative direction. By analysis of this table, one can deduce that 24 men had negative changes in bounceback-burnout along with something else and 23 men had negative changes in work satisfaction along with one or more other factors, while 16 had significant declines in competence ratings by co-workers and 14 had significant increases in work role pathology. Thus one may conclude that our definition of burnout was highly weighted by an individual's own estimation of his abilities and satisfaction. Those individuals who

Combinations Of Significant Declines Over The Course Of the Study
Of The Four Variables Used To Define A Case Of Burnout
 (Two or More Required For Definition)

<u>Combination of Variables</u> <u>Defining Cases of Burnout</u>	<u>Number of Men</u>	<u>Frequency</u>
Work Satisfaction + Competence Rating	3	8.5%
Work Satisfaction + Bounceback-burnout	9	25.7%
Work Satisfaction + Work Role Pathology	5	14.3%
Competence Rating + Bounceback-burnout	9	25.7%
Competence Rating + Work Role Pathology	1	2.9%
Bounceback-burnout + Work Role Pathology	2	5.7%
Work Satisfaction + Bounceback-burnout + Work Role Pathology	3	8.6%
Work Satisfaction + Competence Rating + Work Role Pathology	2	5.7%
All 4 Variables	1	2.9%
Total	35	100.0 %

were defined as "burnout" were very likely to have received that rating because they had shown a significant decrease over the three years in their own estimation of their work satisfaction and ability to bounceback.

2) Promotions and Medical Qualification

The ATCs reported any of these changes to the study teams as they occurred. The reports by the ATCs were then confirmed at the end of the study by FAA records. Table 152 summarizes these changes.

3) Amount of Work Performed

A description of the rationale and procedure for measuring this job outcome is contained in Section IIIB. Briefly, amount of work performed by the ATCs was measured during on-the-job studies. This objective workload measure was standardized across facilities and sectors and an average workload was derived for all ATCs who had participated in field studies at least two times. By reference to these average workload measures, categories of low, medium, and high workload change over the three years in average workload were established.

4) Special Recognitions and Awards

ATCs received various awards and recognitions from the FAA for their job performance. These included: Outstanding Performance Award, Point with Pride, Quality Step-increase, Award for Valor, Yearly-in-grade, Suggestion Award, Special Act Award (group), and Special Achievement Award. The ATCs were asked at Round 5 how many of these awards and recognitions had been received during the three years of the study.

In order to have another dimension of job performance, a total awards index was created in a way that would reflect differences in ATC performance. Of the eight awards, Suggestion Awards, Special Act Awards (group) and Award for Valor were eliminated from the total awards score as these were considered specialized events and not accurately reflective of individual day-to-day job performance. The remaining five awards were differentially weighted to reflect their differing prestige indices of the quality of ATC job performance.

For example, a yearly in-grade promotion was clearly less important in defining job performance than a Point with Pride Award. Based on Nunnally's (1967) suggestion that variables in linear combinations should be weighted by the inverse of their standard deviations, the following weights were attached:

TABLE 152

Administrative Job Changes

<u>Status</u>	<u>Absolute Frequency</u>	<u>Relative Frequency</u>
No Change	283	68.0%
Medical Discharge-Psychiatric	11	2.6%
Medical Discharge-Physical	12	2.9%
Promotion to Supervisor	49	11.8%
Change to DSS	10	2.5%
Transfer to ATC work elsewhere	27	6.5%
Other ¹	24	5.8%

¹The other category represents those ATCs who discontinued participating in the study for a variety of personal reasons.

a) Yearly in-grade = 0.7; b) Quality step-increase = 1.5; c) Outstanding performance award = 1.8; d) Special Achievement Award = 2.6; and e) Point with Pride = 3.6. Thus the total award was equal to the sum of the products of the number of each type of award and the weights for each type respectively. A review of the frequency of each of these recognitions and awards follows.

a) Yearly In-Grade Increase

There was considerable variation in the number of times the ATCs received this increase, with 27 of the men reporting that they received none. Less than 5% of the respondents received four or more such increases. The high incidence rate of this type of recognition justifies its lower weight in the total awards index.

b) Quality Step Increase

The incidence rate for this performance measure is presented in Table 153. As can be seen, 199 men did not receive a quality step increase while 3 controllers reported receiving five such increases during the course of the study. This distribution of awards indicated that this was a measure which could be used to differentiate between ATCs. It was interesting to note that 188 men received a Quality Step Increase while 128 men received an Outstanding Performance Award. It is likely these two were inter-related, but not perfectly, and the lower incidence rate for the latter supports its higher weighting in the total performance awards index.

c) Outstanding Performance Award

The incidence rates for this and other awards are presented in Table 153. As can be seen, 259 ATCs (62%) did not receive an Outstanding Performance Award during the three years they were in the study, whereas one of the controllers received four such awards. The fact that 128 ATCs received this award at least once during the course of the study, while 259 did not, indicates that this award is probably reflective of higher performance as an ATC. If all of the men in the study had received such an award or if none had, it would be a meaningless measure of performance.

d) Special Achievement Award

This award was given to approximately 16% (63 ATCs) of respondents. Three hundred and twenty-four ATCs reported receiving any such award during the three years of the

During the 3-year study period

Awards Received

No of Awards	Yearly In-Grade Increase # Men %	Quality Step Increase # Men %	Outstanding Performance Award # Men %	Special Achievement Award # Men %	Point with Pride # Men %	Suggestion Award # Men %	Special Act Award # Men %	Award For Valor # Men %
0	27 6.5%	199 47.8%	259 72.3%	324 77.9%	364 87.5%	351 84.4%	351 84.4%	386 92.8%
1	146 35.1%	141 33.9%	90 21.6%	56 13.5%	15 3.6%	19 4.6%	15 3.6%	1 0.2%
2	130 31.3%	42 10.1%	30 7.2%	3 0.7%	5 1.2%	6 1.4%	11 2.6%	
3	58 13.9%	1 0.2%	7 1.7%	2 0.5%		4 1.0%	5 1.2%	
4	10 2.4%	1 0.2%	1 0.2%	1 0.2%			1 0.2%	
5	11 2.6%	3 0.7%			3 0.7%	2 0.5%		
6	2 0.5%					3 0.7%		
7	2 0.5%					1 0.2%	3 0.7%	
8				1 0.2%			1 0.2%	
9	1 0.2%					1 0.2%		
No Response	29 7.0%	29 7.0%	29 7.0%	29 7.0%	29 7.0%	29 7.0%	29 7.0%	29 7.0%

study, while one of the men received eight awards. The incidence rate distribution supports the higher weight assigned this award in the total awards index.

e) Point with Pride Award

This award was given quite infrequently as 364 of the ATCs had not received one during the course of the study. On the other hand, it was interesting to note that 3 ATCs reported receiving five awards during the three years of the study.

f) Total Awards Index

Since this measure was a weighted linear combination of the five selected award categories, examination of the score distribution was skewed positively, reflecting the fact that a large number of ATCs received only a few (or no) awards.

In order to provide some evidence for the validity of this index, the relationship between selected job changes and this total awards index was examined. It was expected that those ATCs who were promoted would have higher scores on the awards index while those medically disqualified would have lower scores. As shown in Table 154, the mean awards index for those ATCs promoted was significantly higher ($p < .01$), and the mean awards index for those ATCs medically discharged for psychological reasons was significantly lower ($p < .05$). There was no difference between the mean award index scores for those ATCs medically discharged for physical reasons and those ATCs who remained in the study.

Part C of Table 137 displays the correlations between the number of valid intervals and the rates calculated for them. There were no significant relationships between the number of valid intervals and the annual rates either over all intervals or for any given interval. Consequently we were assured that the number of intervals did not influence the annual rates.

After making these various checks, we were confident about using our overall level classification based on the average annual rate for depression and anxiety episodes. In the remainder of this study the classification of individuals based on monthly psychiatric morbidity is reported in two ways--first, in terms of the overall average annualized rates of episodes, and, secondly, in terms of the asymptomatic, acute, intermittent, and chronic groupings.

SUMMARY

Prevalence and Incidence of Psychological
Health Change

Over the three years in the study, 32.5% of the controllers remained symptom free in our five criterion areas of psychiatric status. About one quarter (23.8%) of the men had some significant symptomatology at intake and an additional 28.1% manifested significant problems after, but not at, intake. A few men (15.6%) were asymptomatic up to the point they dropped out but their later status was not known.

The prevalence of significant symptomatology was 12.7% for impulse control disturbances, 7.6% for mate role problems, 7.5% for alcohol abuse, 6.0% for subjective distress, and 4.1% for work role disturbances.

Alcohol use and abuse were investigated further. Using a standard protocol, 42-61% of the controllers were classified as heavy drinkers compared to 28-31% of a national sample of men, depending on the age group but controlling for race and socioeconomic status. On the other hand, we found that 7.5% were classified as alcohol abusers using behavioral and psychiatric criteria and less than 1% were alcoholics using strict physiological criteria. Other data indicated that most drinking was used as a coping mechanism by the men.

In terms of the overall extent and severity of psychiatric problems for three years, 2.9% of the men were hospitalized for psychiatric reasons, 12% had chronic problems, 22.4% had intermittent problems, 14.95% had an acute problem, 32.5% never had a criterion problem in five evaluations, and 15.4% had no problem by the time they became ineligible for further evaluation.

Evaluations of the average monthly morbidity due to depression revealed that 4.2% had chronic depression (nine or more months with an episode of depression in a year), 6.8% had intermittent depression (3-8.9 months in a year with an episode), 22% had acute depression (.6-2.9 months in a year with an episode) and 66.8% had no, or very infrequent depressive episodes.

The monthly morbidity of anxiety was quite similar with 2.8% experiencing chronic anxiety, 6.8% having intermittent anxiety, 20.5% having acute anxiety episodes and 69.9% having very infrequent or no anxiety episodes over two and a half years.

The monthly morbidity rate of depression was not significantly different from that of other non-patient groups while the monthly morbidity of anxiety was less than that of general non-patient populations.

3. Prevalence of Significant Psychiatric Symptomatology and Morbidity of Depression and Anxiety

Table 138 displays our findings of significant psychiatric symptomatology in the PSS examinations at Boston University over the three years of controller participation. These findings relate to the individual symptom criterion scales. At intake, 6% of the controllers were experiencing significant subjective distress, representing primarily depression and anxiety. By the end of the study, 12.5% had experienced significant subjective distress problems at least once in the three years. The prevalence figure of 6% at intake was somewhat below the prevalence figure of 9.9% in an urban community sample, calculated from data provided by Dr. Jean Endicott of the Evaluation Section, New York State Department of Mental Hygiene and originally collected by Dr. Bruce Dohrenwend (see Table 127). Thus the controllers experienced 39% less significant subjective distress than did the urban community sample. However, as 58% of the community sample were women, the data are not fully comparable. No better comparisons were found.

Impulse control disorders as assessed by the PSS primarily reflect the inability to control anger, drug abuse, and anti-social behaviors. As seen in Table 138 the air traffic controllers experienced a relatively high proportion of impulse control disturbances compared to the urban community sample noted above. In fact, the controllers had four times the prevalence of impulse control disturbances compared to this group. By the end of the study, almost one-third of the controllers had manifested some problem with impulse control. This result was confirmed by our findings on the California Psychological Inventory (see Section IIIB3). In that section we noted that controllers scored very low on their responsibility and socialization scales of the CPI, which reflect dimensions of impulse control problems.

The work role disturbance scale of the PSS assesses whether or not the psychiatric status of an individual interferes significantly with his job performance according to a number of criteria. For this dimension of psychiatric dysfunction, the controllers had a prevalence of 4.1% compared to 2.1% of the urban community sample. The high rate of work-related disturbances was understandable in light of the high level of impulse control disturbances experienced by the controllers, since one would have to have other psychiatric problems before one could find disruptive functioning in the occupational role.

The mate role scale of the PSS assesses whether or not there is dysfunction in the mate relationship of the individual in terms of activities, sexual functioning, communication pat-

TABLE 130
Prevalence Of Significant
Psychiatric Symptomatology
By PSS Examination

<u>Symptom</u> <u>Criterion</u>	<u>Total</u> <u>Number</u> <u>of</u> <u>ATCs</u>	<u>Percent</u> <u>Asymptomatic</u> <u>at</u> <u>Intake</u>	<u>Percent ATCs</u> <u>Symptomatic</u> <u>at</u> <u>Intake</u> <u>(Prevalence)</u>	<u>Percent of</u> <u>Urban Community</u> <u>Sample Symptomatic</u> <u>at First</u> <u>Evaluation</u>	<u>Percent ATCs Who</u> <u>Had or Developed</u> <u>the Problem</u> <u>at Least Once</u> <u>in Three Years</u>
Subjective Distress	416	94.0%	6.0%	9.9%	12.5%
Impulse Control	416	87.3%	12.7%	3.1%	30.3%
Work Role	416	95.9%	4.1%	2.1%	23.8%
Marital Role	384 ²	92.4%	7.6%	6.1%	21.6%
Alcohol Abuse	416	92.5%	7.5%	2.3%	19.0%

See Table III.D.1-3 for complete comparison data.

384 of 416 were married or had a cohabitation mate.

terns with the mate or social patterns of the couple. The prevalence for controllers with this problem was 7.6% compared with 6.1% for the urban community sample, essentially the same rate. Approximately one in five controllers had a disturbance in mate role functioning at some time over the three years of the study.

Finally, the symptom criterion of alcohol abuse was evaluated and the controllers experienced a prevalence of 7.5% at intake, compared with a prevalence of 2.3% among the urban community sample. One needs to exercise restraint in interpreting this comparison because of the sex differences in alcohol use and abuse, and the majority of women in the community sample. In addition, it is quite likely that the urban sample was under-reporting their use of alcohol.

Since alcohol abuse was mentioned very frequently by the air traffic controllers and by the facility administrators as a problem area, we undertook a particularly intense and detailed examination of alcohol use and abuse problems among air traffic controllers. These results are presented separately following the other findings, but generally, the 7.5% prevalence of alcohol abuse problems among the controllers at intake is similar to Northeastern USA prevalence of persons defined as problem drinkers and alcoholics (Chafetz, 1974), but is lower than prevalence figures for a similar occupational group (Cahalan, Gisin, Gardner, Smith, 1972). Hence although the prevalence of alcohol abuse was higher than that of the urban community sample, it was comparable to, or even slightly lower than, a more appropriate comparison group.

Table 139 displays the frequency of occurrence of significant psychiatric symptomatology for those men who were studied all five times by PSS examination at Boston University. These results differ from the preceding in that any man who did not have all five evaluations was not included and hence the total percentage of men experiencing a problem is slightly, but not greatly, different.

The frequency of occurrence of significant psychiatric symptomatology was notable primarily because of the relatively low rates of occurrence of problems two or more times during the three years. The single exception to this observation was impulse control disturbances, which occurred in approximately 15% of the men two or more times.

Table 140 addresses the final overall psychiatric status accorded each man as a result of his examinations at Boston University. The table displays the results using our two methods for describing a man's overall psychiatric status. Part A of

TABLE 139

Frequency Of Occurrence
Of Significant Psychiatric
Symptomatology In Those Studied
All 5 Times By PSS Examination

<u>Symptom</u> <u>Criterion</u>	<u>Total</u> <u>Number</u> <u>of ATCs</u> ¹	<u>% Experiencing</u>		
		<u>Never</u>	<u>Once</u>	<u>Twice or More</u>
Subjective Distress	307	87.9%	7.2%	4.9%
Impulse Control	307	74.3%	11.1%	14.7%
Work Role	305 ²	80.3%	14.4%	5.2%
Mate Role	271 ³	30.1%	11.4%	8.5%
Alcohol Abuse	307	81.1%	9.4%	9.4%

¹ Only those evaluated all 5 times are included, including men who were disqualified from the study.

² Two men had not worked due to physical illness for an entire interval between examinations.

³ 113 men changed their mate (not just spouse) status at different examinations and therefore did not have 5 evaluations.

Overall Psychiatric StatusA. Susceptibility to Psychiatric Problems in Three Years

	<u>No Problems- Incomplete*</u>	<u>No Problems</u>	<u>Any Problems at Intake</u>	<u>Any New Problems After Intake</u>	<u>Total Who Had or Developed A Problem</u>
Number of ATCs	65	135	99	117	216
% of 416	15.6%	32.5%	23.8%	28.1%	51.9%

B. Extent of Psychiatric Problems in Three Years

	<u>No Problems- Incomplete*</u>	<u>No Problems</u>	<u>Acute</u>	<u>Inter- mittent</u>	<u>Chronic</u>	
Number of ATCs	65	135	65	99	52	
% of 416	15.6	32.5	15.6	23.8	12.5	
	<u>No Problems- Incomplete*</u>	<u>No Problems</u>	<u>Acute</u>	<u>Inter- mittent</u>	<u>Chronic</u>	<u>Psychiatric Hospitalization</u>
Number of ATCs	64	135	62	93	50	12
% of 416	15.4	32.5	14.9	22.4	12.0	2.9

* These subjects had no problems before dropping out and their later status was not fully assessed.

Table 140 displays the prevalence of problems according to susceptibility categories discussed earlier. Sixty-five men were classified as having no problems, but this was a result of their having incomplete data. We classified them separately since we felt it was unjustified to consider them the same as those who had no problems at all.

Over the three years in the study 32.5% of the men, or 135 individuals, had no problems on any of the five PSS symptom criterion scales. They were completely asymptomatic. Ninety-nine men, or 23.8%, had one or more significant problems at intake.

One hundred and seventeen men, or 28.1%, developed at least one problem after intake into the study. This group of men did not have any problems at intake, but developed them later.

Finally, Table 140 shows that 216 men either had a problem at intake or developed a problem subsequent to intake. Slightly over half of the men initially enrolled in the study manifested some psychiatric problem either at intake or during the three years. Thus, the susceptibility of air traffic controllers to psychiatric problems was quite high when one considers that by the end of the study, half of the men had at least some psychiatric problem or psychological dysfunction. Unfortunately, there is no comparison group to help interpret whether this figure is particularly high relative to any other occupational groups. However, the magnitude of this value certainly suggests a high prevalence of psychological difficulty.

Part B of Table 140 displays the results of our assessment of the extent of psychiatric problems in three years as opposed to the susceptibility to different problems. Part B of the table is split into two parts, the first including psychiatric hospitalizations in the general statistics, the second displaying hospitalizations separately.

Again, sixty-five men had no problems by the time they dropped out of the study, but since they did not have full assessments, it was impossible to describe accurately the extent of psychiatric problems they may have had throughout the three years. Consequently, their data was considered incomplete. The group with no problems is exactly the same group as in Part A of Table 140. Sixty-five men, or 15.6%, had an acute psychiatric problem, which by definition meant that they had only one significant evaluation of one psychiatric problem over the entire three years. Another 99 men had one or more problems at two or three psychiatric evaluations. These men were defined as having intermittent

psychiatric problems, and they comprised 23.8% of the original group of 416 men enrolled in the study. Men who had one or more problems at four or five of the evaluations were defined as having chronic problems. There were 52 such men or 12.5% of the original study group.

The second half of Table 140, Part B, groups those men who had psychiatric hospitalization into a special category. Three men who were hospitalized for psychiatric reasons had been defined as having acute problems. Six had intermittent problems, and two had chronic problems according to our assessments. Thus a total of 12 men were hospitalized for psychiatric reasons, or 2.9% of the original group. Since these special cases would seemingly indicate particularly significant psychiatric difficulty, we examined their data somewhat more closely across other variables.

Table 141 displays the reported diagnosis, the assessment of psychopathology at intake or later in the study, the extent of psychiatric problems, the burnout category and the FAA award category for these men. The reported diagnoses were obtained either from the medical records of the hospital or were reported directly by the subject on either a Monthly Health Review or during a psychiatric examination. Five of the twelve men had been hospitalized twice during the study.

The reported diagnoses were all psychoneuroses or alcoholism. Alcoholism accounted for 33% of the psychiatric hospitalizations. The remaining diagnoses were basically anxiety or depressive neuroses.

With the exception of one man, the hospitalized subjects were found to have had at least one psychiatric problem on the Psychiatric Status Schedule evaluation. The single man who did not manifest problems on the Psychiatric Status Schedule also was found to have no problems in terms of the extent of psychiatric problems. He was not classifiable according to our burnout category because of incomplete data, and he fell in the high average category for FAA awards for performance. This man would seem to be somewhat of an anomaly since we had no data substantiating his difficulties sufficient to require hospitalization.

Eleven of the 12 men were found to have some psychiatric difficulty on their Psychiatric Status Schedule evaluations. In addition, our burnout classification of men (which used work role pathology as one of four indices) had defined two men as cases of definite burnout, 7 men as preclinical, and

TABLE 141

Psychiatric HospitalizationsN = 12 Men ¹

<u>Reported Diagnosis</u> ²	<u>Problem at Intake or Later</u>	<u>Extent of Psychiatric Problems on PSS Exams</u>	<u>Burnout Category</u>	<u>FAA Award Category</u>
Anxiety Neurosis*	None	None	N/A	High Average
Depressive Neurosis	Later	Intermittent	Preclinical	Low Average
Psychoneurosis*	Later	Acute	Preclinical	High Average
Alcoholism	Later	Intermittent	Definite	N/A
Alcoholism	Later	Chronic	Preclinical	Low
Alcoholism	Later	Acute	Preclinical	High
Anxiety Neurosis*	Intake	Intermittent	N/A	Low
Anxiety Neurosis	Later	Acute	Preclinical	Low
Character Disorder	Intake	Intermittent	Mixed	Low
Alcoholism	Intake	Chronic	Preclinical	Low
Anxiety Neurosis*	Later	Intermittent	Definite	High
Psychoneurosis*	Later	Intermittent	Preclinical	High Average

¹ From medical record or reported by subject

² 5 of the 12 were hospitalized twice. These are marked with an asterisk (*).

one man as a mixed case of positive and negative signs. Hence, 75% of these men were classified as being pre-clinical or definite cases of burnout (See Section III E for a more complete description of the meaning and significance of these burnout outcomes).

We also had collected data on a number of different awards men received from the FAA for their occupational performance (see Section III E). Table 141 shows that five of the twelve hospitalized men were in the very lowest category of FAA performance awards. On the other hand, another five men fell in the highest category of FAA awards for performance. And finally, one man received a low average number of awards. One man could not return for the fifth evaluation during which this information was collected and therefore could not be classified in terms of FAA performance. These data are important to note because they certainly suggest that psychiatric hospitalizations were not related to performance in terms of the awards the FAA would make for such performance. Because of the nature of the data, we were not able to determine whether the awards were made before or after psychiatric hospitalization, but regardless of that fact, it is important for two reasons: If men received their performance award before hospitalization, then clearly their performance was not particularly associated with later hospitalization. On the other hand, if awards were made after psychiatric hospitalization, then the significance of their psychiatric problem did not necessarily interfere with their performance on the job. Hence, although our descriptive results have indicated that certain particular problems such as impulse control disturbances were quite prevalent among controllers, and that psychiatric problems as a whole were experienced by approximately 50% of the men over three years, psychiatric difficulties may not necessarily affect or be related to work performance of air traffic controllers. Findings presented later in this report on the predictive association between certain variables such as the amount of work done, the amount of time spent working, and other of the job measures provided additional support for this suggestion.

As previously described, we also evaluated the monthly morbidity of depression and anxiety. Table 142 displays the prevalence of monthly depression by interval and by the overall average annual levels as previously defined. During the intervals between examinations, only 3.1% to 5.9% of the men experienced chronic depression; 2.6-7.0% experienced intermittent problems; and 7.9-11.8% experienced acute problems during the intervals. During any given interval 76.3% to 80.3% of the men experienced no significant depressive symptomatology.

TABLE 142
Prevalence Of Monthly
Depression By
Interval And Overall Average
Annual Level

Level	Interval 2		Interval 3		Interval 4		Overall Average Annual Level*	
	N	%	N	%	N	%	N	%
Asymptomatic	271	76.3	245	80.3	218	79.0	235	66.8
Acute	42	11.8	24	7.9	34	8.2	79	22.2
Intermittent	25	7.0	18	5.9	11	2.6	24	6.8
Chronic	17	4.8	18	5.9	13	3.1	15	4.2
Totals	355		305		276		353	

*Based on the average annualized rate over the three intervals for the 353 men who had one or more interval rates

With respect to the overall average annual level of the depressive episodes experienced by men over the three years, 66.8% were asymptomatic the entire time, 22.2% had acute episodes, 6.8% had intermittent episodes, and 4.2% had chronic difficulties. If one considers the intermittent and chronic groups to have the more severe episodes of depression, as was shown in Table 136 then approximately 11% of the men experienced significant depressive episodes at a level certainly suggesting a need for treatment. This 11% figure is very similar to that found in psychiatric epidemiological studies of depressive disorders in the general population (Barrett, Hurst, DiScala, Rose, 1978).

Table 143 displays our results on the extent of monthly anxiety by intervals and according to the overall average annual level. It can be seen that 3.9 - 4.8% of the men experienced chronic anxiety during the three intervals between Examinations 2-5. In addition, 5.9% to 6.9% of the men experienced intermittent anxiety episodes, and 6.9% to 13% of the men experienced acute episodes of significant anxiety. Seventy-six percent to 83.3% of the men experienced no anxiety at all during these intervals between examinations.

Considering the overall extent of monthly anxiety over the three years, we found that 2.8% experienced chronic anxiety episodes, 6.8% experienced intermittent episodes, 20.5% experienced acute episodes, and the remaining 69.9% were asymptomatic over the entire period of the study.

The extent of anxiety and depression on a monthly basis was very similar, and in fact, it was quite common for men with depressive problems also to have anxiety problems. The important point is that the more severe intermittent and chronic levels were experienced by only 9.6% of the men with respect to anxiety and 11.0% with respect to depression. As previously noted, these figures are very similar to those found for other populations of non-psychiatric patients.

Psychological problems, including some psychiatric syndromes, were quite prevalent among the men in the study. Slightly more than half had at least one psychiatric difficulty. The most prevalent psychiatric difficulty was impulse control disturbances which reflected a relatively high number of men who had an inability to control overt anger, anti-social impulses, and illicit drug use. Alcohol use was quite high, but alcohol abuse was about the same as in comparable groups of subjects. Anxiety and depression were experienced at levels equal to or less than that experienced in general populations of non-patients. The experience of psychiatric problems was not particularly

TABLE 143

Prevalence Of Monthly
Anxiety By Interval And
Overall Average Annual Level

<u>Level</u>	<u>Interval 2</u>		<u>Interval 3</u>		<u>Interval 4</u>		<u>Overall Average Annual Level*</u>	
	<u>N</u>	<u>%</u>	<u>N</u>	<u>%</u>	<u>N</u>	<u>%</u>	<u>N</u>	<u>%</u>
Asymptomatic	270	76.0	254	83.3	227	82.2	246	69.9
Acute	46	13.0	21	6.9	19	6.9	73	20.5
Intermittent	22	6.2	18	5.9	19	6.9	24	6.8
Chronic	17	4.8	12	3.9	11	4.0	10	2.8
Totals	355		305		276		353	

* Based on the average annualized rate over the three intervals for the 353 men who had one or more interval rates.

related to FAA performance criteria, but on the other hand, these problems in turn affected the men's work role performance. Psychiatric problems in mate role relationships were experienced at approximately the same rate as among the urban community group, and therefore, we would conclude that mate role difficulties were not more frequent among air traffic controllers than among others. Finally, since alcohol use and abuse were problem areas of great concern to both the air traffic controllers and management, we made an especially detailed evaluation of this problem area which is presented in the next section.

4. Alcohol Abuse

Information for the assessment of alcohol use and abuse, drinking behavior and consumption patterns was collected by use of the 16-item alcohol abuse scale of the Psychiatric Status Schedule, by an eight-item scale generated by factor analysis which assessed the ATCs' use of alcohol as a coping mechanism, and by a set of questions relative to frequency, amount, variability and volume of alcoholic beverage consumption.

Problems with Alcohol Revealed By The PSS

The symptoms reported most frequently were the following: they keep drinking at times even though they feel they should stop; they admit to becoming regularly intoxicated; they report periods in which they cannot recall what occurred the night before, and while alone, they have three or more drinks. The symptoms reported least often were those associated with physiological functioning and generally indicative of the symptom cluster labeled "alcoholism." The distribution and ranking of symptoms indicated that the type of problem experienced by the ATCs was generally a psychological dependence rather than physiological addiction.

The relationships between other psychiatric difficulties and alcohol abuse are displayed in Table 144. From 69% to 85% of the sample experienced neither psychiatric problems nor alcohol problems at a given evaluation. In two-thirds of the cases in which problems related to alcohol did occur, they appeared in conjunction with other psychiatric difficulties such as impulse control, mate role impairment and work role impairment. These findings indicated that difficulties with alcohol were associated with difficulties in other areas as

Coping By Drinking

The Coping by Drinking Factor of the ATC Questionnaire assessed alcohol usage as a means of unwinding from work-related stressors, and the effectiveness of drinking as a means of coping with work-related difficulties. High scores were indicative of relatively frequent usage of alcohol as a means of coping with stress or tension. This scale revealed that drinking as a means of unwinding after work was a fairly regular occurrence for ATCs. Approximately 50% were inclined to drink as a means of unwinding on 15 of 20 working days. Sixty to 70% found that when they did drink, it was effective in helping them to unwind and relax. The results shown in Table 145

TABLE 144

Overlap Between Psychiatric Problems And Alcohol Abuse At Each PSS Evaluation

<u>Exam</u>	<u>No Problem</u> <u>N(%)</u>	<u>Psychiatric Problem without Alcohol Abuse</u> <u>N(%)</u>	<u>Psychiatric Problem and Alcohol Abuse</u> <u>N(%)</u>	<u>Alcohol Abuse Only</u> <u>N(%)</u>
1	305(73.3)	80(19.2)	20(4.8)	11(2.6)
2	273(69.6)	95(22.8)	17(4.1)	7(1.8)
3	251(71.9)	61(17.5)	21(6.0)	16(4.6)
4	216(69.0)	65(15.6)	21(6.7)	11(3.5)
5	280(72.2)	76(18.3)	23(5.9)	9(2.3)

TABLE 145

Correlation Matrix: Exam One Through Five
For Coping By Drinking Scale

	<u>Exam 1</u>	<u>Exam 2</u>	<u>Exam 3</u>	<u>Exam 4</u>
Exam 1	-			
Exam 2	.80			
Exam 3	.77	.84		
Exam 4	.71	.78	.64	
Exam 5	.71	.76	.79	.91

All correlation coefficients are significant beyond the .001 level.

also indicated that the ATCs exhibited a high degree of stability in their use of drinking to cope.

Categorizing the men into low, moderately low, and moderately high and high users of alcohol for coping purposes and then cross-tabulating the classifications at the different examinations resulted in the finding that between 57% and 60% of the controllers remained in the same category from exam to exam. About 10% of the men consistently relied on heavy alcohol usage every day of the month to cope with tension from the job.

Alcohol Use As Revealed By Quantity-Frequency-Variability Measures

Frequency of drinking:

A special interview questionnaire about alcohol use was devised for the fourth and fifth examination visits. A systematic evaluation of the frequency, amount, variability and kind of alcohol usage was conducted. The different types of alcoholic beverages were combined by using pure ethanol equivalents. The frequency of drinking represents the number of times that the individual drank in the course of a week, month or year. Table 146 indicates that about 36% of the controllers drank nearly every day and another 20% drank three or four times a week. Cumulatively, about 56% drank at least three or more times a week; only 7% did not drink at all (abstainers).

Quantity of Alcohol Consumed:

Data on the amount of alcohol consumed is presented in Table 147 in terms of the number of ounces consumed per week. About 31% drank between 1 and 7 ounces; 21% drank between 8 and 14; and the remaining 41% drank 15 or more ounces per week. The mean consumption for Examination 4 was 16 ounces per week, while for Examination 5 it was 14 ounces. The correlation between reported alcohol consumption at Examinations 4 and 5 was .64.

Quantity-Frequency-Variability:

Table 148 indicates that approximately half of the ATCs were heavy drinkers (between 47% and 54%) while about a third were light or infrequent drinkers, or abstainers (32% to 39%).

Drinking Occasions:

The controllers were asked if they drank more on their days off or their workdays after work, or if it did not make a difference. Most controllers indicated that their drinking practices were the same for workdays after work and days off.

TABLE 146

Frequency Of Drinking Alcoholic Beverages Among ATC Study Sample

<u>Frequency</u>	<u>Exam 4</u> <u>N(%)</u>	<u>Exam 5</u> <u>N(%)</u>
1. Two times a day	2(.7)	2(.7)
2. Nearly every day	107(35.2)	107(35.2)
3. 3-4 times a week	62(20.4)	58(19.1)
4. 1-3 times a week	74(24.3)	78(25.9)
5. 2-3 times a month	17(5.6)	20(6.6)
6. About once a month	15(4.9)	11(3.6)
7. Less than once a month/ at least once a year	4(1.3)	7(2.3)
8. Never	23(7.6)	21(6.9)

*Figures are adjusted to include those ATCs present at both exam 4 and exam 5 and include only journeyman controllers (N=304).

TABLE 147

Quantity Of Alcohol Consumed By ATC Study Sample
in Ounces Per Week, As Reported In Rounds 4 And 5

Total Consumption: Exams 4 and 5

<u>Ethanol Equivalent Ounces Per Week</u>	<u>Exam 4*</u> N(%)	<u>Exam 5*</u> N(%)
0	23(7.4)	26(6.7)
1-7	92(29.8)	131(6.7)
8-14	67(21.7)	83(21.4)
15-21	37(12.0)	56(14.5)
22-28	34(11.0)	36(9.3)
29-35	21(6.8)	25(6.5)
<u>Over 35</u>	<u>35(11.3)</u>	<u>30(7.8)</u>
Mean	16.37	14.20
S.D.	16.45	14.2
N	309	387
Range	0-140	0-120

* All men who were evaluated were included.

TABLE 148

Quantity-Frequency-Variability Classification

<u>Classification</u>	<u>Exam 4^a</u>		<u>Exam 5^b</u>	
	<u>N</u>	<u>%</u>	<u>N</u>	<u>%</u>
Heavy Drinker	164	54.1	144	47.5
Moderate Drinker	42	13.9	40	13.2
Light Drinker	70	23.1	91	30.0
Frequent Drinker	4	1.3	7	2.3
Abstainers	<u>23</u>	<u>7.6</u>	<u>21</u>	<u>6.9</u>
Totals	304	100.0	304	99.9

^a Figures are adjusted to include those ATCs present at exam four and five
^b Figures include only journeyman controllers.

Type of Beverage:

For those controllers who drank, the beverages most frequently consumed were hard liquor and beer, while wine represented the least frequent beverage.

Comparison of Controllers to National Survey Samples on Quantity-Frequency-Variability

The special alcohol questionnaire given at the fourth and fifth examinations enabled us to compare the controllers to adult males of similar demographic characteristics. National survey data using the same questionnaire was available for comparison.

Compared to the national survey results, ATCs were heavy drinkers about four times more often than those in the national survey. Both samples had similar prevalences of light and moderate drinkers. Controllers were also 4 times less likely to fall within the abstainer group (Table 149).

Age was a possible influence on the difference between national and ATC drinking prevalences. Table 150 indicates less drinking as age increases for the national survey as well as for controllers. In terms of heavy drinking, the national survey results were unaffected by age while heavy drinking tended to decrease with age among controllers. Overall, controllers had a higher percentage of drinkers and heavy drinkers.

Medical Diagnoses of Alcoholism

We declined to make psychiatric diagnoses in order to avoid the pejorative implications and the unreliability associated with these diagnoses. However, in the medical sphere, the internist for the study rendered diagnoses based on medical history, physical examination, serology, urology, radiology, monthly self-reports, and hospital records. Diagnoses rendered on the basis of these data were considered more reliable and subject to specific physical findings and symptoms. Thus, diagnoses of alcoholism made by the internist represented physiological addiction with substantive physical findings present.

The internist diagnosed alcoholism for one man at intake and for three men after intake. Thus, the total number of men receiving diagnoses of alcoholism on physiological grounds was four, or 0.97%. These men had findings of liver disease, tremors, peripheral neuropathy, blackouts, and other physiological symptoms of addiction to alcohol in association with a history of heavy, prolonged intake of alcoholic beverages. All four were hospitalized at least once

A Comparison of Quantity-Frequency-Variability Classification
Between A National Survey Sample And The ATC Sample At Exam Four And Five

	<u>National Survey</u>	<u>Exam Four*</u>	<u>Exam 5*</u>
	<u>N</u>	<u>N</u>	<u>N</u>
Heavy Drinkers	324	168	185
Moderate Drinkers	354	42	49
Light Drinkers	766	72	118
Infrequent Drinkers	404	4	9
Abstainers	893	23	26
Total	32	7.4	6.7
	309	387	

*All men who were evaluated were included for these comparisons.

A Comparison Of Drinkers And Non-Drinkers In A National Survey Sample And The ATC Study Sample At Exams Four And Five Analyzed By Age And Controlling For Socioeconomic Status

Age Categories	Percent Drinkers			Percent Heavy Drinkers		
	National Sample	ATCs Fourth Exam	ATCs Fifth Exam	National Sample	ATCs Fourth Exam	ATCs Fifth Exam
21-29	84	94	96	28	61	56
30-39	86	92	91	30	52	48
40-49	79	90	88	31	56	42

All ATCs from the fourth (N=309) and fifth (N=387) were included. The data for the national sample was drawn from results for white males, high school to college level education, in the same income bracket as ATCs.

because of their condition.

The incidence of alcoholism according to this stringent criterion was about 0.25% per year, a figure nearly identical to the prevalence at intake of 0.24% (1/416). Hence, a strict physiologically based diagnosis of alcoholism was quite rare.

In summary, slightly over 50% of the air traffic controllers were heavy drinkers. At intake into the study, 7.5% had alcohol abuse problems according to psychiatric and behavioral criteria. Nineteen percent experienced an alcohol abuse problem at some point during the three years. According to physiological criteria, less than 1% suffered from alcoholism during the three years. Alcoholism was newly diagnosed at a rate of about 0.25% per year, a figure nearly identical to the prevalence of physiological alcoholism at intake (0.24%).

It is important to recognize that we examined alcohol-related behavior from a variety of perspectives. We did not wish to enter the highly controversial issue surrounding the diagnosis and definition of alcoholism and therefore used several definitional aspects of "alcoholism." From all perspectives, the controllers drank a great deal but relatively few had physiological disorders as consequences.

SUMMARY

JOB OUTCOMES

Certain job outcomes were measured and analyzed as an adjunct to the health outcomes: burnout, promotion, medical disqualification, amount of work performed and special recognition.

Definite burnout was defined as a decline during the course of the study in two or more of four variables: work satisfaction, competence ratings of peers, bounceback/burnout and work role pathology. Partial burnout was defined as a decline in one of these variables.

Using the definition decided upon, 35 men were found to have developed definite burnout after intake into the study. Forty-nine men were promoted to supervisor; 11 men received medical discharges for psychiatric reasons, and 12 men received medical discharges for physical problems.

The men who were promoted received more awards, on the average, than others, and the men who were disqualified for psychiatric reasons had, on the average, fewer awards than those disqualified for physical health reasons, and all other men.

E. Job Outcomes

In addition to the health outcomes in the previous sections, we measured and analyzed certain job outcomes that we considered important adjuncts to our health change data or that were of particular importance to the FAA.

These job outcomes were:

1. Burnout
2. Promotion
3. Medical disqualification
4. Amount of work performed
5. Special recognition awards

The definition, method of measurement, and frequency of occurrence of these outcomes among the study population are reported in this section.

Methods of Measurement

1) Burnout

The phenomenon of burnout has been of great interest both to the controllers and to the FAA. However, no accepted definition of burnout exists; and its importance, if it is an actual phenomenon, has been a matter of controversy. After considerable discussion with participating controllers, the members of the research team decided upon a definition of burnout that might capture the meaning of the term to controllers. We defined burnout as the occurrence in individuals of a significant negative change, over the three years of the study, in two or more of the following four variables: Work satisfaction, bounceback-burnout factor on the ATC Questionnaire, number of times chosen for competence by peers on the sociometric questionnaire, and the presence of significant work role pathology on the Psychiatric Status Schedule. We designated individuals who showed a significant decline in scores on two or more of these variables as a definite case of burnout, and those who declined one of four variables as a case of partial burnout. In order to make this determination, we calculated the average of the scores for each of these variables on Rounds 1 and 2 and again on Rounds 4 and 5. We then examined the differences in these two average scores, subtracting the average of Rounds 1 and 2 from that of Rounds 4 and 5. For the burnout-bounceback factor, the competence ratings and work satisfaction,

those individuals who had the largest declines (in the lowest one-quarter to one-third of the distribution) were designated as having had a significant change in the particular factor. For the work role pathology, individuals who developed work role pathology after not having it at intake were designated as having significant change in this variable. We also eliminated from all groups individuals who were consistently low from intake onward on two or more of the four factors. We wished to discriminate between men who developed burnout during the time they were in the study and those who were already manifesting burnout at intake into the study.

In general there were three selection criteria for determining cases of burnout, potential burnout, and comparison groups.

1. Individuals had to have completed all five rounds of examinations at B.U. They could not have dropped, have been promoted, or have been disqualified. This was necessary because we were measuring change and had to have the data for all times for the necessary calculation. (Medical drop-outs are covered in a separate job outcome variable).

2. Men had to experience significant decline in scores of two or more of the four variables to be labeled a case of burnout.

3. If individuals showed scores in the lowest quartile at Rounds 1 and 2 on two or more of the four defining variables, they were excluded from the analysis (17 cases were found).

These criteria yielded the following grouping of men:

97 men -- comparison group, no significant fall on any of the variables

115 men -- partial burnout cases, fall in only one of the criterion factors

35 men -- burnout cases, fall in two or more of the criterion factors

246 men able to be classified.

The bounceback-burnout factor consisted of scores on four questions in the Air Traffic Controller Questionnaire. As described in a previous section these were found to intercorrelate highly enough to form a single scale. Men who scored high on burnout and hence low on bounceback on this bipolar dimension answered the following questions as indicated:

1. "In the past six months it has been becoming more difficult for me to bounceback to peak performance when I've been away from the boards"
(Answer: Positively)
2. "In the past six months, it's been harder to shift between peak and slow periods."
(Answer: Positively)
3. "How often do you find yourself worrying about your own burnout?"
(High burnout answers: very often or constantly)
4. "At the present time, how close to burnout do you feel?"
(Answer: extremely close or very close)

A second defining criterion for burnout was the score on work satisfaction taken from the Job Description Index (Smith). This scale is answered by the individual indicating his agreement from "completely true" to "completely false" for a list of 19 adverbs describing work such as good, fascinating, routine, satisfying, etc.

The third score used was the number of competence ratings an individual received from co-workers on the first two rounds compared to the fourth and fifth round. Individuals were scored in the direction of burnout when there was a major decline in the number of men who rated them as among the most competent.

The fourth criterion was work role pathology on the PSS for which individuals received a positive (burned out) score if they were found by the interviewer to have significant interference in their ability to work because of psychological problems.

Table 151 lists the number of cases of burnout over the course of the study in terms of the combinations of the four variables used to define the concept. Of 35 cases of burnout, 29 showed a combination of two of the four factors declining seriously, 5 men showed changes on three of the four, and one man showed all four variables changing in a negative direction. By analysis of this table, one can deduce that 24 men had negative changes in bounceback-burnout along with something else and 23 men had negative changes in work satisfaction along with one or more other factors, while 16 had significant declines in competence ratings by co-workers and 14 had significant increases in work role pathology. Thus one may conclude that our definition of burnout was highly weighted by an individual's own estimation of his abilities and satisfaction. Those individuals who

Combinations Of Significant Declines Over The Course Of the Study
Of The Four Variables Used To Define A Case Of Burnout
 (Two or More Required For Definition)

<u>Combination of Variables</u> <u>Defining Cases of Burnout</u>	<u>Number of Men</u>	<u>Frequency</u>
Work Satisfaction + Competence Rating	3	8.5%
Work Satisfaction + Bounceback-burnout	9	25.7%
Work Satisfaction + Work Role Pathology	5	14.3%
Competence Rating + Bounceback-burnout	9	25.7%
Competence Rating + Work Role Pathology	1	2.9%
Bounceback-burnout + Work Role Pathology	2	5.7%
Work Satisfaction + Bounceback-burnout + Work Role Pathology	3	8.6%
Work Satisfaction + Competence Rating + Work Role Pathology	2	5.7%
4 Variables	1	2.9%
Total	35	100.0 %

were defined as "burnout" were very likely to have received that rating because they had shown a significant decrease over the three years in their own estimation of their work satisfaction and ability to bounceback.

2) Promotions and Medical Qualification

The ATCs reported any of these changes to the study teams as they occurred. The reports by the ATCs were then confirmed at the end of the study by FAA records. Table 152 summarizes these changes.

3) Amount of Work Performed

A description of the rationale and procedure for measuring this job outcome is contained in Section IIIB. Briefly, amount of work performed by the ATCs was measured during on-the-job studies. This objective workload measure was standardized across facilities and sectors and an average workload was derived for all ATCs who had participated in field studies at least two times. By reference to these average workload measures, categories of low, medium, and high workload change over the three years in average workload were established.

4) Special Recognitions and Awards

ATCs received various awards and recognitions from the FAA for their job performance. These included: Outstanding Performance Award, Point with Pride, Quality Step-increase, Award for Valor, Yearly-in-grade, Suggestion Award, Special Act Award (group), and Special Achievement Award. The ATCs were asked at Round 5 how many of these awards and recognitions had been received during the three years of the study.

In order to have another dimension of job performance, a total awards index was created in a way that would reflect differences in ATC performance. Of the eight awards, Suggestion Awards, Special Act Awards (group) and Award for Valor were eliminated from the total awards score as these were considered specialized events and not accurately reflective of individual day-to-day job performance. The remaining five awards were differentially weighted to reflect their differing prestige as indices of the quality of ATC job performance.

For example, a yearly in-grade promotion was clearly less important in defining job performance than a Point with Pride award. Based on Nunnally's (1967) suggestion that variables in linear combinations should be weighted by the inverse of their standard deviations, the following weights were attached:

TABLE 152

Administrative Job Changes

<u>Status</u>	<u>Absolute Frequency</u>	<u>Relative Frequency</u>
No Change	283	68.0%
Medical Discharge-Psychiatric	11	2.6%
Medical Discharge-Physical	12	2.9%
Promotion to Supervisor	49	11.8%
Change to DSS	10	2.5%
Transfer to ATC work elsewhere	27	6.5%
Other ¹	24	5.8%

¹The other category represents those ATCs who discontinued participating in the study for a variety of personal reasons.

a) Yearly in-grade = 0.7; b) Quality step-increase = 1.5; c) Outstanding performance award = 1.8; d) Special Achievement Award = 2.6; and e) Point with Pride = 3.6. Thus the total award was equal to the sum of the products of the number of each type of award and the weights for each type respectively. A review of the frequency of each of these recognitions and awards follows.

a) Yearly In-Grade Increase

There was considerable variation in the number of times the ATCs received this increase, with 27 of the men reporting that they received none. Less than 5% of the respondents received four or more such increases. The high incidence rate of this type of recognition justifies its lower weight in the total awards index.

b) Quality Step Increase

The incidence rate for this performance measure is presented in Table 153. As can be seen, 199 men did not receive a quality step increase while 3 controllers reported receiving five such increases during the course of the study. This distribution of awards indicated that this was a measure which could be used to differentiate between ATCs. It was interesting to note that 188 men received a Quality Step Increase while 128 men received an Outstanding Performance Award. It is likely these two were inter-related, but not perfectly, and the lower incidence rate for the latter supports its higher weighting in the total performance awards index.

c) Outstanding Performance Award

The incidence rates for this and other awards are presented in Table 153. As can be seen, 259 ATCs (62%) did not receive an Outstanding Performance Award during the three years they were in the study, whereas one of the controllers received four such awards. The fact that 128 ATCs received this award at least once during the course of the study, while 259 did not, indicates that this award is probably reflective of higher performance as an ATC. If all of the men in the study had received such an award or if none had, it would be a meaningless measure of performance.

d) Special Achievement Award

This award was given to approximately 16% (63 ATCs) of the respondents. Three hundred and twenty-four ATCs reported not receiving any such award during the three years of the

Awards Received

No of Awards	Yearly In-Grade Increase		Quality Step Increase		Outstanding Performance Award		Special Achievement Award		Point with Pride		Suggestion Award		Special Act Award		Award For Valor	
	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%
0	27	6.5%	199	47.8%	259	72.3%	324	77.9%	364	87.5%	351	84.4%	351	84.4%	386	92.8%
1	146	35.1%	141	33.9%	90	21.6%	56	13.5%	15	3.6%	19	4.6%	15	3.6%	1	0.2%
2	130	31.3%	42	10.1%	30	7.2%	3	0.7%	5	1.2%	6	1.4%	11	2.6%		
3	58	13.9%	1	0.2%	7	1.7%	2	0.5%			4	1.0%	5	1.2%		
4	10	2.4%	1	0.2%	1	0.2%	1	0.2%					1	0.2%		
5	11	2.6%	3	0.7%					3	0.7%	2	0.5%				
6	2	0.5%									3	0.7%				
7	2	0.5%									1	0.2%	3	0.7%		
8							1	0.2%					1	0.2%		
9	1	0.2%									1	0.2%				
No Response	29	7.0%	29	7.0%	29	7.0%	29	7.0%	29	7.0%	29	7.0%	29	7.0%	29	7.0%

¹During the 3-year study period

study, while one of the men received eight awards. The incidence rate distribution supports the higher weight assigned this award in the total awards index.

e) Point with Pride Award

This award was given quite infrequently as 364 of the ATCs had not received one during the course of the study. On the other hand, it was interesting to note that 3 ATCs reported receiving five awards during the three years of the study.

f) Total Awards Index

Since this measure was a weighted linear combination of the five selected award categories, examination of the score distribution was skewed positively, reflecting the fact that a large number of ATCs received only a few (or no) awards.

In order to provide some evidence for the validity of this index, the relationship between selected job changes and this total awards index was examined. It was expected that those ATCs who were promoted would have higher scores on the awards index while those medically disqualified would have lower scores. As shown in Table 154, the mean awards index for those ATCs promoted was significantly higher ($p < .01$), and the mean awards index for those ATCs medically discharged for psychological reasons was significantly lower ($p < .05$). There was no difference between the mean award index scores for those ATCs medically discharged for physical reasons and those ATCs who remained in the study.

TABLE 154

Mean Total Award Scores by Administrative Status

<u>Status</u>	<u>N</u>	<u>Mean</u>
Change	282	38.25
Noted	45	50.24
Physically Disqualified-Psychological	5	21.40
Physically Disqualified-Physically	9	35.67

IV. Evidence For The Validity of Self-Reported Data

An important part of the data in the ATC HCS was collected by means of questionnaires answered directly by the study subjects. As in any research project utilizing subject responses to questionnaires, there was some question about the truthfulness of the responses. We were concerned that some of the questionnaire responses might be biased by subjects who might wish to influence the findings toward changes in management policy or in their own job situation.

It was critical, therefore, that we determine the accuracy of the responses to our questionnaires. Reported in this section are a number of checks that were made to ascertain the validity of various self-reports.

SUMMARY

Validity of Self-Report Job Scales

The ATCs' scores on "faking good," "faking bad" and "random response" scales included in the California Psychological Inventory were correlated with scores on job attitude scales as a check on the validity of self-reported job attitudes.

The generally low correlations indicated that the men were responding honestly and without strong bias to the job attitude questionnaires.

A. Validity of Self-Report Job Scales

Although it is difficult to detect directly whether or not questionnaire responses are "faked" (answered to effect a desired conclusion) or answered haphazardly, an indirect means to determine "faking" is to include "faking" scales in the questionnaires or inventories.

Such "faking" scales are included in the California Psychological Inventory (CPI). As this inventory was administered to our ATC subjects during their second examination at Boston University Medical Center, we were able to assess indirectly whether or not answers on job attitude scales were honest by correlating the variables involved with the three response irregularity scales of the CPI.

One of the CPI scales, the "sense of well-being" scale, is generally used as a measure of "faking bad" (Megargee, 1972), although close examination of the evidence would seem to indicate that this scale has excess meaning in terms of measuring the self-reported "well-being" of the respondent.

A second scale, the "good impression" scale, has been used to assess "faking good" or social desirability. Again, close examination of the literature, particularly the adjectives characterizing high and low scoring men (Megargee, 1972), seems to indicate excess meaning for this scale in terms of kindness-unkindness and satisfaction-dissatisfaction.

The third scale, "communality," has been used to identify those respondents who answered in a random fashion. Although meager, the existing evidence (Megargee, 1972) does seem to support this meaning of the scale.

The correlations between these CPI scales and eight measures of job attitude are displayed in Table 155. A high correlation between a person's score on the faking scales and other scales is evidence that the person was falsifying his answers on the second scale. The generally low or non-significant correlations indicate that the ATCs responded honestly to questions concerning their job satisfactions and their supervisors. The low "communality" correlations indicated that the ATCs did not respond in a random fashion to the job attitude questions.

Although there were some statistically significant correlations which might be taken to indicate some degree of faking in responses to the job attitude questionnaires, the low magnitude of the correlations reassured us that if there were some fake responses, they did not represent any strong biases. For

TABLE 155
Correlations Between Job Attitude Scales
and Selected CPI Scales
 Round 2 (N = 392)

<u>Scales</u>	<u>CPI Scales</u>		
	<u>Sense of Well-Being</u>	<u>Good Impression</u>	<u>Communality</u>
Work Satisfaction	.19	.23	.06
Coworker Satisfaction	.34	.26	.13
Pay Satisfaction	.12	.08	.01
Individual Satisfaction	.26	.22	-.01
Group Morale	.19	.17	.02
Initiation of Structure	.04	.04	.03
Consideration	.14	.11	.05
Tolerance of Freedom	.13	.08	.06

For N=392, correlations of .10 and .13 are significant at the 5% and 1% respect levels respectively

example, the highest correlation (.34) only indicates 11.5% of shared co-variation between these two variables. Furthermore, the excess meaning attached to the first two CPI scales would lead to the expectation of a positive relationship between the two CPI variables and measures of job satisfaction. That is, the "well being" emphasis of the first CPI scale and the "happiness-unhappiness" excess meaning of the second CPI scale would lead to the expectation of a positive relationship with job satisfaction as this empirical relationship has been found previously (Kavanagh and Halpern, 1977). If the correlations between the CPI scales and the industrial scales were larger, in the .60 to .80 range, we could conclude that the ATCs were biasing their answers. However, the results in Table 155 suggest that the ATCs were thoughtful and honest in their responses to the job attitude questionnaires.

SUMMARY

External and Internal Validators vs. MHR

The accuracy of the self-reports on the Monthly Health Review were checked by both external information and internal comparisons of information reported.

Telephone interview by the study's physician with selected ATCs resulted in confirmation of the MHR diagnosis of 43 of 58 illness events.

Comparisons of reported gastrointestinal symptoms with actual serum pepsinogen 1 levels demonstrated that reports of continuing gastrointestinal problems were much more frequent, as expected, among those with high pepsinogen 1 levels.

Internal analysis of data on upper respiratory infection (URI) showed that:

- 1) With an increase in number of URI symptoms reported, use of medical care increased, and proportion of episodes involving four or more days lost from work increased sharply;
- 2) the same symptoms reported as isolated events were less often attended by a physician and resulted in fewer days down;
- 3) reports of symptoms followed known seasonal variations.

Generally, the MHR self-reports were affirmed as accurate in all of these checks.

B. External and Internal Validators vs. MHR

Two general approaches to checking the accuracy of self-reported illness information on the Monthly Health Review (MHR) were utilized: external and internal criteria.

The external validations involved 1) telephone interviews by the study's physician to ATCs reporting respiratory symptoms to assess the accuracy of the diagnoses made on the basis of MHR information; and 2) comparison of reported gastrointestinal symptoms with actual serum pepsinogen levels to ascertain whether or not expected relationships were actually observed.

Internal validation of the MHR was assessed by analysis of reported symptoms to ascertain whether or not their frequency followed known seasonal variations in prevalence of specific illness conditions (e.g. upper respiratory infections in winter), and to check whether reports of symptoms as "episodes," "isolated events," and "continuing problems" reflected clinical medical expectations with regard to level of medical care involved, to days of restricted activity, and to known clusters of symptoms for the illnesses diagnosed.

Results of the telephone interviews confirmed that diagnoses based on the MHR information alone were identical to the diagnosis rendered by the physician on the basis of the telephone interviews in 43 of 58 events. Among the 15 remaining events, all but 2 were diagnosed within the same group of illness conditions as the MHR diagnosis. Of the remaining 2 diagnoses, 1 was considered an isolated symptom by the physician, but an episode of common cold on the basis of MHR scoring; the other was considered to be too non-specific to be diagnosed by the physician while it was categorized as an upper respiratory infection on the basis of the MHR symptoms.

The comparison of reported gastrointestinal symptoms with actual serum pepsinogen I levels demonstrated that, as would be expected, those with the lowest serum pepsinogen I levels did not report having symptoms such as nausea and/or vomiting as a continuing problem; and again as would be expected, those with the highest pepsinogen levels reported having such symptoms at an average rate of 37.5 symptomatic months per 100 person-years. Reports of stomach pain, abdominal cramps or heartburn were also more common as continuing problems in persons with high pepsinogen I levels, as would be expected.

Analysis of 125 URI episodes in the months from February through April, 1975 showed that as the number of reported symp-

toms in the URI cluster increased, the number of events utilizing doctors' care also increased, and the proportion of episodes involving 4 or more days lost from work increased sharply. Another indication of the validity of the MHR reports was that the same symptoms reported as isolated events occurred much less frequently, were less often attended by a physician, and resulted in fewer days lost from usual activities. Again, the ebb and flow of symptoms reported followed known seasonal variation.

Analysis of the clustering of individual respiratory symptoms showed that the ATCs related the symptoms to the three alternative choices of chronicity: illness episode, isolated symptom or continuing problem. The symptoms checked as illness episodes were in fact reported far more frequently in fall and winter than in spring and summer. "Sneezing, stuffy or runny nose," for example, was checked most frequently as part of an illness episode, but far less frequently as an isolated symptom, and only rarely as a chronic problem. On the other hand, frequent dry cough, productive cough, and "aches or pains in muscles or joints other than back" were reported as chronic problems by almost as many ATCs as those reporting them as acute episodes.

Other reports of symptoms with the expected chronicity - e.g. reports of diarrhea, stomach pain/abdominal cramps, back pains, headaches, sleep problems, heartburn, excess fatigue, and others primarily as isolated events - also tended to affirm the accuracy of the MHR reports.

An extended discussion of the methods of validation summarized briefly above, and more detailed results of the analyses performed to assess the accuracy of the MHR reports is available in a paper prepared for publication, "Use of a Monthly Health Review to Ascertain illnesses and Injuries in the Air Traffic Controller Health Change Study."

SUMMARY

Validity of Self-Reported Marital Satisfaction:
Relationship with Mate-Role Function as Evaluated
by PSS Interviewer

Self-reported marital satisfaction, checked against the diagnoses of mate role problems made by a trained interviewer during the psychological examinations, appeared to be accurate and honest, as was also self-reported compatibility between mates on family goals.

C. Validity of Self-Reported Marital Satisfaction: Relationship with Mate-Role Function as Evaluated by PSS Interviewer

As discussed in Section IIIB, the Air Traffic Controller Biographical Questionnaire (ATC BQ) contained a self-reported measure of the ATC's marital satisfaction. In order to examine the accuracy of this self-reported data, the relationship between mate role dysfunction on the basis of the PSS interview and self-reported marital satisfaction were examined. Correspondence between diagnosed mate role problems, as determined by a trained interviewer, and a self-reported measure of marital satisfaction would provide some evidence that the ATCs responded honestly.

Analysis revealed strong and statistically significant differences in degree of marital satisfaction between ATCs diagnosed as asymptomatic and those diagnosed as symptomatic in mate role dysfunction on the PSS ($p < .0001$). ATCs diagnosed in the PSS interview as having mate role problems had a mean of 3.519 on the marital satisfaction item, whereas those judged to have no problems by the interviewer had a mean of 1.655 on a response scale ranging from 1, "very happy and satisfied," to 5, "very unhappy and dissatisfied." The mean of the symptomatic ATCs was midway between "neutral, or very mixed feelings" and "somewhat unhappy and dissatisfied."

In addition to the self-report of marital satisfaction, the ATC BQ also contained a measure of the ATC's perception of how well he and his wife agreed on family goals (see Section IIIB.). Examinations of the relationship between the total goals compatibility score for the self-report and the mate role status as evaluated in the PSS interview provided strong evidence that the ATCs' perceptions of the compatibility in their marriages, as self-reported, were accurate. Those ATCs diagnosed as asymptomatic perceived much greater compatibility between themselves and their spouses than did those diagnosed as symptomatic ($P < .0003$). This result provides additional evidence for the validity of the self-reported data.

SUMMARY

Technological and Management Changes Reflected in
Job Attitude Questionnaire Results

Self-reported individual satisfaction of ATCs and group morale showed an expected positive change at the Islip facility as a result of a change in management policy.

At the same time, introduction of new technological equipment, for radar control at all facilities, resulted, as expected, in a negative change in work satisfaction.

The lack of any changes in coworker or pay satisfaction at this time tended to affirm the honesty of the responses on the other scales.

Together, the reflection of events in the responses to the attitude scales provided evidence of the honesty of the responses.

D. Technological and Management Change Reflected in Job Attitude Results

In late 1974, the study team received a request from the new facility head at Islip to evaluate the impact of his new managerial philosophy and policies. Coincidentally, the new technology for controlling aircraft was implemented in all of the facilities in the study. This technological change in the radar equipment was made to simplify the ATC's job, and thus to improve the quality of job performance. However, it was the study team's observation, while talking to the men, that they really did not like this technological change.

Thus, there were two significant changes that we wished to investigate. One of the most common findings in the literature on organizational change is that employee attitudes are usually affected by any change (cf. French and Bell, 1973; Huse, 1975; Thomas and Bennis, 1972). In this case, we expected the technological change to have a negative effect on the attitudes of the ATCs toward their work, while the change in management policy at Islip was expected to lead to positive attitude changes in general.

Actual occurrence of the hypothesized attitudinal changes would constitute evidence for the validity of the responses on attitude questionnaires. That is, if the ATCs were responding honestly to the job attitude questionnaires, these "natural" changes in their work environment should have been manifested in attitudinal changes.

Since job attitudes were collected continuously during the time when the changes were made, it was possible for us to test our hypotheses. The facility chief change occurred in December, 1974, approximately the same time as the technological change. Using attitudinal data collected during October and November 1974 as a pre-measure and that collected during January and February 1975 as a post-measure, we were able to assess attitudinal changes.

For the analysis, we contrasted the attitudinal changes at Islip with those at the other facilities. As expected, the ATCs' satisfaction with their work itself decreased significantly at Islip. Furthermore, work satisfaction decreased significantly in the other facilities, and the negative change at Islip was the same as the change in all other facilities. As discussed in Section IIIB5, this specific aspect of job satisfaction is concerned with the actual work the ATC does. The negative change in satisfaction with this aspect in part is due to the technological change introduced into the ATC's job. Since this change

occurred in all facilities, it provides strong evidence that the ATCs were responding honestly on this attitude scale.

The significant positive changes in both individual satisfaction and group morale at Islip were as expected. These two variables did not show any change for the other facilities. These two scales measure overall or general satisfaction in terms of individual and group factors on the job. Thus, a change in management philosophy or policy would be expected to affect these overall measures.

Finally, the lack of any changes in co-worker or pay satisfaction also provides indirect evidence that the ATCs were responding honestly to these scales. One would not expect either a technological or management policy change to affect the ATCs' attitudes toward their co-workers or their pay.

In summary, the pattern of changes in attitudes coincidental with important changes in their work environment provided strong evidence that our study group responded honestly to the self-report measures of their attitudes.

SUMMARY

Relation of Hypochondriasis, Hysteria, Depression and Anxiety to the Frequency of Diagnosed Physical Health Changes

To test whether or not a psychological propensity to complain might generate self-reports of symptoms and ultimate diagnoses of illness conditions, hypochondriasis, hysteria, depression and anxiety scales were administered and scores were correlated with number and level of illnesses reported during the interval following.

ATC scores were lower than the average of the norm group in all except hysteria, in which higher than average scores were attributed to a tendency to deny personal problems. There was no evidence that men with greater psychological propensity to complain had a higher frequency of any level of physical health changes.

E. Relation of Hypochondriasis, Hysteria, Depression and Anxiety to the Frequency of Diagnosed Physical Health Changes

When the diagnosis of physical health changes is based in whole or in part on self-report, one must consider the possibility that illness reporting, and hence, the probability of rendering diagnoses will be influenced by such personality characteristics as tendencies toward hypochondriasis, hysteria, depression and anxiety, all of which could generate a propensity to complain about minor physical symptoms.

In order to examine this possibility in the ATC HCS, the hypochondriasis and hysteria scales from the MMPI, and brief but validated depression and anxiety scales from the same test, were administered at the third round of examinations. The scores obtained were compared with population norms established for the MMPI and correlated with the frequency of physical health diagnoses at Level 0, Level 1, Level 2, and Level 3 during the interval which followed the third round of examinations. This analysis was thus a prospective determination of the relationship between these psychological tendencies and the frequency of diagnoses made by the study physician on the basis of the health surveillance procedures utilized in the study.

Results

For the 295 ATCs having complete data for interval 3, the mean, the maximum and the minimum number of health changes at each level is listed below:

<u>Level of Health Change</u>	<u>Mean</u>	<u>Maximum</u>	<u>Minimum</u>
Level 0	0.5	6	0
Level 1	1.5	9	0
Level 2	0.2	3	0
Level 3	0.04	1	0

It is correct to infer that the majority of men had zero health changes at each level indicated. A fairly good distribution of Level 0 and Level 1 health changes occurred, but for Level 2 and Level 3, the distribution was extremely truncated.

The mean scores for each of the psychological scales on the PSY 130 instrument administered at Round 3 are shown below in standardized metric with 50 equal to the mean of Minnesota normal adults and 10 equal to the standard deviation of their distribution.

<u>Scale</u>	<u>Mean</u>	<u>Maximum</u>	<u>Minimum</u>
Hypochondriasis	47.8	72	39
Hysteria	57.1	80	36
Depression (D30)	48.6	82	37
Bendig Anxiety	44.7	80	34
Hysteria Subscales:			
Admission of symptoms	47.8	74	38
Denial of problems	60.1	81	34

The table reveals that this sample of ATCs had a lesser tendency toward hypochondriasis than the standardizing group of "Minnesota normal adults." Depression score was also somewhat lower than the normative sample of college students free of psychological disorders. The Bendig Anxiety scale -- a short form of the Taylor Manifest Anxiety Scale -- had a considerably lower mean than the original standardizing sample. On the hysteria scale, however, the ATCs scored higher than the Minnesota normals. When the hysteria scale was broken down into its two components, however, it became apparent that this elevation in mean score came completely from the tendency of ATCs to deny personal and interpersonal problems (this scale being one standard deviation above the normative mean). On the other hand, the tendency to admit physical symptoms, as measured by the "admission" scale coincided with the finding for the hypochondriasis scale that ATCs were slightly below average adults.

The correlations between the six psychological scales and the frequency of diagnosed health changes at Levels 0, 1, 2, and 3 can be summarized simply. The 24 correlations in this matrix all ranged between +.08 and -.10. Fourteen of these small insignificant correlations were in the negative direction and 10 in the positive direction. Under the hypothesis that psychological problems would generate greater numbers of diagnosed physical health changes, one would expect the great majority of these correlations to be positive and to be of much greater magnitude.

Conclusion

The evidence from these data analyses was clear and consistent. ATCs were not hypochondriacal, anxious or depressed to a greater degree than the average population. The only elements in their personality which could have been considered

"hysterical" in nature were somewhat higher frequencies of denial of problems. Although the range of psychological scores was considerable for this sample of ATCs, there was no tendency for men with greater psychological propensities to complain to have a higher frequency of any level of physical health change as diagnosed by the study physician.

SUMMARY

Relationship of Subjective Distress in the Psychiatric
Interview to Prior Depression and Anxiety

Monthly self-reports of anxiety and depression were checked against the assessments of anxiety and depression by the professional psychologists administering the PSS (Subjective Distress Scale).

Cross tabulations of interviewer and self assessments showed that the interviewer's positive findings of anxiety and depression were largely substantiated by the earlier self-reports, but there were in addition a large number of self-reports of symptoms that were not matched by interviewers' assessments of significant symptomatology. This surfeit of self-reports may have reflected less significant, or transient symptoms, or general over-reporting.

F. Relationship of Subjective Distress in the Psychiatric Interview To Prior Depression and Anxiety

The monthly assessments of depression and anxiety were self-report, pencil-and-paper instruments. On the other hand, the psychiatric interviews were conducted in a structured, clinical format which allowed professional judgment in ascertaining symptomatology. We checked the validity of the monthly self-reports by comparing them with the impressions of the professional interviewer. As the Subjective Distress criterion scale of the psychiatric interview (PSS) primarily assessed significant symptoms of depression and anxiety, it was chosen as the most appropriate PSS scale for comparison with the self-reports.

Table 156 shows that men assessed by the professional interviewer as having significant subjective distress had previously reported rates of depression nine times higher than those found in asymptomatic persons during their psychiatric interview. The cross-tabulation results shown in the lower half of this table indicate that only 2 of 17 men who were symptomatic in the interviews had self-reported rates of depression categorized as asymptomatic. On the other hand, 66 of 81 men who were symptomatic by self-report were asymptomatic by interview.

Table 157 shows the same comparisons for monthly anxiety. Essentially the same results were found for anxiety as for depression.

An appropriate conclusion from the validity check might be that men who were having problems with anxiety and depression by assessment of the PSS interviewer had self-reported the problems previously. However, an additional group of men reported that they were having these problems, but appeared not to be having significant symptomatology by the time of the interview. These men may have been overreporting less significant symptoms, or their symptoms may have been transient. The validity check did establish that the positive findings of the PSS interviewer were substantiated by the previous self-report.

Annualized Rate Of Monthly Depression Between The Second
And Third Examinations At Boston University For
ATCs With And Without Subjective Distress At Their Third Examinations

	<u>Total Available Subjects</u>	<u>Subjective Distress Asymptomatic</u>	<u>Subjective Distress Symptomatic</u>
	347	330	17
Age Rate (episodes /yrs/year)	.76	<u>.57</u>	<u>4.50</u>
	1.90	1.60	2.70
	$t = 9.37 \quad p < .0001$		

Cross-tabulation Of Monthly Depression
Asymptomatic And Symptomatic Categories Between
The Second And Third Examinations At Boston University
ATCs With And Without Subjective Distress At Their Third Examinations

	<u>Monthly Depression</u>		<u>Totals</u>
	<u>Asymptomatic</u>	<u>Symptomatic (Acute to Chronic)</u>	
<u>Asymptomatic</u>	264 (observed) (253) (expected)	66 (77)	330
<u>Symptomatic</u>	2 (13)	15 (4)	17
<u>Totals</u>	266	81	347

$\chi^2 = 38.34 \quad p < .00001$

TABLE 157

Annualized Rate Of Monthly Anxiety Between The Second And
Third Examinations At Boston University For ATCs
With And Without Subjective Distress At Their Third Examinations

	<u>Total Available Subjects</u>	<u>Subjective Distress Asymptomatic</u>	<u>Subjective Distress Symptomatic</u>
	347	330	17
Rate of (monthly/	.78	<u>.68</u>	<u>2.80</u>
	<u>2.01</u>	<u>2.00</u>	<u>2.70</u>

$$t = 4.26 \quad p < .0001$$

Cross-tabulation Of Monthly Anxiety Asymptomatic And
Symptomatic Categories Between The Second And Third Examinations
At Boston University For ATCs With And Without
Subjective Distress At Their Third Examinations

	<u>Monthly Depression</u>		<u>Totals</u>
	<u>Asymptomatic</u>	<u>Symptomatic (Acute to Chronic)</u>	
<u>Asymptomatic</u>	262 (252)	68 (78)	330
<u>Symptomatic</u>	3 (13)	14 (4)	17
<u>Totals</u>	<u>265</u>	<u>82</u>	<u>347</u>

$$\chi^2 = 30.82 \quad p < .00001$$

SUMMARY

Liver Function Tests as an Index of the Validity
of Alcohol Abuse and Drinking Assessments

Three tests sensitive to liver damage were performed during the physical examinations and provided a means of checking the validity of the alcohol use and abuse assessments.

Two of the liver function tests discriminated the heavy drinkers and the alcohol abusers from the others, with the strongest association between alcohol abusers and liver damage. The PSS assessments of alcohol abuse were confirmed by the Liver Test data.

C. Liver Function Tests As An Index Of The Validity
Of Alcohol Abuse And Drinking Assessments

Three liver function tests were performed as part of the serology studies conducted at each evaluation at Boston University - serum glutamic oxalacetic transaminase, serum glutamic pyruvic transaminase and alkaline phosphatase. These tests are sensitive to liver damage and the values generated become elevated as the liver becomes impaired. The tests, therefore, provided a means of checking on damage to the liver that might be associated with alcohol use and abuse.

Table 158 displays the results of comparisons of the liver function tests of those who were asymptomatic on the Psychiatric Status Schedule evaluation of alcohol abuse with those who were symptomatic according to our criteria. Two of the liver tests were significantly elevated among those classified as symptomatic alcohol abusers according to behavioral and psychiatric criteria. There was also greater variability in the liver function tests among those classified as symptomatic.

Table 159 displays the ethanol consumption per week among those who had abnormal liver function tests and those who did not at the end of the study. As expected, ethanol intake was significantly higher among those who were abnormal on two of the three tests.

It was interesting to note that the relationship between alcohol abuse and abnormal liver functioning was stronger than that between ethanol intake and liver functioning (this comparison can be made by comparing the absolute magnitude of the t-tests).

In sum, two of the liver function tests were clearly elevated among those having alcohol abuse problems defined in psychiatric and behavioral terms. In addition, men with abnormal liver function as determined either by SGOT or alkaline phosphatase, independently reported higher volumes of ethanol consumption to the study interviewers. Hence, a completely different and blind (to the psychiatric interviewers) source of data confirmed the validity of our interview data and the significance of our classification of alcohol abuse.

TABLE 158

Alcohol Abuse Effects On Liver
Function Tests At Intake

	<u>Alcohol Abuse Status</u> <u>At Intake Examination</u>		<u>t</u>	<u>p</u>
	<u>Asympto-</u> <u>matic</u> <u>(N=383)</u>	<u>Sympto-</u> <u>matic</u> <u>(N=31)*</u>		
Serum Glutamic Oxalacetic Transaminase**	Mean 43.83 (S.D.) (13.67)	58.13 (44.98)	4.27	.0001
Serum Glutamic Pyruvic Transaminase**	Mean 23.85 (S.D.) (12.64)	26.58 (26.15)	1.04	N.S.
Alkaline Phosphatase**	Mean 60.70 (S.D.) (20.43)	82.68 (28.81)	3.29	.002

*

The results of two men were excluded because the laboratory assay was invalid.

**

Normal limits: SGOT, 0-45 International units/liter
SGPT, 0-41 International units/liter
Alk.Phos., 33-110 units/liter

TABLE 159

Ethanol Consumption Differences Between
Men With And Without Abnormal Liver
Function Tests At Their Final Examinations

Normal Serum Glutamic Oxalacetic Transaminase (N=376)	13.92 (14.05)	$t=2.23 \text{ } p < .03$
Abnormal Serum Glutamic Oxalacetic Transaminase* (N=9)	24.56 (17.21)	
Normal Serum Glutamic Pyruvic Transaminase (N=339)	13.74 (14.15)	$t = 1.76 \text{ } p = \text{N.S.}$
Abnormal Serum Glutamic Pyruvic Transaminase** (N=44)	17.75 (14.46)	
Normal Alkaline Phosphatase (N=364)	13.76 (13.08)	$t = 2.44 \text{ } p < .02$
Abnormal Alkaline Phosphatase*** (N=23)	21.77 (25.72)	

* Normal limits: 0-45 International units/liter

** Normal limits: 0-41 International units/liter

*** Normal limits: 33-110 units/liter

SUMMARY

Legal Problems as Validation of Impulse
Control Symptomatology Classifications

To check the possibility that our finding of a high rate of impulse control symptomatology might have been due to an unrealistic cut-off score on the PSS Impulse Control scale, we checked for legal problems indicated in the life change inventories completed at each examination at Boston University Medical Center.

We found that men with impulse control disturbances at intake had significantly more legal problems before and after intake than others, and that these problems did not particularly distress them. These findings confirmed the validity of the classification system for impulse control disorders.

H. Legal Problems As Validation Of Impulse Control Symptomatology Classifications

We found a high rate of impulse control disorders among the air traffic controllers, and we wondered if this high rate might have been generated by a cut-off score that was unrealistic. Therefore, we undertook several checks on the appropriateness of our impulse control criterion cut-off score. One check involved an investigation of the relationship between legal life events and our impulse control classifications.

By definition and theory, men with impulse control problems should have a higher probability of having legal problems because their antisocial behavior would be likely to draw attention from law enforcement officials, or be the cause of legal actions against such individuals. The ROLE legal life events inventory contained a number of legal life events such as being jailed, sued, foreclosed and so on. Other events were subsuned by the Holmes and Rahe (HR) and the Paykel, Prusoff and Uhlenhuth (PUP) list; the ROLE listed all of these and several others. Since subjects completed the ROLE at intake and subsequent examinations, it was possible to determine if the theory was correct. If our findings supported the theory, we could be much more confident in our findings of higher rates of impulse control disorders being real. If we were misclassifying subjects, then we would not find the expected association with legal problems.

Table 160 shows that men with impulse control disorders at intake (prevalence cases) had significantly higher PUP legal scores than either asymptomatic controls or those diagnosed after intake. Since the correlation between PUP scores and the number of events was .90 or above (see Jenkins and Rose, 1978), we could safely conclude that men diagnosed to have impulse control disorders had the expected number of legal problems prior to intake.

Results in Table 160 also suggest that legal problems lead to impulse control disorders since the incidence was not different from the asymptomatic cases.

Table 161 shows that men with impulse control disorders at intake had significantly higher legal life event scores during the interval between intake and the second evaluation (scores were derived from their reports at the second evaluation looking backwards over this time span). Our data showed that our case assignments of impulse control disorders did differentiate those men who

Legal Life Events As A
Validity Index Of Impulse Control
Symptomatology: Comparison Of
Asymptomatic Controls, Prevalence Cases And Incidence Cases

Life Event Score For 6 Months Prior To Intake		Asymptomatic	Prevalence	Incidence	F	p
		Controls* N=131	Cases* N=50	Cases* N=71		
Holmes and Rahe Legal Life Changes	Mean (S.D.)	2.33 (7.50)	5.38 (13.39)	1.39 (3.69)	3.50	.04
Paykel, Prusoff & Uhlenhuth Legal Life Changes	Mean (S.D.)	2.40 (5.64)	4.04 (8.49)	1.38 (3.46)	3.04	.05
ROLE Legal Life Change Distress	Mean (S.D.)	6.52 (18.79)	13.55 (35.39)	4.27 (11.68)	2.51	.09

*
Asymptomatic controls were ATCs who never had any significant symptomatology in the 5 criterion areas of the Psychiatric Status Schedule examination. Four controls did not complete the life change assessment and were excluded from this analysis. Prevalence cases had significant impulse control symptomatology at intake. One such case did not complete the life change assessment and was excluded from this analysis. Incidence cases developed significant impulse control symptomatology after intake and did not have it at intake.

TABLE 161

Legal Life Events As A
Validity Index Of Impulse Control
Symptomatology: Later Events As A
Function Of Intake Status

Life Event Score Between Intake and Second Examinations		Asymptomatic* N=341		Symptomatic* N=51		t	p
		Mean	(S.D.)	Mean	(S.D.)		
Olimes and Rahe Legal Life Changes	Mean (S.D.)	1.64 (7.35)		6.67 (18.62)		3.50	.0009
Sykel, Prusoff and Jenhuth Legal Life Changes	Mean (S.D.)	1.91 (5.27)		4.90 (10.35)		3.23	.002
Legal Life Change Distress	Mean (S.D.)	9.84 (28.26)		28.24 (57.71)		3.65	.0006

*Asymptomatic = No impulse control disturbance assessed in Psychiatric Status Schedule examination at intake.

*Symptomatic = Impulse control disturbance above criterion level on Psychiatric Status Schedule examination at intake.

had and would have more legal problems than men without this disorder.

In summary these data supported our impulse control disorder classifications and reassured us that the high rate of impulse control disorders was not an artifact of our criterion cut-off scores.

SUMMARY

Predictors of Mild and Moderate Health Change

Average annualized illness rates were computed and were related to psychological variables measured before onset of the illnesses.

The following factors were found to be related to total morbidity:

- 1) The group with the most illness had the most work-related anxiety, as measured by the ATC questionnaire;
- 2) The high illness group had the lowest ability to discharge tension effectively and reported that ATC work "cost" them a lot in terms of interference with other aspects of their lives;
- 3) Those in the high illness group were least often chosen by their peers for amicability or as ideal team members;
- 4) The high illness group had the lowest group morale as measured by the Kavanagh scale, the least satisfaction with management, and consistently rated their supervisors as having inadequate consideration for others;
- 5) The high illness group was more job-involved, more Type A, as measured by the Jenkins Activity Survey, and more dominant, more sociable and more accepting of themselves as measured by the CFI;
- 6) The high illness group had significantly more life changes that were distressing, and this proved to be one of the strongest predictors of total morbidity;
- 7) The high illness group showed significantly lower cortisol secretion and significantly less variability in blood pressure at field studies.

Discriminant function analyses, using the variables that were significant in univariate studies, indicated that the predictor variables were best for discriminating between individuals in the highest and the lowest illness groups, but not of great value in discriminating individuals in the middle groups of health change. The variables that predicted low vs. high rates were: Amount of distressing life change, systolic residual range (range beyond that expected from the level of blood pressure), total cortisol secretion, and Type A personality.

Using these four variables, 76.7% of the individuals in the high

group and 79.1% in the low group were predicted. Predictors were determined separately for each of the four diagnostic categories in which mild and moderate illness was most frequent.

V. PREDICTIVE FINDINGS1. Predictors of Mild and Moderate Physical Health Changes

Mild and moderate health changes were defined for purposes of this study as those illnesses and injuries scored at severity levels 1 and 2. The frequency of these events was treated as a continuous score adjusted for the amount of time each respondent was in the study and the percentage of Monthly Health Reviews returned. The derivation of the basic statistic, the average annualized compressed illness rate, was described earlier (Section III C). The present section describes the psychological, biographical and field predictors of average annual illness rates for all causes of morbidity and then separately for nine major categories of medical diagnoses.

Average annualized illness rates were computed for all four intervals of the study and these were related to psychological variables measured at Round 1. Because a larger array of psychological variables were available for Round 2, these were also entered into the analyses but in order to avoid the problems of circularity caused by the presence of interval one illness events in the overall averages, new indexes of morbidity were calculated based on the average for intervals 2, 3, and 4. For these indexes, all Round 1 and Round 2 psychological data were truly predictive inasmuch as the data on the predictor variables were collected before the beginning of interval 2. The average illness rates for this shorter time period also eliminated from consideration a number of men who participated in the study only through interval 1, i.e., to the second round of examinations. To the extent that there were unreliabilities in psychological data and in medical data at the beginning of the study which were eliminated after both participants and staff became more familiar with the routine, the average rates for intervals 2 through 4 may also be more reliable expressions of respondents' particular morbidity patterns.

Total Average Morbidity

The total of average annualized morbidity for all diagnostic categories including injuries represents the best single overall index of physical health change available to the study. It is heavily weighted by the most common diagnostic categories such as acute respiratory disorders which comprise 45% of all illness episodes. The total index is also administratively important because it represents also short term absenteeism from work due to illness, and those factors which predict the total index will also predict the short term absenteeism.

ATCs were divided into four groups on the basis of their average annualized illness rate. Only men who had at least one adequately reported interval of observation were included in the analyses. The low illness group averaged less than one minor illness episode or

injury per year, the high illness group averaged five or more illness episodes or injuries of any kind per year and the two intermediate groups had correspondingly less illness. The exact delimitations of the groupings and the number of men in each category for the analyses based on all four intervals and those based on the three intervals after the first are shown in the small table below:

AVERAGE NUMBER OF ILLNESS EPISODES

	Total Sample	Less Than One Per Year	1.0 - 2.5 Per Year	2.6 - 4.5 Per Year	5.0 or More Per Year
Analyses for inter- vals 1-4	378	58	129	131	60
Intervals 2-4 only	344	72	103	112	57

The one-way analyses of variance grouped men in the four categories above and calculated mean scores on the possible psychosocial predictors. Fifty-two such predictors were used from Round 1 of examinations and 57 from Round 2. Utilizing the $P = .05$ level of statistical significance, 7 of 52 Round 1 predictors and 18 of the 57 Round 2 predictors were significantly different across groupings by degree of illness averaged for all four illnesses of observation. When the outcome variable was the average illness rates for the three intervals excluding the first, 3 variables from Round 1 were found significant, whereas 15 Round 2 predictors were significantly associated with illness rates in the three ensuing intervals. To eliminate the possible effect of controllers' first interval illness on their psychological responses during the Round 2 examinations, Round 2 variables are discussed only as possible predictors of illnesses occurring after the second examination, i.e., the average rates based on intervals 2-4. The reason why Round 1 variables were so much weaker as predictors of total illness rates is not clear. We suspect that the greater length of the interview and questionnaire procedures at the intake examination may have led to fatigue and carelessness in subjects' responses and that this may have weakened the validity of the psychological variables. We also believe that reporting of illnesses became more reliable as the study progressed and that the procedures for assigning diagnoses became more methodical after the first few months. For these several reasons the analysis of predictors of mild and moderate illnesses will concern mainly the illness averages generated by the last three intervals of observation and the psychological data gathered at Round 2.

Psychological and Job-Related Predictors of Total Morbidity

There was a consistent tendency for variables reflecting psychological distress and anxiety to be predictive of future physical illnesses as diagnosed by the study physician. Scores on the work-related anxiety factor generated by the Air Traffic Controller Questionnaire were associated with future illness in that the most healthy group had the lowest mean and the group with 5 or more illnesses per year had the highest mean of the four groups considered ($P = .004$). This high illness group also had the lowest ability to discharge tension effectively ($P = .003$) and reported that ATC work "cost" them a lot subjectively in terms of expenditure of efforts, countering of inconveniences and creating a drain on their emotional resources ($P = .02$).

Nominations by the controllers of those among their peers whom they found to be most amicable and those whom they would wish to work with on their ideal team also were associated with future illness rates. Men in the highest illness categories were least often chosen for amicability or as ideal team members ($P = .001$ and $P = .005$). Ratings of technical competence as an ATC were not associated with future illness risks.

Three variables dealing with an ATC's satisfaction with the work situation were associated with future illness. Group morale as measured by the Kavanagh Scale was lowest both at Round 1 ($P .03$) and at Round 2 (but only marginally significant at $P = .09$) in men who had highest illness rates for intervals 2-4. This high illness group also had least satisfaction with management ($P = .01$) and consistently rated their supervisors as showing less than adequate amounts of consideration for others. Although many of the 344 men included in these specific data analyses had the same limited number of supervisors, the men who perceived supervisors as more considerate remained physically healthier than those who perceived them as having less consideration for the employees ($P = .02$).

Several long-standing personality traits were strongly predictive of future illness. Both the Jenkins Activity Survey, a test for the coronary-prone behavior pattern, and the California Psychological Inventory, a multidimensional personality measure, had predictive qualities. Men who were most Type b -- that is, those who had fewer of the competitive, hurried, achievement-oriented traits of coronary proneness -- were the most healthy of the study population. The high illness group was significantly more Type A ($P = .02$). This tendency came mostly from the greater job involvement which was characteristic of the higher illness groups ($P = .02$) and secondarily from the greater haste, impatience and irritability which high illness persons tended to show ($P = .02$). On the CPI, high illness persons were significantly more dominant ($P = .04$) -- a finding consistent with their tendency to be more Type a. They were also more

sociable ($P = .03$) and more accepting of themselves (less self-critical and less prone to guilt) ($P = .02$).

Among the strongest predictors of total morbidity was the amount of life stress and life change encountered in the period immediately preceding the beginning of intervals 2-4. This study used three different methods for scoring life change. These variously reflected either effort for adjustment and/or amount of distress associated with the changes in one's life circumstance. All of these variables were strongly related in that the two groups have illness rates above the sample median, had substantially more life changes than the healthier groups. The Holmes-Rahe Scale was significant at $P = .009$, the Paykel Scale was significant at $P = .002$ and the self ratings of distress associated with life change, developed specifically for this study, were significant at $P = .0001$.

Biographical Predictors of Total Morbidity

Several of the biographic items revealed by the ATCs on the Biographical Questionnaire that was completed at the intake examination were found to be associated with total average annual rate of illness. However, among these, only two associations were considered sufficiently significant to report.

The amount of education completed was associated with the illness rates, though not in linear fashion. College graduates had the lowest rates, high school and grade school graduates had intermediate values, and men with some college education short of a college degree had the highest average illness rates among these different groups ($P = .004$).

Men who lost a parent before age 18 because of separation or divorce had higher illness rates than those who lived in a two-parent household or those who lost a parent by death.

None of the biographical variables predicted total illness with the clarity or statistical strength of the stronger psychological or field predictors.

Biological Field Predictors of Total Morbidity

Two of the major predictors of increased moderate and mild health change observed in the study were related to the measurement of serum cortisol and blood pressure in the field studies. In order to obtain a more stable estimate of individuals' physiological responses to air traffic work, we selected men who had three or more field studies, and averaged their responses over all studies to obtain a characteristic value for cortisol and blood pressure response. In doing this, we were unable to use these characteristic levels of cortisol or blood pressure response as predictors of health change,

because they were actually measured concurrently with the health changes observed during the course of the study. However, we were able to separate individuals' values from their first blood pressure or cortisol examination. These values obtained during this first study could be used as a predictor variable, as it preceded interval two.

We totaled each man's cortisol values collected every twenty minutes for five hours. We then averaged the three or more studies to obtain an average total cortisol for the 227 men who were studied this frequently. We then divided these men into terciles of high, middle and low values. The high group did not get below 13 $\mu\text{g}/100$ ml while the individuals who were in the low group in the morning went below 10 $\mu\text{g}/100$ ml. Similar differences were observed in the afternoon. These groups are shown in Figure Y. Because each of the three groups, high, middle and low, were actually composed after three or more studies, the results are very stable and very significantly different.

We were surprised to observe that individuals in the lowest cortisol group had significantly more health change during the course of the study as is shown in Table 162. These differences are highly significant and whether one measures total cortisol for the day or the maximum cortisol on position, those men with the lowest values had significantly more health change ($p < .003$ and $p < .003$ respectively).

Because of the rather surprising finding that individuals who had low or perhaps suppressed levels of cortisol at work had a greater amount of moderate or minor illness, we decided to investigate whether or not the first cortisol values obtained during the first field study would be predictive of the average annualized health change in the same way that the values obtained for the average total cortisol were correlated with increased health change. These data are presented in Table 163, and it is clear from this table that the individuals in the lowest level of annualized health change, i.e., those with less than 1.0 illness episodes per year, had a total cortisol in the first field study of 1205 $\mu\text{g}/100$ ml compared to those in the highest illness category, those with 5 episodes per year, who had a total cortisol of 1102 $\mu\text{g}/100$ ml. This difference is significant at the .02 level. Therefore, the lowered secretion of cortisol observed in the first field study is predictive of individuals who showed more frequent health change, the same result that was observed when the cortisol for all visits was averaged. It is of note that the first field study was performed, on the average, 3.9 months before the start of the second interval, at which time we began averaging the cortisol data as explained earlier in this section. Only 12% of the sample had the first field study after their second examination at B.U. and the beginning of the second interval.

WORK

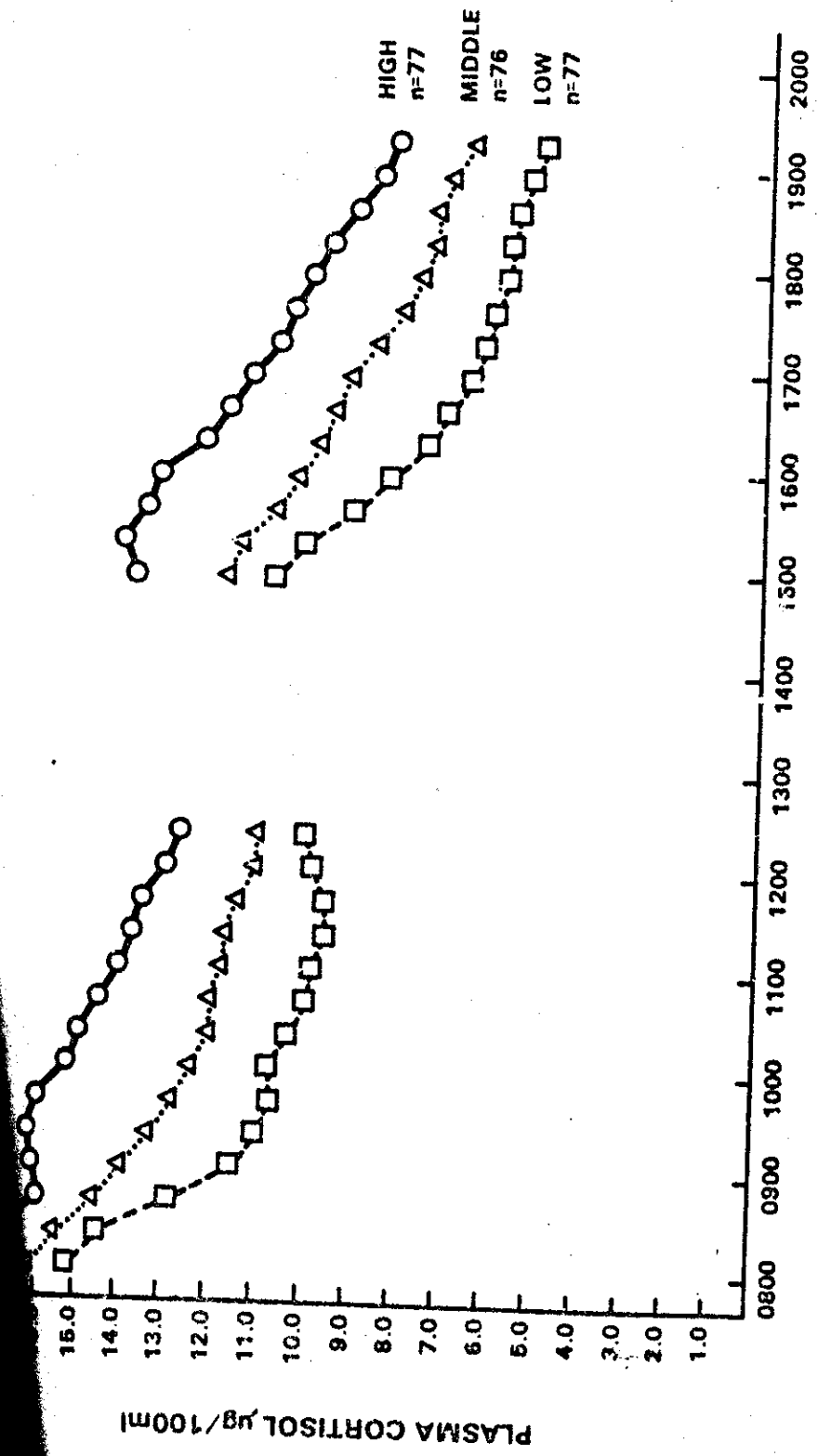


TABLE 162

Differences In Rate Of Physical Health
Change As A Function Of Cortisol Levels
At Work Among ATCs

AVERAGE TOTAL CORTISOL FOR MEN
With ≥ 3 FIELD STUDIES

		<u>LOW</u>	<u>MIDDLE</u>	<u>HIGH</u>	<u>F</u>	<u>P</u>
AVERAGE TOTAL	MEAN	3.80	2.75	2.75	6.24	<.003
ANNUAL RATE	STD	2.72	1.63	1.84		

MAXIMUM CORTISOL ON POSITION

		<u>LOW</u>	<u>MIDDLE</u>	<u>HIGH</u>	<u>F</u>	<u>p</u>
AVERAGE TOTAL	MEAN	3.91	2.79	2.59	9.36	<.0003
ANNUAL RATE	STD	2.62	1.91	1.56		

TABLE 163

Total Cortisol At Work As A Predictor Of
Average Annualized Health Change

<u>Average Annualized Health Change Category</u>	<u>n</u>	<u>Average Total Cortisol (All Visits)</u> Mean \pm S.D. (ug/100ml)	<u>Total Cortisol First-Field Study</u> Mean \pm S.D. (ug/100ml)
<1.0/yr	(47)	1231 \pm 137	1205 \pm 200
1.0-2.5/yr	(68)	1219 \pm 134	1203 \pm 210
2.6-4.9/yr	(68)	1186 \pm 99	1158 \pm 176
> 5.0/yr	(44)	1145 \pm 120	1102 \pm 122

F = 4.63
p = .004

3.38
.02

(Performed on the average
of 3.9 months before start
of second interval)

We were interested in how useful the initial visit values were in classifying individuals compared to the classification obtained by averaging the total cortisol across all visits. These data are presented in Table 164. It is clear that there was a highly significant relationship between classification of individuals on their initial visit and the classification obtained by averaging all three visits. Part of this relationship was due to the fact that the average across all visits contained the initial visit, but nevertheless it was apparent that individuals who were high in the first visit tended to remain high while individuals who were low on the first visit tended to remain low, and individuals in the middle tended to be high, middle or low subsequently. The relationship was highly significant with a chi square of 88.99, $p < .00001$, and the correlation between visit one and the total average was .71. It was possible to classify men by the first visit, and the reliability of this classification was enhanced at the higher and lower range of cortisol.

We were interested in trying to clarify the relationship between lower cortisol secretion and higher illness rates. We compared individuals' maximum cortisol while working on position during a day when their workload was very heavy and a day when it was very light. We selected men who experienced maximum differences in workload, the workload one day being in the highest quartile of the distribution for all men and another day being in the lowest quartile. These data are presented in Table 165. It is clear from this table that the maximum cortisol on position, controlling for time of day, was significantly higher during the high workload day for all men and lower on the low workload day. However, the 90 men who could be selected in terms of having experienced these extremes of workload showed relatively small differences in maximum cortisol secretion between high workload and low workload. This can be explained by a look at the distribution of differences among these 90 individuals. Thirty-four individuals showed relatively little change and 23 individuals showed a significant decrease in cortisol when workload increased. These individuals might be labeled as "inverse responders." We were interested in seeing whether individuals who showed this inverse response - cortisol falling when workload was increased - had a different incidence of mild to moderate health change. Again, this was not a predictive finding but a correlational one as it was done concurrently with the measurement of health change. Nevertheless, we did find a significant relationship between inverse responders and increased health change. Table 166 compares men whose maximum cortisol on position increased, did not change or decreased when workload increased. Those individuals who were inverse responders had an annualized health change of 4.22 episodes compared to 2.76

Prediction Of Average Total Cortisol
(3 to 5 Visits) By First Visit

		<u>AVERAGE CORTISOL ALL VISITS</u>			<u>RAW</u>
		<u>HIGH</u>	<u>MIDDLE</u>	<u>LOW</u>	<u>TOTAL</u>
<u>INITIAL</u> <u>VISIT</u>	<u>HIGH</u>	50 (26)	25 (27)	4 (26)	79
	<u>MIDDLE</u>	25 (27)	32 (28)	25 (27)	82
	<u>LOW</u>	1 (23)	20 (23)	47 (23)	68
<u>COLUMN TOTAL</u>		76	77	76	229

Chi Square 88.99
df = 4, p < .00001

CORRELATION VISIT 1 X TOTAL AVERAGE = .71

TABLE 165

Comparison Of Individuals'
Maximum Cortisol While Working On Position
When Workload Is Heavy Versus Light

	<u>HIGH WORKLOAD</u>	<u>LOW WORKLOAD</u>
NORMALIZED MAXIMUM CORTISOL ON POSITION	125.5	118.3

ONE WAY ANOVA $F = 4.52$ $p < .05$
REPEATED MEASURES (38,1)

Individuals Fall Into 3 Groups
When Calculating Differences Between
Maximum Cortisol On High Minus Low Workdays

INCREASES	>15	$\frac{n}{34}$	
NO CHANGE	-10 to 15	33	
<u>DECREASES</u>	<-10	23	'INVERSE RESPONDERS'

Comparison Of Men Whose Maximum Cortisol
On Position Increases, Does Not Change,
Or Decreases When Workload Increases
In Terms Of Total Annualized Health Change

ANNUALIZED HEALTH CHANGE EPISODES

POPULATION VALUE	3.20	±	1.95	n = 90
MAXIMUM CORTISOL <u>INCREASES</u>	2.76	±	1.61	n = 34
MAXIMUM CORTISOL <u>NO CHANGE</u>	2.94	±	1.97	n = 33
MAXIMUM CORTISOL <u>DECREASES</u> 'Inverse responders'	4.22	±	2.07	n = 23

one-way anova

F = 4.65
(87,2)

p < .012

for those whose cortisol increased and 2.94 for those whose cortisol did not change when workload increased. This difference was significant at the .012 level.

In summarizing the relationship between cortisol secretion and annualized health change, three findings were made. The first was that during the study, individuals who showed lower cortisol levels at work experienced more health change, a concurrent relationship. Second, we found that individuals whose first field study revealed lower levels of cortisol at work also showed in the subsequent two to three years an increased level of illness. Third, those individuals whose cortisol decreased when traffic increased, so-called "inverse responders," also showed an increased level of annualized health change.

The significance of these findings are not yet clear. The relationship appears to be a stable finding and has prompted us to begin to investigate more carefully what characteristics might describe individuals who do show this inverse response or diminished cortisol responsivity at work that seems to carry with it an increased risk for developing health change. Since in some ways this finding is replicated in terms of blood pressure responsivity, the potential implications are all the more interesting and must be pursued.

The other major physiological response which correlated with and to some extent possibly predicted health change was the systolic residual range at work. The systolic residual range was a variable representing the variability of systolic blood pressure at work when one controlled for initial levels. Because variability or range is correlated with average level, we regressed each individual's average level from the range to obtain a systolic residual range for blood pressure while working.

The results of our study of blood pressure response may be viewed as parallel with the cortisol response. Those individuals who showed diminished systolic variability (diminished systolic residual range) had an increased amount of mild to moderate illness. These data are shown in Table 167. The average systolic residual range for all visits for those who showed the lowest amount of health change (less than one episode per year) was 2.0 ± 6.6 mm Hg as contrasted with those in the highest category of health change, those with ≥ 5 episodes per year, who showed a systolic residual range of 1.32 ± 4.2 . This difference was significant at the .03 level. We also attempted to clarify whether or not the average systolic residual range during the first field study was predictive of the subsequent health change. The values were clearly in the right direction with individuals at the lowest level of health change showing a residual range of 3.13 mm Hg while individuals in the

TABLE 167

Systolic Residual Range At Work As A Predictor
Of Average Annualized Health Change

<u>Average Annualized Health Change Category</u>		<u>Average Systolic Residual Range All Visits</u>	<u>Average Systolic Residual Range First Field Study</u>
	<u>n</u>	Mean \pm S.D. (mm Hg)	Mean \pm (mm Hg)
< 1.0/yr	(56)	2.01 \pm 6.6	3.13 \pm 13.3
1.0-2.5/yr	(72)	-0.11 \pm 4.9	-4.28 \pm 10.5
2.6-4.9/yr	(86)	-0.15 \pm 6.9	-1.14 \pm 11.5
\geq 5.0/yr		-1.32 \pm 4.2	0.53 \pm 12.52

F = 2.95
p = .0328

1.88
.132 N.S.

(performed on the average of 4.4 months before start of second interval)

highest level of health change showed a residual range of 0.53. However, as is evident from the table, the standard deviation was considerably higher for the first field study for each of these categories compared to the average data, reflecting the lack of stability from one study alone. Consequently these differences were not statistically significant, $p = .132$. Viewed from another perspective, the first blood pressure study did not correlate as highly with the average data obtained on three or more visits ($r = .51$) as the first cortisol value correlated with that obtained on three or more visits. Nevertheless, these data were provocative in that individuals who did show throughout the course of the study a reduced variability in blood pressure independent of level were experiencing an increased amount of health change. As noted previously, this observation was parallel from a physiological perspective with the fact that individuals who showed lower cortisol response to work also had increased health change.

It was interesting that among the 10 individuals who had the highest amount of health change, i.e. two standard deviations from the mean, or more than 7 episodes per year, 7 had total cortisol values and systolic residual range below the mean. Seven of these 10 men therefore would be considered hyporesponders in both physiological systems.

Health History and Health Habits as Predictors of Total Morbidity

As noted in a previous section, all individuals had a very careful review of their medical history along with their physical examination at their intake examination into the study. One of the reasons for collecting history of past illnesses as well as a record of current physical health was to be able to ascertain whether or not individuals who experienced increased levels of health change during the course of the study had come into the study with more previous illness. One might argue that individuals who had more health change during the three years of surveillance simply came into the study less well to begin with, with more chronic illnesses, etc. Therefore it was necessary to collect, as well as we could, information about their health status at intake.

In addition to dividing intake diagnoses into various physical systems, we also totaled all intake diagnoses to be studied as a potential predictor of the individual's average annualized health change. These data are presented in Table 168. There was no relationship between the total intake diagnoses and the annualized health change, $f = 0.56$, N.S. For two categories of health change, allergies and GU complaints, there was a significant relationship between intake diagnoses and the subsequent number of illness episodes in these two specific categories. However, as allergies only accounted for 6% of the total annualized health change and GU 3%,

Total Intake Diagnoses As A Potential
Predictor Of Average Annualized Health Change

<u>Average Annualized Health Change Category</u>	<u>Number of Men</u>	<u>Mean ± S.D. Intake Diagnoses</u>
< 1.0/yr	(72)	4.35 ± 2.56
1.0-2.4/yr	(103)	4.56 ± 1.88
2.6-4.9/yr	(112)	4.73 ± 2.25
≥ 5.0/yr	(57)	4.75 ± 2.07

F = 0.56 N.S.

the relationship between intake and subsequent diagnoses within these two categories did not significantly affect the total. Nonetheless, this specific relationship was important in studying potential predictors of illness episodes in these two systems.

Health habits were also investigated as potential predictors. In the first round of examinations we asked individuals the number of cigarettes, cigars and pipes of tobacco they smoked, the amount of coffee they drank, the amount of medications they took, etc. These health habits did not significantly predict the annualized health rates, and therefore did not influence the various psychosocial and work-related predictors of mild to moderate illness.

Discriminant Function Analyses of Significant Predictors of Total Morbidity

In an effort to examine the overall predictive utility of the psychosocial and the cortisol and blood pressure predictors, discriminant function analyses were performed using the ten variables that were significant when studied in a univariate fashion. We found that we were best able to discriminate between individuals in the highest and lowest groups and that our predictors were not of great value in discriminating individuals in the middle groups of health change. The variables that differentiated between men with high and low annual rate of mild or moderate physical health change are shown in Table 169. These could be summarized as follows: The individuals who showed greater amounts of physical health change, i.e., those with five or more episodes a year, had approximately three times the amount of life change events in the period of time before the illnesses occurred, were more Type A in their personality, were chosen less often by their peers in terms of their amicability (ease to work with), rated themselves as having more anxiety at work, scored higher on the self-acceptance scale of the CPI, rated themselves as having more subjective costs relating to controlling traffic, showed more job involvement on the Jenkins Activity Scale, part of the Type A personality complex, and showed lowered systolic residual range at work and lowered total cortisol at work and maximum cortisol on position.

Of the ten variables which individually discriminated between those with low and high rates of annualized health change, only four were found by stepwise discriminant function analysis significantly to predict low vs. high rates. These data are shown in Table 170. The major variable that discriminated between the two groups was the amount of life change distress, labeled as life change distress rating, followed by the two physiological measures at work, systolic residual range and total cortisol, and the fourth variable that contributed to the significant discrimination between these groups was the increased Type A personality among those with high

Variables That Differentiate Between Men
With High And Low Annual Rate Of Mild And Moderate
Physical Health Change

(10 SIGNIFICANT UNIVARIATE)

<u>VARIABLE</u>	<u>MEAN</u> < 1 per yr.	<u>VALUE</u> 5 +/-yr.	<u>F</u>	<u>p</u>
Life Change Distress	125.7	359.8	20.15	.0001
Type A Personality	-6.28	-.00	12.19	.001
Amicability Choices (peer)	2.30	1.51	9.92	.01
Anxiety Factor	46.42	53.33	9.61	.01
Self Acceptance Scale (CPI)	56.65	61.60	8.02	.01
Subjective Costs	49.56	54.72	6.96	.01
Job Involvement (JAS)	-7.49	-3.85	5.27	.05
Average systolic BP residual range at work	1.86	-1.33	7.00	.01
Average total cortisol at work	1222.19	1142.45	8.39	.01
Average maximum cortisol on position	123.30	114.30	6.80	.05
N	43	43		

TABLE 170

Stepwise Discriminant Function Analysis
To Predict Low Versus High Annual Illness Rate

<u>STEP</u>	<u>VARIABLE</u>	<u>F</u>	<u>p</u>
1	Life change distress	20.15	.0001
2	Average systolic BP residual range at work	9.79	.01
3	Average total cortisol at work	8.27	.01
4	Type A personality	7.17	.01

		<u>PREDICTED</u>		Total	%Correct
		<1/yr	5+/yr		
ACTUAL	<1/yr	34	9	43	79.1%
	5+/yr	10	33	43	76.7%
TOTAL				86	

rates of annualized illness. Using these four variables we were able to predict correctly 76.7% of the individuals in the high group and 79.1% of individuals in the low group.

Predictors of Average Annualized Health Change Rates For the Three Most Frequent Diagnostic Categories

In addition to determining the predictors of total average annualized mild and moderate health changes, we also analyzed the predictors of these health changes by diagnostic category within the total. Nine major sub-categories were identified and analyzed: Respiratory, Acute Gastrointestinal, Chronic Gastrointestinal, Non-Specific Viral, Skin Diseases, Bones, Muscles and Joints, Allergies, Genitourinary and Injuries. Preliminary efforts to determine predictors showed that for those diagnostic categories with small numbers of affected persons, such as chronic G.I., Skin, GU and Bones, Muscles and Joints, it was difficult to establish valid relationships. Therefore, the discussion is confined to the four categories in which average annualized mild and moderate health changes were most frequent: Respiratory, Acute Gastrointestinal, Non-Specific Viral and Injuries.

Respiratory Illness

As compared with men who had more respiratory problems, the men most free of respiratory problems were older and more experienced ($P = .002$ and $p = .005$ respectively), did not have psychological problems that interfered with their work role performance (measured by PSS, Round 2 vs. respiratory illness in intervals 2-4, $p = .03$), were most likely to have higher average blood pressures on busy work days than on quieter days (systolic increases, $p = .05$, diastolic increase, $p = .01$), secreted significantly more serum cortisol at work ($p = .02$), served in the armed forces the modal 4 years found for all subjects in this study ($p = .003$), had wives who were employed full time ($p = .04$), went out with their wives less frequently than three times a week ($p = .003$), were less satisfied with their marital situation ($p = .003$), and were more alienated from social values (measured by Srole Anomie scale, $p = .05$).

The high respiratory illness group was, by comparison, more job involved ($p = .02$), had considerably higher anxiety concerning their work ($p = .02$), had greater marital resource support ($p = .03$), had lower cortisol and blood pressure reactivity at work ($p = .02$), were younger and had less experience with the FAA ($p = .002$ and $.005$ respectively) had some college but did not graduate ($p = .05$), had wives who were homemakers ($p = .04$), were more likely to go out frequently with their wives ($p = .003$), had either neutral or happy feelings about their marital situation ($p = .003$) and were not alienated from social values ($p = .05$).

Acute Gastrointestinal Illness

Men who tended to have the highest levels of acute G.I. disease showed a complete absence of clinical degrees of subjective distress and work role disorder, freedom from clinically significant alcohol abuse, greater social alienation (anomie scale, $p = .02$), greater expressed discrepancies between their own and their wives' goals for their marriage ($p = .001$), lower socio-economic status in childhood than their wives ($p = .02$) and perceptions of their parents as very different from one another in personality and values ($p = .02$).

In addition concurrent associations were revealed between increased risk for acute G.I. episodes and less cortisol responsivity ($p = .04$) and less blood pressure responsivity on the job.

Non-specific Viral Disease (NSV)

The strongest predictors of NSV were the sociometric ratings at Round 2. ATCs who were free of NSV in the ensuing 2-21 years were frequently selected by their co-workers as being amicable ($p = .007$), competent ($p = .002$) and as ideal team members ($p = .004$).

The second strongest predictors were the life change scores preceding the intervals at risk. Men with frequent NSV had the highest life change scores by two methods of measurement (Holmes-Rahe and Paykel, Uhlenhuth and Prusoff, $p = .03$) and somewhat lower scores by the third method (self-ratings of life change distress preceding a period at risk, $p = .06$).

Additional predictors of higher rates of NSV were: low interviewer judgments from the intake round on coping with training responsibilities ($p = .02$) and overall coping score ($p = .04$), more anxiety about potential air traffic incidents ($p = .02$) and work-related anxiety (ATC Questionnaire, $p = .0007$), feelings that the supervisor gave inadequate structuring to the job situation and had little consideration of others ($p = .0007$ and $p = .005$ respectively), feelings of higher subjective costs associated with ATC work ($p = .04$), less ability to discharge tensions promptly ($p = .02$), higher job involvement ($p = .02$), greater hard-driving characteristic (Jenkins Activity Survey, $p = .004$), less social conformity (communality scale, $p = .03$), longer residence in the same county (more than 20 years), substantial upward mobility.

All in all, the picture of the NSV-prone man is that of a person with less than an average amount of esteem from his peers, but nonetheless highly job involved, hard-driving, competitive and perhaps somewhat non-conforming. These men at high risk for NSV find

that their job takes a lot of energy and resilience from them, often arouses anxiety, and leaves them less able to discharge tensions and cope with difficulties. There appears to be a large psychosocial component in vulnerability to non-specific viral disease.

Injuries

There were more predictors of injuries than of any other category of health change in the study. Sixteen psychosocial predictors were associated with injuries at the $p = .05$ level or better.

Men who incurred the most mild or moderate injuries were chosen less often both for "ideal" team members (in peer nominations, $p = .06$ and $p = .002$ for Round 1 and Round 2 data, respectively) and for amicability ($p = .05$ and $p = .01$ for Rounds 1 and 2, respectively), were by far the strongest Type A in their behavior ($p = .0001$), had greater life change distress (Paykel, $p = .03$; self-ratings of distress, $p = .004$; Holmes-Rahe, $p = .008$), had a much higher frequency of work role disorders (Psychiatric Status Schedule Round 2, $p = .008$), greater anxiety concerning the possibility of traffic incidents ($p = .05$) and other work-related anxiety, less satisfaction with management ($p = .05$), more difficulty in discharging their tensions ($p = .02$ for both Round 1 and Round 2 data), and lower blood pressure responsivity at work (lower maximum blood pressure during the first 3 to 5 days they were measured in the job both for systolic, $p = .01$ and diastolic, $p = .04$).

In addition, men with high injury rates reported that they got along with their parents somewhat worse or much worse than other teenagers ($p = .05$), and they were least satisfied with their marriages ($p = .03$).

Among those men (99%) who had served in the Armed Forces, the 64% who were non-commissioned officers had substantially more injuries than those who remained at the enlisted man level ($p = .02$).

The fact that the injury category had the largest number of psychosocial predictors of all categories may be due to the clearly overriding involvement of behavior and psychological factors in the causation of injury, but also may be influenced by the fact that large numbers of men generated moderate and high numbers of injuries, thus leading to the kind of distribution of values which allows more powerful tests of the role of psychosocial predictors. These findings have important implications because they may lead to interventions to reduce the second most common cause of lost time from work and need for medical attention.

SUMMARY

Predictors of Hypertension

Predictors were sought primarily for the development of hypertension during the course of the study, that is, predictors of the 36 new cases of hypertension that developed by the study's own criteria for determination of the disease. Some additional analyses involved intake cases of hypertension.

The following relationships were found:

- 1) Compared to those who stayed normotensive, body weight at intake was significantly higher in intake cases of hypertension but not in new cases developing during the study; however, body weight increased slightly over the course of the study for those who developed hypertension during this time;
- 2) Compared with those who remained normotensive, intake cases were older, but new cases were not older;
- 3) Compared with those who remained normotensive, systolic and diastolic blood pressure measured at the intake interview was elevated both in those who had hypertension at intake and in those who developed it during the course of the study, systolic and diastolic blood pressure measured at work were significantly higher in those who developed hypertension, and were as high during the first field study as in those who already were diagnosed hypertensive at intake; measurements made at work on high workload and low workload days showed that the 36 new cases of hypertension had significantly greater elevations of systolic blood pressure on the high workload day compared with those diagnosed hypertensive at intake and with normotensives;
- 4) The major change that occurred to cause the diagnosis of hypertension among the 36 new cases was a rise in diastolic pressure, while systolic pressure remained at the same level or, in some cases, was reduced;
- 5) Coping with difficulties by use of alcohol was more prevalent among future hypertensives, as was ability to cope on heavy days (rated by a psychologist interviewer);
- 6) Individuals who became hypertensive had significantly lower marital resources, significantly less distressing life change events, and were more Type B (less hard-driving) personalities.

Discriminant function analysis showed that the most important variable discriminating between those who remained normotensive and those who developed hypertension was the systolic average at work, and other variables contributing to discrimination were Type B behavior, diastolic average at work, interview rating of coping on heavy days, decreased marital support and decreased life change distress.

2. Predictors of Hypertension

In an earlier section describing the nature of physical health findings, we reviewed the prevalence and incidence of hypertension in our population. These values varied significantly depending on the criteria that were employed, i.e., whether they were the HANES, Framingham, our own research criteria, or the FAA criteria. For predictive purposes, we used the most rigorous research criteria for defining hypertension that could be employed. We called men hypertensive at intake or subsequently only if their blood pressure readings in two successive visits were above the criterion level, systolic pressure of 140 or more or diastolic pressure of 90 or more. The tabulation of participants according to the research criteria is displayed in Table 171. Most of the predictors to be discussed were studied in an attempt to discriminate between the men who remained normotensive and those who developed hypertension after intake into the study. However, other predictors that differentiated between normotensive and prevalence cases (intake cases) are also discussed.

Perhaps the first approach that might reasonably be taken in a search for predictors of future hypertension would be to examine the relationship between hypertension in our men and variables known to predict hypertension in the general population. These include body weight, chronological age, and blood pressure while visiting the physician at the first examination. It is well known that people who develop hypertension tend to have increased blood pressure on previous physical examination. Body weight and age are also known to be predictive of development of hypertension. The values at the intake examination for weight, age and first blood pressure measures for the three groups of men (normotensive, prevalence cases and new cases) are given in Table 172.

Body weight at intake was significantly higher in those with hypertension at intake but was not significantly higher in those developing new cases of hypertension compared to the normotensives. Similarly, those who had hypertension at intake were older, but those developing new cases of hypertension were not older compared with the normotensives. The systolic and diastolic blood pressures (from the second reading during the first, intake exam) showed a different distribution among three groups. Compared with normotensives, systolic blood pressure was elevated not only in those individuals who had hypertension at intake but also in those who developed hypertension later. Similarly, in comparison with those who remained normotensive, diastolic blood pressure at the first examination was elevated for those who had hypertension at intake and those who later developed the condition.

We compared the three groups of men - normotensives, hypertensives at intake and new cases - with respect to their blood pressure

TABLE 171

Prevalence And Incidence Of Hypertension
Among Participants In ATC HCS By The Study Criteria

Normotensive Men	245
Prevalence Cases (Intake And Second Round)	135
New Cases During Study Must Meet Criteria Over 2 Successive Visits (3 Year Incidence)	36
Total Participants	416

TABLE 172

Physical Measures On 3 Groups Of
ATCs At Intake Exam

<u>Variable</u>		<u>Normotensive</u> (n=245)	<u>Hypertensive</u> <u>At Intake</u> (n=135)	<u>New Cases Of</u> <u>Hypertension</u> (n=36)	<u>F</u>	<u>p</u>
WEIGHT	mean	179.5	194.4	181.8	15.10	.0001
	s.d.	24.9	26.6	22.4		
AGE	mean	35.6	37.4	35.9	5.98	.003
	s.d.	5.0	4.8	5.6		
2nd SITTING SYSTOLIC BP	mean	125.5	139.0	132.1	81.62	.0001
	s.d.	9.1	9.3	9.2		
2nd SITTING DIASTOLIC BP	mean	83.1	96.5	86.0	131.0	.0001
	s.d.	7.5	6.7	5.4		

on the initial and final examination. We did this in order to clarify whether or not it was a change in systolic or diastolic blood pressure, or both, that resulted in the classification as a case of hypertension. These data are presented in Table 173. This table also gives body weight and shows a slight increase in body weight from intake to final exam for new cases. However, the most interesting finding was that there was not a significant increase in systolic blood pressure. The systolic blood pressure actually fell in the normotensive group approximately 4.2 mm Hg and even showed a very small, but nonsignificant fall in the new cases of hypertension. This fall in systolic blood pressure perhaps reflects a return to usual pressure after the increased arousal attendant upon coming to B.U. for the first time. This initial arousal phenomenon was one reason why we established the criterion that elevated blood pressures must be evident on both their initial and second round examinations for classification as a prevalence case and on any two successive exams after intake for classification as a new case.

The major change that occurred to cause our population to be classified hypertensive was the change in diastolic blood pressure. There was a slight increase of approximately 2 mm Hg in the normotensive and 0.5 mm Hg of diastolic blood pressure in those hypertensive at intake, while there was a relatively large increase in diastolic blood pressure from 86.0 at intake to 93.9 mm Hg at final exam, a change of almost 8 mm Hg, in the men who developed hypertension. It is evident from these data that individuals who developed hypertension in this study were experiencing an increase in diastolic blood pressure above criterion value rather than increased systolic blood pressure.

We found 9 variables, listed in Table 174, that were significantly different between the group who developed hypertension and the group that remained normotensive. Since we required all individuals to have values for all variables when we performed discriminant analyses, there was slight attrition of the number of men compared, leaving 28 of 36 new cases and 183 of 245 normotensives. As noted, systolic blood pressure at the first physical exam was significantly higher in individuals who later developed hypertension. We also found, as is discussed later in this section, that systolic and diastolic blood pressure at work were significantly higher in cases who developed hypertension compared to those who remained normotensive. Another univariate predictor of new cases was coping by drinking, which was more prevalent in future hypertensives. This score was taken from the Air Traffic Controller Questionnaire in which individuals responded to such items as "going drinking with other controllers after work to unwind," etc. Another variable that discriminated between hypertensive and normotensive cases was an interview rating by a psychologist of the ATC's effort and success in coping on heavy days. Those individuals who developed

TABLE 173

Comparison Of Physical Findings On
Initial And Final Examinations
(3 Years Apart) On Three Groups

	<u>Normotensive</u>	<u>Hypertensive</u> <u>At Intake</u>	<u>New Cases Of</u> <u>Hypertension</u>
<u>WEIGHT</u>			
INTAKE	179.5	194.4	181.8
FINAL	180.0	192.9	184.7
<u>SYSTOLIC BP (SITTING)</u>			
INTAKE	125.5	139.0	132.1
FINAL	121.3	136.1	131.8
<u>DIASTOLIC BP (SITTING)</u>			
INTAKE	83.1	96.5	86.0
FINAL	85.4	97.0	93.9

Variables That Predict New Cases Of
Hypertension Compared To Those Who Stay Normotensive

<u>VARIABLE</u>	<u>MEAN</u>		<u>VALUE</u>	
	<u>Normotensive</u>	<u>Develop H.T.</u>	<u>F</u>	<u>P</u>
1st Systolic BP at physical exam	125.4	132.3	12.88	.0001
Systolic at work	126.4	138.8	25.69	.0001
Diastolic at work	84.6	91.8	21.76	.0001
Smoking by drinking	48.4	52.4	4.69	.05
Interview rating of smoking on heavy days	3.75	4.46	5.19	.05
Spiritual resources	49.4	45.4	4.12	.05
Life change distress	275.8	134.2	7.29	.01
'A' personality	-2.6	-6.6	4.93	.05
Smoking driving factor	-3.31	-6.1	11.50	.001
N	183	28		

hypertension were rated by the interviewer as higher in this coping characteristic. This implies that better copers are more susceptible to blood pressure increases or that the increased effort to cope, despite its apparent success, may force up diastolic blood pressure. We also found that individuals who became hypertensive had significantly lower marital resources and significantly less distressing life change events. New cases of hypertension were found to have more Type B and less Type A personality. In addition, individuals who developed hypertension were also found to be less hard-driving, consistent with their more Type B personality.

In order to assess how well psychological variables could predict future cases of hypertension, we performed a discriminant analysis that utilized only psychological variables and found that they were able to predict correctly 67.9% of new cases as shown in Table 175. The most important psychological factor was the less hard-driving, more Type B personality.

As noted earlier, one of the most important predictors of new cases of hypertension was the blood pressure responses of men while actually controlling traffic. Table 176 shows the mean blood pressure responses at work during the first field study. We compared normotensive individuals, those hypertensive at intake, those who had a diagnosis of hypertension after nine months in the study, i.e., beginning with the second examination, and those who were found to be hypertensive at 18 months or later. It can be seen from this table that compared to normotensives those individuals who developed hypertension either earlier or later in the study had significantly elevated blood pressure responses during their first field study. As a matter of fact it is evident from this table that those who developed hypertension later had blood pressure responses as elevated during their first field study (before the diagnosis was made) as those who were diagnosed hypertensive at intake. Furthermore, as there was no difference between those who developed hypertension later in the study and those who developed it earlier, proximity of the diagnosis was not a crucial variable. This further supports the power of the first field study for prediction of hypertension.

In order to clarify the nature of the relationship between increased blood pressure responses at work and the later diagnosis of hypertension, we made another comparison of normotensives with those who were hypertensive at intake and those who later developed hypertension. We selected 257 men whose workload on one day while they were studied was significantly greater than that on another study day. Only 257 men met this criterion of two study days differing significantly in magnitude of workload. Of this number, 149 were normotensives, 84 were hypertensive at intake and 24 were new cases of hypertension. Table 177 compares the average systolic blood pressure on the high work day with the average systolic blood pres-

Stepwise Discriminant Function Using
Only Psychological Predictors

<u>STEP</u>	<u>VARIABLE</u>	<u>F</u>	<u>p</u>
1.	Hard driving on JAS	11.51	.001
2.	Coping by drinking	4.84	.05
3.	Life change distress	4.67	.05
4.	Interview coping heavy days	5.50	.025
5.	Marital support	6.26	.025

Using These 6 Predictors Yields:

67.9% correct prediction of H.T. cases (Sensitivity)
72.1% correct prediction of normotensives (Specificity)

Mean BP Responses At Work During First Field Study

mm Hg	Normotensive	Hypertensive At Intake	Hypertensive After 9 mos.	Hypertensive After 18 mos.	F	P
	n = 194	n = 86	n = 16	n = 15		
AVERAGE SYSTOLIC	126.7	136.6	135.8	138.8	19.86	.0001
MAXIMUM SYSTOLIC	146.8	158.1	157.2	159.0	12.32	.0001
AVERAGE DIASTOLIC	84.3	90.7	92.7	89.4	19.12	.0001
MAXIMUM DIASTOLIC	97.9	104.6	105.5	103.5	12.88	.0001

TABLE 177

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Comparison Of Normotensives, Those With
Hypertension At Intake, And New Cases Of
Hypertension In Terms Of Blood Pressure
Responses To High Versus Low Workload

<u>Group</u>	<u>Normotensives</u>	<u>Intake HT</u>	<u>New HT</u>	<u>Total</u>
n	149	84	24	257
Average systolic on High work- ed day	127.4	137.7	139.1	
Average systolic on Low work- ed day	124.9	134.6	127.5	
Difference High minus Low day	2.5	3.1	11.6	
Difference High minus Low day controlling for level on Low day	-2.46	2.15	7.76	

sure on the low work day for these groups. All three groups showed an increase in systolic blood pressure on the high day compared to the low day, but the biggest differences were observed for the new cases of hypertension, who averaged 11.6 mm hg difference between these two days. Because one might argue that the value on the high day could also be a function of the value of the low day since low day and high day were correlated, we calculated differences in the high day minus low day, controlling for the low by regression analysis. This removed the influence of initial blood pressure, i.e., blood pressure on the low day, from the value observed on the high day. When this adjustment was made, it was still apparent that the new cases of hypertension showed significant elevations of blood pressure on the high day compared to the low day, averaging 7.6 mm hg compared to only 2.5 for those who had hypertension at intake and $r=2.46$ for the normotensives, a highly significant difference. These data suggest that men who were becoming hypertensive not only showed elevated blood pressures during work, but also a highly significant increase in systolic blood pressure when they worked a heavier day compared to when they worked a lighter day.

We wanted to evaluate the predictive power of the biological variables by themselves in discriminating new cases of hypertension from those who remained normotensive. These data are presented in Table 178. This table lists the average systolic blood pressure at work, as well as the first blood pressure on physical exam. It can be seen from this table that the average systolic blood pressure at work was the most significant discriminator of normotensive and new cases of hypertension, with F value of 25.69, and only a small amount of variance was accounted for by diastolic blood pressure at work and by the first blood pressure on physical exam at B.U. The average systolic blood pressure at work represents the mean systolic blood pressure for those men with three or more study days and actually represents a value that was concurrent but not predictive because it was collected during the entire course of the study. In many instances one or more field studies included in this average were performed after the diagnosis of hypertension had been made. From this point of view the average of the field studies is merely correlated with hypertension. However, as was seen in Table 177, individuals who developed hypertension also had significantly elevated blood pressure responses during their first field study, and use of this data was predictive. The average blood pressures are used to illustrate the associative nature of a stable measure and are presented as a more stable reflection of the first field study pressures, which were predictive. Using these three biological measures, we could identify 73.2% of the new cases of hypertension and 71.4% of those who remained normotensive.

From the perspective of blood pressure responses at work, the men who developed hypertension were different in three ways. The

TABLE 178

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Stepwise Discriminant Function Using Only
Biological Variables

<u>STEP</u>	<u>VARIABLE</u>	<u>F</u>	<u>P</u>
1	Average Systolic BP at Work	25.69	.0001
2	Average Diastolic BP at work	5.49	.025
3	1st BP at physical exam	4.17	.05

Using these 3 predictors yields:

73.2% correct prediction of H.T. cases (sensitivity)
71.4% correct prediction of normotensives (specificity)

first way was the increased average blood pressure during the first field study, the second was that their average systolic blood pressure for all times at work was significantly higher, and the third way was that they had significantly increased blood pressure response to increasing workload compared to those who remained normotensive.

The final analysis was to evaluate how accurately we could predict new cases of hypertension using all the variables at our disposal, i.e., psychological variables, initial blood pressure, and blood pressure at work. These data are provided in Table 179. Six variables contributed to the discrimination between individuals who remained normotensive and those who developed hypertension. These six predictors yielded an 85.7% correct prediction of new cases of hypertension and an 82.0% correct prediction of normotensives. The most important variable in discriminating between these two groups of men remained the systolic average at work, and other variables which added to a correct prediction were Type B behavior, diastolic average at work, interview rating of coping on heavy days, decreased marital support, and decreased life change events.

The final table, 180, compared the various predictors from the point of view of implementing a screening procedure. We addressed ourselves to the question of how would one predict new cases of hypertension taking into consideration the cost and difficulty in making these predictions. It was apparent that the easiest thing to do would be to evaluate a man's blood pressure at physical examination. As this was a significant predictor, we examined how well this variable by itself could discriminate between new cases of hypertension and those who remained normotensive. Using the first systolic blood pressure measured in the physician's office, we found that this variable value correctly predicted 64% of new cases and 64% of normotensives. However, it did falsely classify 66 as new cases of hypertension, and although it predicted 18 out of 28 cases who did develop hypertension correctly, it missed 10 cases, i.e., false negatives. We therefore examined how much we could increase our predictive power by studying men in the field. We added the field measures of average systolic at work and average diastolic at work to the predictive equation. We had a significant increase in accuracy in predicting both new cases as well as those who remained normotensive. Finally we added the psychological predictors to the field predictors and we again improved our predictive power. Using the entire array of variables that we collected in the study, we correctly predicted 24 of 28 cases (85.7%) who developed hypertension and 150 out of 183 who did not.

We also examined data collected in the biographical questionnaire filled out by the participants for any association between background data and the development of hypertension. Similar to the marital satisfaction questionnaire we found that in the data collected

Stepwise Discriminant Function Using
All Possible Predictors To Predict New Cases Of Hypertension

(Significant Univariate)

<u>STEP</u>	<u>VARIABLE</u>	<u>F</u>	<u>p</u>
1	Systolic Average at Work	25.69	.0001
2	Hard Driving on JAS	9.55	.005
3	Diastolic Average at Work	5.90	.025
4	Interview Rating Coping Heavy Days	5.03	.025
5	Marital Support	5.55	.025
6	Life Change Distress	7.29	.01

Using these 6 predictors yields:

85.7% correct prediction of H.T. cases (sensitivity)

82.0% correct prediction of normotensives (specificity)

TABLE 180

Improvement Of Prediction Of New Cases Of
Hypertension By Field Studies And Psychological Variables

		<u>1st Systolic BP Measured In Physician's Office</u>			
		<u>PREDICTED</u>		Total	%
		Norm	New Hypertension		Correct
<u>ACTUAL</u>	Normotensive	<u>117</u>	66	183	63.9
	New Hypertension	10	<u>18</u>	<u>28</u>	64.3
Total				211	

		<u>Adding Field BP Measures</u>			
		<u>PREDICTED</u>		Total	%
		Norm	New Hypertension		Correct
<u>ACTUAL</u>	Normotensive	<u>134</u>	49	183	73.2
	New Hypertension	8	<u>20</u>	<u>28</u>	71.4
Total				211	

		<u>Adding Psychological Predictors</u>			
		<u>PREDICTED</u>		Total	%
		Norm	New Hypertension		Correct
<u>ACTUAL</u>	Normotensive	<u>150</u>	33	183	82.0
	New Hypertension	4	<u>24</u>	<u>28</u>	85.7
Total				211	

in the biographical questionnaire, men who were more happy with their marital relationship were more likely to remain normotensive whereas those who were only moderately happy were more likely to become hypertensive. Both intake cases of hypertension and new cases after intake were associated with growing up in an above average neighborhood. Growing up in better economic circumstances than one's wife was also associated with increased risk for hypertension, as was having parents with somewhat different social background and education than oneself.

In summary, as noted earlier, air traffic controllers did have an elevated incidence and prevalence of hypertension in our study compared to other studies. Furthermore, we were able to predict significantly those individuals who developed hypertension and this related to several psychological factors as well as to increased blood pressure responsivity at work. We also found that men who developed hypertension had increased blood pressure responses to workload - lower blood pressure on a low day of workload and increased blood pressure on a high workload day. One might conclude that when individuals are predisposed to develop hypertension, for whatever combination of genetic and biological factors, their increased blood pressure responses to increased work significantly contribute to the development of the disease along with such characteristics as a more Type B personality, less life change and less marital support.

SUMMARY

Predictors of Other Serious Illnesses and Injuries

Comparison of those who incurred serious illnesses or injuries with a "clean control group" who were free of serious illnesses, injuries and hypertension and who had less than the median level of mild and moderate health changes, produced the following differences:

- 1) Those who experienced severe injuries were more likely to have grown up in moderately large cities and suburbs, and were more likely to have moved residence frequently in childhood;
- 2) Men with serious injuries more often reported that they had occasionally wanted to quit high school, and men with serious illnesses had considered quitting high school even more frequently;
- 3) Men who later developed serious illnesses or injuries were selected significantly less often by peers as ideal team members; men who incurred serious injuries had the fewest number of peer selections for competence, those who developed serious illnesses had an intermediate number of peer selections, and the "clean controls" had the greatest number of selections for competence;
- 4) Men who later developed serious illnesses and injuries had higher levels of work satisfaction and social resources for coping with problems;
- 5) Men who later developed serious illnesses had less experience with the agency for their age; men with serious injuries had the lowest average experience with the agency;
- 6) The ATC's report of pay satisfaction declined in the round before they incurred a serious injury or illness;
- 7) Diastolic blood pressures at work were highest for the "clean control group," intermediate for the injuries group, and lowest for those with other serious illnesses.

3. Predictors of Other Serious Illnesses and Injuries

Illnesses and injuries serious enough to be rated as Level 3 were relatively infrequent in the ATC study. Of all the men with adequate amounts of predictive data to permit analysis, only 18 developed one or more injuries at L-3, and 23 developed severe (L-3) illnesses. Psychosocial predictors from Round 1 were utilized, and in addition a "sliding interval analysis" (see Section II) was conducted for those psychological and work-related variables gathered at each round. The biographical questionnaire and field data were also examined for their predictive possibilities. In all of these analyses, comparison was made with a "clean control group." To be eligible for inclusion in this group, men had to be free of all Level 3 injuries and illnesses, to be free of hypertension by the ATC study criteria both at intake and subsequently, and also to have less than the median level of average annualized mild and moderate health changes. These criteria were fulfilled by 167 men, who comprised the "clean control group."

Findings

Analyses of the biographical questionnaire completed at intake into the study revealed that the 17 men who later experienced severe injuries were more likely to have spent their childhoods in moderately large cities and in suburbs of large metropolitan areas. They did not come from small towns or rural areas ($p = .002$). Mobility of residence during childhood was a marker of men who later developed L-3 illnesses. Such men were more likely than controls to have moved residence four or more times prior to reaching age 13 ($p = .006$). Men who later qualified for the "clean control group" more often reported that they had never seriously considered quitting high school during their adolescence. Those men who developed L-3 injuries more often reported occasionally wanting to quit whereas those with L-3 illnesses seriously considered this still more frequently ($p = .02$).

Six psychosocial predictors from the first examinations were significantly distinctive across the illness, injury and control groups. Men who later developed L-3 injuries and illnesses were selected significantly less often than controls in the peer selections for ideal controlling team ($p = .04$). In addition, the selections for competency as a controller were significantly different, with men who later had accidental injuries scoring by far the lowest, men with L-3 illnesses scoring at an intermediate level, and the clean control group being picked far more frequently ($p = .02$).

Two other variables went "in the wrong direction" in terms of the hypothesis originally held for them. Men who later developed serious illnesses and injuries had higher levels of work satisfaction and social resources for coping with problems than the clean

control group at Round 1 ($p = .01$ and $p = .005$ respectively). It is difficult to see how increased work satisfaction or greater availability of social coping resources could prove a risk factor for each of these kinds of serious conditions. One might, however, entertain the notion that there may be a subjective distortion of perception about these variables among men who are about to develop serious problems.

The remaining two significant variables at the intake examination dealt with the relation of age to experience. They both tell the same story. Men who later developed L-3 illnesses were older relative to the amount of experience they had than was the clean control group ($p = .02$). Another way of saying this was that they had less experience with the agency for their age than the clean control group ($p = .006$). These findings were interesting inasmuch as age was not significantly associated with risk of serious health changes ($p = .30$), but years of experience considered alone approached a significant difference among the three groups ($p = .07$), but for this table it was the men with serious injuries who had the lowest average experience. The equivocal nature of these latter two statistics leads us to accept the more significant and more consistent findings first reported. The implication for the agency, if these findings are replicated on larger samples of people with serious problems (such as those receiving medical discharges from the agency) would be to reconsider the advisability of hiring men into the agency at ages beyond those which are average for incoming ATCs, but the benefits of this action would need to be reconciled with costs in terms of other results.

The sliding interval analyses identify the time at which an L-3 illness or injury occurred and then move to the immediately prior round of examinations to gather predictive data. Of course this method of analysis can be done only for those psychosocial variables which are gathered at each round of examinations. This analysis yielded one replication of Round 1 findings and one new finding. ATCs' choices among their peers for competence were associated with later serious health change: The clean control group had the most frequent selections (mean = 3.45), whereas the L-3 injury and L-3 illness group were picked significantly less often (means = 1.35 and 2.00 respectively for a probability of .023). Another finding was that ATCs' reports of pay satisfaction declined in the round before they incurred a serious injury or illness and no such decline was apparent in the clean control group. This resulted in the sliding interval analyses showing both health change groups to have significantly lower pay satisfaction than the healthy controls ($p = .02$).

A number of biological variables gathered in the field were also significantly associated with the presence of serious health changes. There are some problems in the interpretation of these

findings, however, as they are based on anywhere from 3 to 10 days of on-the-job study, some of which may have taken place after the L-3 event occurred. Nevertheless it is possible that the L-3 event may not have affected the behavior or the blood pressure of these men, and so these findings will be reported but with the above note of caution.

The amount of behavior arousal and motor activity at work was significantly different among the three groups ($p = .01$) with men who developed other illness having by far the least amount of motor arousal and those who incurred injuries being the most active per period of observation. This finding needs further examination before being judged to be with or without circularity.

Diastolic blood pressures at work were highest for the clean control group, intermediate for the accident group and lowest for those with other illnesses. This was true for two measures of diastolic blood pressure, the average of all readings for three to five work days of study ($p = .04$) and the average maximum peak of diastolic pressure reached on each of the three to five days of study ($p = .02$). These findings were consistent with those reported elsewhere for average annualized mild and moderate health changes. In those analyses also, the group with the most frequent illness or injury outcomes had the lowest levels of blood pressure reactivity.

Despite the fact that a number of variables from the biographical questionnaire, psychosocial predictors, and field predictors were significantly associated with the presence of serious health changes, it must be remembered that a very large number of variables existed in each of these data pools and only a small minority of these achieved statistical significance. The basic question regarding these findings is whether or not the predictors of this small group of severe health changes are the same as those for mild and moderate illnesses and for hypertension.

SUMMARY

Predictive and Concurrent Risk Factors For
Psychological Health Change

We found that a great variety of medical, on-the-job, and psychological variables differentiated between people with psychiatric problems and those without such problems. The clearest distinction could be made between men without any problems over three years, those who had problems at intake, and those who developed problems only after intake. There was a slight association between total health change rates and psychiatric health change, but this association was accounted for by a large number of other significant differences between these groups. In general, only three to five variables out of the large number that were significantly different between the various psychological health change outcome groups accounted for the majority of significant differences between these groups.

It was very difficult to distinguish between new cases with different extents of psychiatric problems and between cases with varying frequencies of monthly depression and anxiety. On the other hand, the predictive accuracy for new nine month onset cases versus asymptomatic controls for the five primary psychiatric areas was quite good. The classification results were sufficiently sensitive and specific that programs could be implemented to identify subjects at risk for these five psychiatric problems, and for people who might develop new problems across several areas. On the other hand, the specificity and sensitivity of predictive results for closely related groups, who were distinguished only by their rate or extent of problems was not sufficiently good to suggest programs for implementation of risk identification and intervention.

Finally, we found that those who had psychiatric problems according to our overall susceptibility index were disqualified at much higher rates from the FAA for both medical and psychiatric reasons than were asymptomatic subjects. There also was a tendency for subjects with a heightened susceptibility and a greater extent of psychiatric problems to have fewer FAA performance awards. Asymptomatic subjects tended to have the highest number of these awards.

Predictive and Concurrent Risk Factors for Psychological Health Change

The predictive and concurrent risk factors for psychological health change presented in this section were assessed by questionnaire, interview and physiological responses on the job. Although a large number of variables were tested for their predictive ability, for purposes of clarity and simplicity only significant findings are reported. We used considerable caution in our statistical analyses since the large number of variables would make it possible to generate a large number of significant differences purely by chance. To control for this factor we used rigorous statistical standards for significance, and in almost all cases, subjected all variables showing a significant relationship to a particular outcome to further analyses which would control for the overlap and confounding relationship between predictor variables.

Most of the predictive findings reported in this section are based on assessments made at intake into the study. However, on occasion, predictive variables were assessed at the second evaluation, and persons with problems preceding that evaluation were excluded from the analyses. For example, this procedure was required when analyzing the monthly depression and anxiety morbidity since the depression and anxiety questionnaires were not sent out until after the second evaluations.

In other analyses, concurrent measures were used. These concurrent measures primarily were derived from our field studies and represented the average work, blood pressure, cortisol, or other assessment of an individual over the three years in the study. As these measurements were relatively unstable over time, concurrent assessments were necessary to arrive at the most stable characteristics of the men and then to associate them with changes in psychological functioning. We have made an effort to distinguish clearly between predictive and concurrent findings in tables and text.

Finally, although a large number of psychiatric outcomes were discussed and evaluated for descriptive purposes in Section IIID, these outcomes were not all significantly associated with other factors and are not all, therefore, discussed below. Rather, we concentrated on five major assessments of psychological functioning: subjective distress, impulse control disorders, alcohol abuse, mate role and work role.

One outcome discussed in this section is susceptibility to psychiatric problems, defined by an assessment of abnormality on any of the five criterion scales of the Psychiatric Status Schedule. Comparisons of susceptibility were made among three groups: those having no psychiatric problems over the three years, those with

problems at intake, and those who developed problems after intake.

Another overall assessment was the extent of psychiatric problems defined by quantity and frequency of problems. Four groups were compared: men who had no problems on any of the criterion scales across the three years of the study; mild new cases with one criterion scale abnormal at only one of five examinations; moderate cases with one or more criterion scales abnormal at two or three of five examinations; and, chronic cases with one or more criterion scales abnormal at four or five examinations.

Predictors of the onset of psychiatric problems were determined by a procedure that was called "sliding interval" analyses, in which men who developed a problem during the study were compared on a number of variables with men who never developed a problem - a case and control procedure, with the special feature that the data on the predictor variables was taken from an examination immediately preceding onset of the symptoms, and the data for the comparison group was taken from matching time periods.

The monthly self-reports of depression and anxiety were used to define the following comparison groups for predictive analyses: asymptomatic controls, acute cases, intermittent cases and chronic cases. Asymptomatic controls were men who had an average rate of - 8.9 monthly episodes per year, and chronic cases had 9 or more monthly episodes per year. As was discussed in Section III D, all but a few of the men could be classified in this fashion. These classifications and definitions are repeated in the tables for clarity.

Finally, a summary is presented of the relationship between psychological health change and other outcomes in this study including mild and moderate health changes, FAA performance awards, and job-related outcomes of varying kinds.

1. Susceptibility to Psychiatric Problems

The three groups delineated above - an asymptomatic group, prevalence cases and incidence cases - were compared on a number of predictor variables. Men who had no problems, but who did not have all five evaluations (N = 65 for most analyses) were excluded because we did not know their later psychiatric status. As is indicated in the tables following, some subjects had incomplete data and therefore, the number of subjects in each of these groups was reduced. The reductions in each area are indicated on each table.

A number of measures of on-the-job behavior responsivity were devised and used as concurrent risk factors for psychiatric health change. Table 181 displays the relationship between on-the-job behavioral response and overall psychiatric susceptibility status. Men who remained asymptomatic throughout the study tended to have extremely low behavioral responses at work, whereas men who developed problems over the course of the study tended to have higher levels of behavioral response on the job. Men who came into the study with psychiatric problems had behavioral responses at about the levels expected by chance.

The relationship between the average normalized cortisol on the job and the overall psychiatric susceptibility is displayed in Table 182. The lowest level of cortisol expressed either in terms of total cortisol output or maximum cortisol output, on position, was found among men who never developed any psychiatric problems in the study. The highest levels of cortisol output were associated with having psychiatric problems at intake into the study. Those men who developed psychiatric problems during the study had cortisol output in between these two groups. Hence, cortisol responsivity was associated with the presence rather than the development of psychiatric problems.

A large number of blood pressure measures were devised to assess cardiovascular responsivity at work. Table 183 displays the relationship of the average systolic blood pressure at work to overall psychiatric status susceptibility. Men who remained asymptomatic throughout the study tended to have either very low average systolic blood pressure or very high systolic blood pressure at work, whereas men who developed psychiatric problems tended to have an average level of systolic blood pressure and were very much less likely to have very low or very high average systolic blood pressures. Men who came into the study with psychiatric problems tended to have much higher than expected rates of high average systolic pressure at work, and were under-represented in the very low average systolic blood pressure at work categories.

Behavioral Response to Behavioral Susceptibility Status
(N=233)*

Ratio of Observed to Expected Numbers of Subjects in Each Psychiatric Susceptibility Group	Asymptomatic		Prevalence		Incidence		Total N
	Cases		Cases		Cases		
Extremely low behavioral response (less than -1 s.d.), controlling for total time worked	1.32		1.00		.57		73
Average (+ 1. s.d.) behavioral response, controlling for total time worked	.89		1.04		1.12		190
Extremely high behavioral response (greater than + 1 s.d.), controlling for total time worked	.96		.93		1.12		54

$\chi^2 = 9.64$ df = 4 p < .05

Extremely low behavioral response (less than -1 s.d.), controlling for total time worked

Average (+ 1. s.d.) behavioral response, controlling for total time worked

Extremely high behavioral response (greater than + 1 s.d.), controlling for total time worked

*

Men w/o psychiatric problems but who were not evaluated all 5 times (N=65) and men with less than 3 on the-job results for behavior (N=34) were excluded from this analysis. The psychiatric groups were reduced as follows: Asymptomatic (135 remained 135), Prevalence cases (reduced from 99 to 84) and Incidence cases (reduced from 117 to 98).

**

A ratio of 1.00 means that the number of men observed in a category was exactly equal to that expected by chance.

TABLE 182
The Relationship of Average Normalized
 Cortisol On-The-Job To Overall
 Psychiatric Susceptibility Status*

	Mean	Asymptomatic Group	Prevalence Cases	Incidence Cases	F	P
Average Normalized Total Cortisol Output	1179.1 S.D. 121.8 N** 95	1179.1	1231.1	1198.9	3.20	<.05
Average On-Position Maximum Cortisol Output in 20 minutes	117.9 S.D. 14.4 N*** 101	117.9	126.3	119.5	6.32	<.003

* Overall Psychiatric Susceptibility Status groups were defined as:
 Asymptomatic - all 5 PSS criterion scales were asymptomatic at all 5 evaluations (N=135)
 Prevalence cases - any of the 5 PSS criterion scales were symptomatic at intake (N=99)
 Incidence cases - any of the 5 PSS criterion scales were symptomatic after intake but not at intake (N=117)

** Men who had no problems but who did not have all 5 PSS evaluations (N=65) and men who did not have the specified cortisol assessment (N=132) for three or more field studies were excluded.

*** Men who had no problems but who did not have all 5 PSS evaluations (N=65) and men who did not have the specified cortisol assessment (N=124) for three or more field studies were excluded.

TABLE 183
The Relationship Of Average Systolic
 Blood Pressure At Work To Overall Psychiatric Status
 Susceptibility Groups*

	Ratio of Observed to Expected Numbers of Subjects in Each Psychiatric Susceptibility Group**			Total N
	Asymptomatic	Prevalence Cases	Incidence Cases	
Low average systolic (less than -1s.d.) at work	1.44	.50	.77	41
Average systolic BP (1s.d.) at work	.88	1.04	1.15	193
High average systolic (greater than +1s.d.) at work	1.18	1.30	.50	39

$$\chi^2 = 13.44 \text{ df}=4 \text{ p} < .01$$

men with no psychiatric problems but who were not evaluated all 5 times (N=65) and men with less than 3 on-the-job blood pressure studies (N=145) were excluded from this analysis. The psychiatric groups were reduced as follows: Asymptomatic (135 reduced to 122), Prevalence cases (99 reduced to 67) and Incidence cases (117 reduced to 84).

A ratio of 1.00 means that the number of men observed in a category was exactly equal to that expected by chance.

Hence, men who were susceptible to psychiatric problems over the course of the study tended to have higher than expected levels of behavioral response, slightly higher than average cortisol output on the job, average levels of systolic blood pressure at work and less than expected low and high blood pressure levels at work, whereas men who came into the study with psychiatric problems had average behavioral responses to work, much higher than average cortisol outputs, and more average systolic blood pressures at work. Men who remained free of psychiatric problems over the course of the study tended to have extremely low behavioral responses at work, low cortisol output, and either high or low, but not average, systolic blood pressure responses at work.

The ATCs were also administered a large number of psychological tests at intake and at their second evaluations. Table 184 displays differences on the Job Description Index, the ATC Questionnaire and by age and experience levels. Men who developed problems were significantly younger and had significantly less experience than men who remained asymptomatic or who had problems at intake. In fact, those who developed new problems during the course of the study had a lower age than their experience would suggest, whereas men who remained asymptomatic were older than their experience would indicate.

Men who came into the study with problems had significantly lower satisfaction with work and with their co-workers. Moderate levels of satisfaction with work and co-workers were expressed by those who developed new problems, and the greatest satisfaction was expressed by those who remained asymptomatic over the course of the study. Men who tended to avoid work in order to cope with the pressures of the job tended already to have problems at the beginning of the study. Also, as indicated in Table 134 it was interesting to find that the more an ATC was invested in his identity as a controller, the more likely he was to develop problems over the course of the study. Those men who had less of a need to be super controllers tended to remain asymptomatic. Men who came into the study with psychiatric problems felt that their job cost them a lot in many areas of their lives. Those who remained symptom free felt that the job had cost them relatively less in terms of their personal lives.

Table 185 displays differences on the ATC Questionnaire and on our interview ratings of coping, burnout, and investment. Men who came into the study with psychiatric problems used physical activities as a coping mechanism significantly less often than asymptomatic controls or men who developed new psychiatric problems. The use of alcoholic beverages as a coping mechanism was significantly higher among men who came into the study with psychiatric problems than either asymptomatic controls or the incidence cases. Both those who

TABLE 184

Intake Differences Between Overall Psychiatric
Susceptibility Status Groups: Age, Experience
And Job Related Characteristics*

<u>Intake Variables</u>		<u>Asympto- matic Group (N=135)</u>	<u>Preva- lence Cases (N=99)</u>	<u>Inci- dence Cases (N=117)</u>	<u>F</u>	<u>p</u>
JDI=Job Descrip- tion Index ATCQ=ATC Questionnaire						
Age	Mean (S.D.)	36.60 (4.85)	36.80 (5.16)	34.68 (5.27)	6.14	.003
Experience	Mean (S.D.)	11.16 (4.68)	11.79 (4.57)	10.05 (4.74)	3.91	.02
Age With Experience Controlled	Mean (S.D.)	.40 (2.73)	.02 (2.74)	-.46 (2.39)	3.35	.04
JDI Work Satisfaction	Mean (S.D.)	52.07 (8.83)	45.52 (10.82)	50.55 (9.97)	13.10	.0001
JDI Co-Worker Satisfaction	Mean (S.D.)	52.69 (9.69)	47.76 (9.96)	48.02 (10.46)	10.10	.0002
ATCQ Work Avoidance Factor	Mean (S.D.)	48.85 (9.12)	52.03 (10.15)	49.57 (9.39)	3.27	.04
ATCQ Investment in ATC Identity Factor	Mean (S.D.)	48.81 (10.32)	49.02 (10.76)	51.89 (9.79)	3.27	.04
ATCQ Subjective Costs Factor	Mean (S.D.)	48.05 (8.65)	53.97 (10.71)	50.97 (9.74)	10.52	.0001

asymptomatic - no PSS criterion scale abnormal in 5 evaluations;
prevalence - any criterion scale symptomatic at intake; and incidence
any criterion scale symptomatic after intake but not at intake. Men
who were asymptomatic but who were not evaluated all 5 times were ex-
cluded (N=65), since their later status could not be determined. Group
sizes varied slightly due to missing or not applicable data for some
subjects.

Intake Differences Between Overall Psychiatric
Susceptibility Status Groups: Coping And Interview Assessments*

Intake Variables		Asympto- matic Group (N=135)	Preva- lence Cases (N=99)	Inci- dence Cases (N=177)	F	P
ATCQ=ATC Question- naire, Interview= Global rating from 1(low) to 7(high)						
ATCQ Coping by Physical Activities Factor	Mean (S.D.)	52.61 (9.02)	47.20 (9.85)	50.14 (9.97)	8.82	.0004
ATCQ Coping by Drinking Factor	Mean (S.D.)	47.18 (7.97)	54.14 (11.06)	50.64 (9.82)	14.80	.0001
ATCQ Marital Coping Resources Factor	Mean (S.D.)	52.55 (8.13)	47.06 (10.80)	48.30 (10.15)	9.53	.0003
Interview: Coping with Difficult Days at Work	Mean (S.D.)	4.16 (1.57)	3.20 (1.55)	3.75 (1.54)	10.73	.0001
Interview: Coping with Trainees and Training	Mean (S.D.)	3.80 (1.37)	3.25 (1.49)	3.61 (1.53)	4.02	.02
Interview: Overall Coping	Mean (S.D.)	4.04 (1.34)	3.21 (1.25)	3.69 (1.40)	10.85	.0001
Interview: Global Burnout	Mean (S.D.)	1.96 (1.08)	3.00 (1.79)	2.11 (1.24)	18.33	.0001
Interview: Investment in ATC Identity	Mean (S.D.)	5.17 (1.59)	4.22 (2.14)	4.91 (1.67)	8.27	.0006

*

Asymptomatic - no PSS criterion scale abnormal in 5 evaluations; Prevalence - any criterion scale symptomatic at intake; and Incidence - any criterion scale symptomatic after intake but not at intake.

Men who were asymptomatic but who were not evaluated all 5 times were excluded (N=65), since their true status could not be determined. Group sizes varied slightly due to missing or not applicable data for some subjects.

had problems coming into the study and those who developed problems over the course of the study rated themselves as having much lower marital coping resources than those who remained symptom-free over the course of the study. By self-report measures, therefore, coping mechanisms were primarily different between those who already had psychiatric problems and those who remained symptom-free. Those who developed new psychiatric problems tended to score between those two groups.

Our special interview to assess coping, burnout, and investment also significantly discriminated between groups. Those men who came into the study with psychiatric problems were given coping ratings significantly lower than the asymptomatic group and the incidence cases. Coping was rated as highest among those men who remained asymptomatic throughout the study. It is important to remember that these are predictive results. The interviewees at that time had no idea how men would change in their psychiatric status over the course of the study.

Two other ratings are of particular interest. Burnout was rated highest amongst those who had psychiatric problems at intake and lowest amongst those who continued asymptomatic throughout the study. Investment in the air traffic controller identity was rated lowest amongst those who had problems at intake, and highest amongst those who remained asymptomatic throughout the study. This result contrasted with the self-reported difference in investment (see Table 184) where the asymptomatic cases scored lowest on investment, and new cases of psychiatric problems were higher.

Other psychological intake differences between the overall psychiatric susceptibility groups are shown in Tables 186-188. The sense of anomie and alienation was highest amongst men who had problems coming into the study, and lowest amongst those who remained symptom-free. Psychophysiological anxiety symptoms, life changes, and ethanol consumption per week were highest amongst those who came into the study with psychiatric problems. Men who were more Type B tended to have no psychiatric problems at all over the course of the study.

These many significant differences between men who had no problems, men who had problems coming into the study, and men who developed problems over the course of the study were subjected to multi-variate discriminant analyses in order to find the most significant and parsimonious set of predictors. Table 189 displays the five variables which contributed to the maximum discrimination between these groups. Once these five variables were taken into account, none of the other significant differences reported thus far contributed to a significantly greater differentiation between groups. As seen in Table 189, the CPI sense of well being and

Intake Differences Between Overall Psychiatric
Susceptibility Status Groups: Psychological Characteristics,
Life Changes, And Ethanol Consumption*

<u>Intake Variable</u>		Asympto- matic Cases (N=135)	Preva- lence Cases (N=99)	Inci- dence Cases (N=117)	F	p
ATCQ=ATC Questionnaire LCU=Life Change Units						
Srole's anomie (High scores = less anomie)	Mean (S.D.)	13.71 (1.94)	12.81 (2.22)	13.20 (2.01)	5.72	.004
ATCQ Psychophysio- logical Anxiety Factor	Mean (S.D.)	47.82 (8.74)	53.47 (11.16)	50.39 (9.20)	9.54	.0002
ATCQ Bounceback (High)-Burnout (Low) Factor	Mean (S.D.)	52.29 (8.58)	47.30 (11.81)	50.69 (9.49)	7.16	.0015
ATCQ Tension Discharge Rate Factor	Mean (S.D.)	52.72 (8.96)	47.78 (11.17)	48.53 (9.79)	8.56	.0005
Paykel, Uhlenhuth, And Prusoff LCU Total for 6 Months prior to Intake	Mean (S.D.)	28.24 (23.08)	36.56 (24.07)	36.00 (27.25)	4.21	.02
Review of Life Events Distress Total for 6 months prior to Intake	Mean (S.D.)	171.80 (79.71)	206.55 (192.97)	241.22 (240.54)	6.25	.003
Ethanol Consump- tion per week in absolute ounces	Mean (S.D.)	7.75 (13.30)	14.24 (12.13)	8.44 (8.93)	8.57	.0005

* Asymptomatic - no PSS criterion scale abnormal in 5 evaluations; Prevalence - any criterion scale symptomatic at intake; and Incidence - any criterion scale symptomatic after Intake but not at intake.

* Men who were asymptomatic but who were not evaluated all 5 times were excluded (N=65), since their true status could not be determined. Group sizes varied slightly due to missing or not applicable data for some subjects.

TABLE 187
California Psychological Inventory (CPI) Differences
Between Overall Psychiatric Susceptibility Status Groups*

<u>CPI Characteristics**</u>		Asympto- matic Cases (N=134)*	Preva- lence Cases (N=94)	Inci- dence Cases (N=111)†	F	p
Capacity for Status	Mean (S.D.)	52.61 (8.55)	49.42 (8.78)	50.51 (10.25)	3.61	.03
Sociability	Mean (S.D.)	53.24 (9.80)	49.28 (10.36)	52.23 (9.52)	4.60	.02
Sense of Well-Being	Mean (S.D.)	52.31 (8.21)	43.15 (10.93)	47.60 (10.24)	25.01	.0001
Responsibility	Mean (S.D.)	44.40 (9.53)	38.57 (10.34)	39.46 (10.49)	11.61	.0001
Socialization	Mean (S.D.)	50.62 (7.55)	42.10 (10.52)	44.22 (8.80)	29.52	.0001
Self-Control	Mean (S.D.)	50.39 (8.36)	42.67 (8.52)	45.51 (8.79)	23.99	.0001
Tolerance	Mean (S.D.)	50.28 (8.15)	44.55 (9.71)	46.83 (9.84)	11.32	.0001
Good Impression	Mean (S.D.)	47.78 (10.05)	40.27 (9.77)	43.56 (9.08)	14.85	.0001

* asymptomatic - no PSS criterion scale abnormal in 5 evaluations; Prevalence - any criterion scale symptomatic at intake; and Incidence - any criterion scale symptomatic after intake but not at intake. Men who were asymptomatic but who were not evaluated all 5 times were excluded (N=65) since their true status could not be determined. Eleven others dropped out before completing the CPI and 1 asymptomatic subject answered the CPI invalidly.

† See Table for interpretive descriptions of these characteristics.

California Psychological Inventory (CPI) And
Jenkins Activity Survey (JAS) Differences Between
Overall Psychiatric Susceptibility Status Groups*

<u>CPI or JAS Characteristic**</u>		<u>Asympto- matic Cases (N=134)*</u>	<u>Preva- lence Cases (N=94)*</u>	<u>Inci- dence Cases (N=111)*</u>	<u>F</u>	<u>P</u>
Communality	Mean (S.D.)	55.88 (6.62)	52.32 (8.23)	52.16 (9.14)	8.50	.0005
Achievement Conformity	Mean (S.D.)	54.33 (8.89)	45.79 (9.73)	49.32 (9.49)	24.12	.0001
Intellectual Efficiency	Mean (S.D.)	51.48 (8.91)	45.98 (9.99)	47.50 (10.59)	9.90	.0002
Flexibility	Mean (S.D.)	47.73 (10.98)	51.13 (9.86)	50.23 (11.64)	3.09	.05
Feminity	Mean (S.D.)	47.39 (8.39)	50.59 (8.20)	48.10 (8.39)	4.26	.02
JAS Type A Personality	Mean (S.D.)	-4.54 (3.26)	-2.76 (9.10)	-1.41 (9.60)	3.79	.03
JAS Speed And Impatience Factor	Mean (S.D.)	-5.14 (8.27)	-4.01 (8.89)	-.03 (9.67)	14.50	.0001
JAS Hard Driving Factor	Mean (S.D.)	-1.62 (8.56)	-2.00 (8.88)	1.03 (9.18)	3.80	.03

*
Asymptomatic - no PSS criterion scale abnormal in 5 evaluations; Prevalence - any criterion scale symptomatic at intake; and Incidence - any criterion scale symptomatic after intake but not at intake. Men who were asymptomatic but who were not evaluated all 5 times were excluded (N=65) since their true status could not be determined. Eleven others dropped out before completing the CPI and JAS and 1 asymptomatic subject answered the CPI invalid and was excluded.

**
See Table for Interpretive descriptions of CPI characteristics and Chapter for interpretive descriptions of JAS characteristics.

TABLE 189

The Most Significant And Parsimonious
Discriminators Between Asymptomatic, Prevalence
And Incidence Cases of Overall Psychiatric Susceptibility Status*

<u>Distinguishing Characteristic</u>	<u>Asymptomatic Controls</u>	<u>Prevalence Cases</u>	<u>Incidence Cases</u>
California Psychological Inventory C Questionnaire Description Inventory	High=highest of three groups Medium = middle of three groups Low = Lowest of three groups		
Sense of Well-Being	High	Low	Medium
Responsibility	High	Low(tie)	Low(tie)
Tension Discharge Rate Factor	High	Low	Medium
Work Satisfaction	High	Low	Medium
Alcohol consumption per week absolute ounces	Low	High	Medium

Asymptomatic controls for this analysis (N=104 of 135) were defined as never having had any significant symptomatology on any PSS criterion scale. Prevalence cases (N=79 of 99) were defined as men having any of the 5 PSS criterion scales abnormal at intake. Incidence cases (N=88 of 117) were defined as men having any of the 5 PSS criterion scales abnormal after intake but not at intake. Men without 5 PSS evaluations who were asymptomatic (N=65) were excluded because their later status could not be determined. The reduced group sizes were due to missing data on any of the predictor variables.

responsibility scales were differentiating traits between the groups. Men who had a high sense of well being and a high responsibility score tended to remain symptom-free throughout the study. Those who scored low on the well being or responsibility scales tended to have problems or develop problems. Men with high rates of tension discharge tended to remain symptom-free whereas men who had low tension discharge rate either had or developed psychiatric problems. Work satisfaction was greatest among those who remained symptom-free and lowest among those who had problems at intake. Finally, ethanol consumption per week was highest among those with psychiatric problems at intake and lowest among those who remained symptom-free.

These variables were combined in the discriminant functions for predicting the overall psychiatric susceptibility status of men during the study. Table 190 displays the classification accuracy of these discriminant functions. As can be seen, the specificity of these classifications was 70.2%, which represents the percentage of controls who were correctly identified. The sensitivity of the discriminant functions to pick up cases was 57.0% for those who had problems at intake and 47.7% for those who later developed problems. The overall percentage correct of the classification functions was 59.0%. One-fourth to one-third of the men were incorrectly classified as false negatives or false positives.

The discriminant and classification results were good, though not excellent. They indicated that it would be possible to identify with a high degree of statistical significance those men who remained symptom-free in a three-year period of time, but that the identification of men with problems or who developed problems was more difficult. The greatest amount of misclassification occurred between those who had problems and those predicted to develop problems. From a standpoint of implementing programs this would be of minimal significance since individuals predicted either to have problems or to have a high likelihood of developing problems could be defined as the at-risk group, who might then profit from counseling or other intervention services.

The results presented were the strongest of a larger group from a conceptual, methodological and statistical standpoint. A number of other statistically significant results were found but because of the level of measurement (categorical) and/or the number of results that could have occurred by chance in these areas, they are presented separately. Subsequent studies may be able to integrate the results reported on the pages following with the results reported above, but at the time of this report, we are not convinced of their overall significance and meaning. However, since they may prove to be illuminating or of particular significance in their own right, they are presented next.

TABLE 190
Classification Accuracy Of The
Most Parsimonious And Significant Discriminants
Between Overall Psychiatric Status Susceptibility Groups*

	<u>Asymptomatic</u> <u>Controls</u>	<u>Prevalence</u> <u>Cases</u>	<u>Incidence</u> <u>Cases</u>
<u>Specificity</u> -- % of controls correctly identified	70.2%		
<u>Sensitivity</u> -- % of cases correctly identified		57.0%	47.7%

Classification Matrix

		<u>Predicted Group</u>			
		<u>Asymptomatic</u>	<u>Prevalence</u>	<u>Incidence</u>	<u>Total</u>
<u>Actual</u>	<u>Asymptomatic</u>	73	7	24	104
	<u>Prevalence</u>	14	45	20	79
	<u>Incidence</u>	26	20	42	88
					271

Overall Percent Correct = $73+45+42/271 = 59.0\%$

Percent False Positives = $31/104 = 29.8\%$

Percent False Negatives = $14+26/167 = 24.0\%$

*

Asymptomatic (N=104 of 135) defined as never having had any significant symptomatology on any PSS criterion scale. Prevalence cases (N=79 of 99) were defined as men having any of the 5 PSS criterion scales abnormal at intake. Incidence cases (N=88 of 117) were defined as men having any of the 5 PSS criterion scales abnormal after intake but not at intake. Men without 5 PSS evaluations who were asymptomatic (N=65) were excluded because their later status could not be determined. The reduced group sizes were due to missing data on any of the predictor variables.

Table 191 displays the relationship between mild and moderate health change rates and overall psychiatric susceptibility status. Men who developed psychiatric problems over the course of the study had higher rates of respiratory illness than men who had problems at intake, but only marginally higher respiratory illness rates than asymptomatic men. There were no significant differences in other categories of mild and moderate illness between those with and those without psychiatric susceptibility. On the other hand, when we summed across all the illness categories, the men who developed psychiatric problems over the course of the study had significantly higher average mean illness rates of mild and moderate health changes than men who remained asymptomatic, or who had problems coming into the study.

In general, therefore, we found only a slight association between mild and moderate health change and susceptibility to psychiatric problems. This association was due primarily, if not solely, to an increased rate of respiratory problems among those who developed new psychiatric problems during the study compared to those who had such problems coming into the study.

An important implication of this finding was that a general complaint, or malaise, syndrome was ruled out of our results. If such a syndrome was predominant or even a general factor, we would have had considerable overlap in our medical and psychiatric outcomes. Since we did not, we could rule out this possible factor.

We also were interested in the possibility that a man's general medical history might account for his later psychiatric status. Out of nearly one hundred possible items we assessed in their medical history prior to intake, only six were significant at the .05 level. By chance we could have expected at least five significant items. Therefore the following results are offered for the sake of completeness in describing our results.

Table 192 displays the significant differences between the overall psychiatric susceptibility groups on certain facets of medical history prior to intake. Men who later developed problems in the study had a history of frequent night sweats, prostate trouble, and close contact with tuberculosis. Men who had psychiatric problems coming into the study reported previous history of pain in the chest or with breathing; operations on the head, neck, or face; and allergic reactions to penicillin. Some of these findings make intuitive sense; we are not sure of the overall meaning of the others.

In summary, we can say that a man's prior history of physical illness had little, if any, effect upon his psychiatric status during the study.

TABLE 191
Mild To Moderate Health Change Rates
As A Function Of Overall Psychiatric
Susceptibility Status*

		<u>Average Number of Months Per Year</u> <u>During Which Illness/Disorder Was Experienced**</u>				
		<u>Asymp-</u> <u>tomatic</u> <u>Controls</u>	<u>Preva-</u> <u>lence</u> <u>Cases</u>	<u>Inci-</u> <u>dence</u> <u>Cases</u>	<u>F</u>	<u>p</u>
Age	Mean	1.64	1.42	1.84	4.23	.02
	(S.D.)	.99	1.08	.98		
Pro-	Mean	.52	.36	.51	1.97	N.S.
	(S.D.)	.67	.55	.63		
Specific Illness	Mean	.42	.43	.53	1.10	N.S.
	(S.D.)	.58	.65	.69		
Psycho- somatic	Mean	.14	.14	.16	.06	N.S.
	(S.D.)	.35	.35	.36		
Disorders	Mean	.15	.12	.20	1.20	N.S.
	(S.D.)	.36	.33	.40		
Joint Disorders	Mean	.22	.15	.20	.70	N.S.
	(S.D.)	.41	.36	.40		
Disorders	Mean	.30	.25	.36	.89	N.S.
	(S.D.)	.52	.53	.63		
Disorders	Mean	.53	.52	.64	.96	N.S.
	(S.D.)	.66	.75	.80		
Psycho- somatic Disorders	Mean	.14	.11	.06	2.44	.10
	(S.D.)	.35	.31	.23		
Overall Average Illness Rate	Mean	2.44	2.44	2.73	3.66	.03
	(S.D.)	.88	.98	.95		

Significant Differences Between Overall
Psychiatric Susceptibility Groups On Certain
Facets of Medical History Prior To Intake*

Significant Items from Health History Prior to Intake	Ratio of Observed to Expected Positive Responses for Overall Psychiatric Susceptibility			X ²	P
	Asymptomatic**	Prevalence**	Incidence**		
Frequent night sweats	.50	1.00	1.56	6.05	<.05
Pain in chest or with breathing	.25	2.33	.75	7.62	<.03
Close contact with tuberculosis	1.38	.17	1.29	6.19	<.05
ii.D. told ATC had prostate trouble	.27	1.33	1.50	11.15	<.005
Had operation on head/neck/face	1.26	1.17	.55	7.96	<.02
Allergic to penicillin	.43	2.20	.83	9.09	<.02

*Overall Psychiatric Susceptibility groups were defined as (1) Asymptomatic if all 5 PSS criterion scales were normal throughout the study; (2) Prevalence cases if any of the PSS criterion scales were symptomatic at intake; or (3) incidence cases if any of the PSS criterion scales were symptomatic after intake. Men with no problems but who did not have all 5 evaluations (N=65) were excluded.

**

Some subjects had incomplete medical histories and therefore the number of subjects was reduced for these analyses to: Asymptomatic (135 down to 130), Prevalence (99 down to 97) and Incidence (117 down to 115)

2. Sociodemographic Relationships to Psychological Health Change

In their intake evaluation for the study the controllers were administered a biographical questionnaire that assessed many areas of each man's functioning in the past as well as in the present. In this section, we present a description of the sociodemographical variables which were significantly related to psychological health change up to but not including the final evaluation in the study. A very large number of findings could have been generated from the more than 500 analyses conducted in this area. However, only the statistically significant and more interesting findings will be described in general terms in order to help present a more global image of those who had or developed psychiatric problems.

We used a number of indices of social mobility. One was defined as the difference in socioeconomic level of one's home neighborhood between childhood and the present. We found that those with the least social mobility tended to develop more psychological health changes. Those whose present home neighborhood was in a better socioeconomic area than the home neighborhood of childhood had fewer psychological problems develop over the course of the study.

We asked about the sibling composition of men's parental families. We found that men who were the only child had the fewest psychological health changes with 72% having no problems over the course of the study. Of those with one or more siblings, 50-55% had no problems over the course of the study.

We inquired about the educational level of both the controller and his parents. Thirty-six percent of those ATCs who had far more education than their fathers had an impulse control problem at some time during the first four rounds, whereas only 17% of those whose fathers had equal or more education were so affected. More generally only 40% of those controllers with far higher levels of education than their fathers remained free of psychological health problems over the first four evaluations, whereas 50% of those with lesser differences in education between the father and the controllers, and 67% of those whose fathers had equal or greater education remained free of psychological difficulties over the first four rounds.

The educational level of the controller himself was significantly related to impulse control problems. Those who completed high school and had some vocational training had the fewest such problems. Those few who did not graduate from high school or who did graduate from college had somewhat more impulse control problems. Over all areas of psychological functioning, the two majority groups having middle levels of schooling - high school graduates with vocational

training and high school graduates with some college - had the lowest percentage of psychological problems over the first four rounds.

A special set of five questions on the biographical questionnaire asked the controller to compare his parents with regard to five areas which might have generated a conflict of values or expectations in the study subject. The controllers were asked to indicate how similar or different their parents were in terms of social background, education, religious emphasis, their goals for child rearing, and their personality. A composite score was calculated across these areas.

The 25% of men who reported the greatest differences between their parents had substantially higher frequencies of impulse control problems. This was true both for men with and without such problems at intake. Overall this parental discrepancy variable showed a strong predictive relationship. Only 34% of those men who reported their parents as being very different from one another showed no psychological abnormalities over the first four rounds, whereas 56-60% of those with more similar parents were free from such psychological difficulties.

Subjects were asked about their relationship with their parents during their teenage years. Those who reported worse than average relationships developed psychological problems significantly more often than those who said their relationship with their parents was average or better than average.

Our sociodemographic background variables included an assessment of the size of the city in which a man was reared and certain other habits and characteristics. It was found that men who were born in large cities had fewer problems with subjective distress (anxiety and depression) than those men who were born in small towns or suburbs. However, those men born in large cities also had more work role difficulties than those born in small towns or suburbs.

Subjects also were asked how often they had seriously considered quitting high school. Those who had never considered quitting had significantly fewer impulse control problems and less susceptibility to any psychiatric problems over the first four evaluations. Men who said they never seriously considered quitting high school developed one or more psychological difficulties only 28% of the time, whereas those who had occasionally or frequently considered quitting school later developed one or more psychiatric problems 42% of the time.

The few men who had never married had more impulse control and alcohol problems. In addition, they had a much greater frequency of having three or more problem areas over the first few rounds, than did those men who were married one or more times. Men who were married only once compared to those who were married more than once were not significantly different from one another.

We also assessed the difference between controllers and their wives in socioeconomic level (SES) during their childhood. Men with a higher background than their wives had half the incidence of new problems (14%) than did men with equal or lower SES backgrounds than their wives (34-38%).

A general marital satisfaction question was asked; "All things considered, how happy and satisfied have you been this year in your relationship with your wife?" Only about 16% of the married men gave neutral or unhappy answers. These individuals with lower marital satisfaction experienced six times as much subjective distress at intake and developed seven times as many new problems over the course of the study. These particular men who were unhappy in their marriages had significantly more impulse control disorders, more alcohol abuse, and of course, also far more mate role disturbances. This single question was highly related to the later development of psychological health changes.

We considered all of these findings to be particularly interesting since the characteristics assessed with respect to background and current life situation should be quite stable. However, all of these variables were categorical or ordinal in nature. In addition more than one hundred background variables were examined for these same outcome groups and many of the differences observed could have been due to change. Further analyses may be able to determine their overall significance in the prediction of men who develop psychiatric problems.

3. Extent of Psychiatric Problems

All of the preceding types of analyses were repeated for men differentiated according to extent of their psychiatric problems over the course of the study. The asymptomatic control group remained the same as for the analyses on susceptibility to psychiatric problems. Three case groups were labeled as mild new cases, moderate new cases, and chronic new cases. Men who had problems at intake and men who had incomplete evaluations were excluded from these analyses. All of the same predictive variables (medical history, field study, and psychological variables) were subjected to these analyses.

A fewer number of variables discriminated among the groups of men who had different levels and frequencies of psychiatric problems for the first time. Table 193 displays significant intake predictor differences between these groups: Men who became chronic new cases of psychiatric problems had the highest tension discharge rate, the highest level of coping by drinking, the lowest satisfaction with their co-workers, the highest life change by either of two methods, the highest marital coping resources, and were the youngest and least experienced controllers. Mild and moderate new cases had the lowest tension discharge rate, the next highest levels of drinking to cope, moderately low satisfaction with their co-workers, and moderately high levels of life change. They also tended to be younger and less experienced than asymptomatic controls and reported the lowest levels of marital coping resources.

Table 194 displays significant personality correlates associated with extent of psychiatric problems. There were a large number of significant differences on these personality variables. Here again it is clear that the least adjusted and most hurried and impatient Type A individuals developed the most severe psychiatric problems.

Again, the large number of significant intake predictors and personality characteristics were subjected to discriminant analysis to find the most significant and parsimonious set of discriminators between the extent of psychiatric problem groups. Table 195 displays the results of the discriminant analyses. The coping by drinking factor, life change experience in the six months prior to intake, the CPI responsibility scale, the JAS speed and impatience factors, and the marital coping resources factor were the primary discriminants between groups. No other variables contributed to a further differentiation between these groups once these five variables were taken into account. The pattern of results on each of these variables is displayed in Table 195. These variables were then placed into discriminant functions for predicting and differentiating between the groups.

TABLE 193

Significant Intake Predictors
Of The
Extent Of Psychiatric Problems
Among Air Traffic Controllers*

Contrast Among Asymptomatic Controls (N = 135) And
New Cases Of Mild (N=52), Moderate (N=54) And
Chronic (N=11) Disorders Over Three Years, Excluding
Prevalence Cases At Intake (N=99) And Incomplete Cases (N=65)**

<u>Predictive</u> <u>Intake Variable</u>	<u>Asympto-</u> <u>matic</u> <u>Controls</u> <u>Mean</u> <u>(S.D.)</u>	<u>Mild</u> <u>New</u> <u>Cases</u> <u>Mean</u> <u>(S.D.)</u>	<u>Moderate</u> <u>New</u> <u>Cases</u> <u>Mean</u> <u>(S.D.)</u>	<u>Chronic</u> <u>New</u> <u>Cases</u> <u>Mean</u> <u>(S.D.)</u>	<u>F-ratio</u> <u>between</u> <u>groups</u>	<u>p of</u> <u>F-ratio</u>
Tension Discharge Rate Factor	52.72 (8.96)	49.02 (9.83)	47.09 (9.45)	53.27 (10.43)	5.56	.002
Coping by Drinking Factor	47.18 (7.79)	48.65 (8.42)	51.76 (10.97)	54.54 (8.69)	5.03	.003
Satisfaction with Co-Workers	52.69 (8.69)	47.49 (10.65)	48.79 (10.46)	46.82 (10.30)	5.12	.003
"PJP" Life Change Units	28.24 (23.08)	36.20 (30.12)	31.68 (21.07)	55.91 (33.20)	4.91	.003
"ROLE" Life Change Distress	171.31 (140.49)	253.96 (310.09)	204.28 (145.51)	357.50 (219.13)	4.31	.006
Age	37.13 (4.61)	34.62 (4.50)	34.96 (5.57)	30.50 (4.09)	8.49	.0001
Experience	11.56 (4.61)	9.93 (4.42)	10.09 (4.99)	7.00 (3.33)	4.20	.007
Marital Coping Resources (Asymptomatic, N=107, 79%) (Mild, N=43, 83%) (Moderate, N=46, 88%) (Chronic, N=7, 64%)	52.52 (8.20)	47.33 (9.27)	48.48 (11.22)	55.57 (7.23)	4.91	.003

TABLE 193 cont'd.

Footnotes

ent of psychiatric problems was evaluated using the Psychiatric Status
le, Subjective Distress, Impulse Control Disturbances, Work Role Dis-
ces, Mate Role Disturbances and Alcohol Abuse were used as the criterion

omatic controls: Never had a symptomatic criterion scale
ases: 1 criterion scale abnormal at only 1 of 5 examinations
ate cases: 1 + criterion scales abnormal at 2 or 3 of 5 examinations
ic cases: 1 + criterion scales abnormal at 4 or 5 of 5 examinations
plete cases: Asymptomatic up to time of dropping out - later status
valuated

Significant Personality Correlates
Of The
Extent Of Psychiatric Problems Among
Air Traffic Controllers

Among Asymptomatic Controls (N=134) And New Cases Of Mild
Moderate (N=50), And Chronic (N=11) Disorders Over Three
Excluding Prevalence Cases At Intake (N=99) And Incomplete
(65 On PSS, 7 On CPI And JAS)**

Personality Characteristic	Asymptomatic Controls Mean (S.D.)	Mild New Cases Mean (S.D.)	Moderate New Cases Mean (S.D.)	Chronic New Cases Mean (S.D.)	F-ratio between groups	p of F-ratio
Self-Acceptance	58.68 (8.54)	58.24 (11.07)	62.16 (8.72)	52.73 (12.88)	3.71	.02
Well-Being	52.31 (8.21)	49.04 (10.29)	47.66 (9.77)	40.82 (10.66)	7.90	.0002
Responsibility	44.40 (9.53)	40.08 (10.13)	39.72 (10.29)	35.46 (13.03)	5.64	.002
Socialization	50.62 (7.55)	44.96 (8.94)	44.40 (8.10)	40.00 (10.77)	13.74	.0001
Self-control	50.39 (8.36)	48.06 (7.91)	43.78 (8.93)	41.82 (9.47)	9.68	.0001
Tolerance	50.28 (8.15)	47.34 (9.02)	47.50 (9.84)	41.46 (12.49)	4.53	.005
Good Impression	47.28 (10.05)	45.34 (9.20)	42.64 (9.08)	39.64 (7.14)	4.40	.006
Communality	55.88 (6.62)	51.96 (10.08)	53.04 (6.77)	49.09 (13.47)	5.31	.002
PI Achievement-conformity	54.33 (8.89)	50.82 (7.46)	49.26 (9.86)	42.82 (13.57)	8.50	.0001
PI Intellectual efficiency	51.48 (8.91)	47.98 (11.18)	47.98 (9.20)	42.82 (13.42)	4.40	.006
JAS Type A score	-4.54 (8.21)	-3.79 (8.57)	.52 (10.42)	.44 (7.89)	4.65	.004
JAS Speed and Impatience Factor	-5.14 (8.27)	-3.39 (8.17)	3.18 (10.12)	.63 (9.59)	11.72	.0001

TABLE 194 cont'd.

Footnotes

Extent of psychiatric problems was evaluated using the Psychiatric Status Schedule. Subjective Distress, Impulse Control Disturbance, Work Disturbance, Mate Role Disturbance, and Alcohol Abuse were used as criterion scales.

Asymptomatic controls: Never had a symptomatic criterion scale
Mild cases: 1 criterion scale abnormal at only 1 of 5 examinations
Moderate cases: 1 + criterion scales abnormal at 2 or 3 of 5 examinations
Severe cases: 1 + criterion scales abnormal at 4 or 5 examinations
Incomplete cases: Asymptomatic up to time of dropping out - later status not evaluated. Seven other subjects also did not complete the California Psychological Inventory (CPI) or Jenkins Activity Survey (JAS).

TABLE 195

The Most Significant And Parsimonious
Discriminators Of The Extent Of Psychiatric
Problems Among Air Traffic Controllers*

<u>Discriminating Characteristics</u>	<u>Asymptomatic Controls</u>	<u>Mild Cases</u>	<u>Moderate Cases</u>	<u>Chronic Cases</u>
California Psychological Inventory ATC Questionnaire Jenkins Activity Survey	High=Highest of four groups Med. High=Next to highest group Med. Low=Next to lowest group Low=Lowest of four groups			
Coping by Drinking	Low	Med. Low	High	Med. High
Uhlenhuth and Prusoff Change Units	Low	Med. High	Med. Low	High
Responsibility	High	Med. Low	Low	Med. High
Speed and Inpatience Factor	Low	Med. Low	High	Med. High
Marital Coping Sources	Med. High	Low	Med. Low	High

Overall Extent of Psychiatric Problems was defined using the 5 criterion scales from the PSS evaluations. The asymptomatic controls were men who never had a symptomatic criterion scale (116 of 135 possible men for this analysis). The mild cases had 1 criterion scale abnormal at only 1 of 5 examinations (45 of 52 possible men). The moderate cases had 1 or more criterion scales abnormal at 2 or 3 of 5 examinations (46 of 54 possible men). Chronic cases had 1 or more abnormal scales at 4 or 5 of 5 examinations (7 of 11 possible men). Reduced group sizes were due to missing or not applicable data for some men.

Table 196 displays the classification accuracy of these discriminant functions. The specificity of these discriminant functions was 59.5%, representing the percent of controls correctly identified. Sensitivity was 37.8% for mild cases, 41.3% for moderate cases, and 28.6% for chronic cases of psychiatric difficulties. The overall percent exactly correct over 4 categories was 50.0%. A relatively high percentage of false positives (40.5%) was obtained, but a much lower rate of false negatives occurred (24.5%). The classification matrix indicates that the primary difficulty of the classification analyses was distinguishing between the amount of psychiatric difficulties as opposed to the simple asymptomatic versus case distinction. These results were not good enough to suggest that one could implement a system of predicting the extent of psychiatric problems, whereas previous results indicated that it would be much more feasible to implement a program distinguishing among men with a susceptibility to psychiatric problems.

TABLE 196
Classification Accuracy Of The
Most Parsimonious And Significant Discriminants
Between Overall Extent Of Psychiatric
Problem Groups*

	<u>Asymptomatic</u> <u>Controls</u>	<u>Mild</u> <u>Cases</u>	<u>Moderate</u> <u>Cases</u>	<u>Chronic</u> <u>Cases</u>
Efficiency--% of controls correctly classified	59.5%			
Efficiency--% of cases correctly classified		37.8%	41.3%	28.6%

Classification Matrix

	<u>Asymptomatic</u>	<u>Mild</u>	<u>Moderate</u>	<u>Chronic</u>	<u>Totals</u>
<u>Asymptomatic</u>	69	14	20	13	116
<u>Mild</u>	12	17	7	9	45
<u>Moderate</u>	11	11	19	5	46
<u>Chronic</u>	1	2	2	2	7
					214

Overall Percent Correct = $69+17+19+2/214 = 50.0\%$
 Percent False Positives = $14+20+13/116 = 40.5\%$
 Percent False Negatives = $12+11+1/98 = 24.5\%$

Overall Extent of Psychiatric Problems was defined using the 5 criterion symptom scales from the PSS evaluations. The asymptomatic controls were men who never had a symptomatic criterion scale (116 of 135 possible men for this analysis). The mild cases had 1 criterion scale abnormal at any 1 of 5 examinations (45 of 52 possible men). The moderate cases had 2 or more criterion scales abnormal at 2 or 3 of 5 examinations (46 of 54 possible men). Chronic cases had 1 or more abnormal scales at 4 or 5 of 5 examinations (7 of 11 possible men). Reduced group sizes were due to missing or not applicable data for some men.

4. Onset of Specific Psychiatric Problems

We were also interested in the possibility of distinguishing between men who had developed specific kinds of problems for the first time during the study, and men who did not develop any psychiatric problems. Separate analyses were performed for subjective distress, impulse control disorders, work role disorders, mate role disorders, and alcohol abuse as evaluated in the Psychiatric Status Schedule examination. As described elsewhere for the "sliding interval" type of analysis, predictors were derived from the examinations preceding the development of problems in each of these areas. Predictor variable data for the asymptomatic controls were taken from certain examinations to match the number who became symptomatic for the first time at a particular examination. Table 197 displays the final set of the most parsimonious and significant intake discriminators between completely asymptomatic controls and new nine-month onset cases in these five psychiatric symptom areas.

Those who developed subjective distress for the first time had significantly lower work satisfaction, co-worker satisfaction, and tension discharge rates than asymptomatic controls. They also had significantly higher investment in their ATC identities and significantly higher distress from life changes preceding the development of their problems for the first time.

On the other hand, those who developed impulse control disorders were most distinguished from the asymptomatic controls by their high levels of investment in the ATC identity, high levels of subjective cost that controller work exacts from other areas of their lives, and high levels of drinking to cope.

Those who developed work role disorders had significantly lower work satisfaction but significantly higher subjective costs, life change distress, and drinking to cope, scores than did their asymptomatic controls.

Those who developed mate role problems were significantly different from the asymptomatic controls in that they had lower satisfaction with their co-workers, lower tension discharge rates, lower use of physical activities to cope, and higher life change units assessed with the Paykel, Uhlenhuth, and Prusoff Inventory.

Those who developed alcohol abuse had significantly higher use of drinking to cope, more life change units and higher shift change costs compared to their asymptomatic controls.

It is important to remember that all of these assessments occurred at the time that these onset cases were asymptomatic. Therefore, even though it is possible that they may have been pre-clinical at that time, it is also possible that some of the controls

The Most Parsimonious And
Significant Intake Discriminators
Between Completely Asymptomatic Controls (N=131-135)
And New, 9-Month, Onset Cases In Five
Psychiatric Symptom Areas: Common And Distinctive
Contrasts*

	Subjective Distress (N=25)	Impulse Control (N=68)	Work Role (N=72)	Mate Role (N=51)	Alcohol Abuse (N=44)
Reaction	Low	_____	Low	_____	_____
Satisfaction	Low	_____	_____	Low	_____
Exchange Rate	Low	_____	_____	Low	_____
	High	High	_____	_____	_____
Costs	_____	High	High	_____	_____
Change Distress	High	_____	High	_____	_____
Drinking	_____	High	High	_____	High
Physical Activities	_____	_____	_____	Low	_____
Change Units	_____	_____	_____	High	High
Life Costs	_____	_____	_____	_____	High

of psychiatric problems in each of the five criterion areas was the first occurrence of significant symptomatology after intake among those with any significant symptomatology at intake. Asymptomatic controls were sampled proportionately and randomly from examinations according to the proportion found symptomatic at an examination. "Low" refers to the onset cases in comparison to controls. The parsimonious set of predictors were derived from the complete set of univariate discriminants between groups using a simultaneous multivariate discriminant analysis.

are sampled at the same time were pre-clinical as well. By
large, the results in Table 197 indicate that particular psych-
c disorders are predicted by some distinctive variables as
as by some common characteristics.

These variables were then all placed into respective discrimi-
functions for classifying the subjects as either cases or
controls in each of these five areas of psychiatric dysfunctions.
Table 198 displays the classification accuracy of the discriminant
functions.

The specificity of the discriminant functions was quite good,
ranging from 70.4% for impulse control disorders to 84.3% for
subjective distress disorders. The sensitivity of the discriminant
functions also was quite good, ranging from 64.0% for subjective
distress to 72.7% for alcohol abuse cases. The overall percent
correct range from a low of 60.5% for impulse control disorders to
a high of 81.1% for subjective distress disorders.

This relatively sophisticated methodology indicated that it
is not only possible but perhaps feasible to distinguish men who
develop particular problems over a set period of time from those
who do not develop those problems. The results for specificity
and sensitivity for particular kinds of problems are much better
than they were for the overall psychiatric variables of susceptibility
and extent of problems.

Classification Accuracy Of The
Most Parsimonious And Significant Intake
Discriminators Between Completely Asymptomatic
Controls (N=131-135) And New, 9-Month, Onset Cases
In Five Psychiatric Symptom Areas

	Subjective Distress (N=25 cases vs 134 controls)	Impulse Control (N=68 cases vs 135 controls)	Work Role (N= 72 vs 134 controls)	Mate Role (N=51 cases vs 131 controls)	Alcohol Abuse N=44 cases vs 132 controls)
SPECIFICITY					
Actual % Correct--Asymptomatic	84.3	70.4	71.6	78.6	79.5
SENSITIVITY					
Actual % Correct--New Onset	64.0	67.6	68.1	70.6	72.7
Overall % Correct--Total	81.1	69.5	70.4	76.4	77.8
% False Asymptomatic of Symptomatic	36.0	32.0	32.0	29.0	27.0
% False New Onset of Asymptomatic	16.0	30.0	28.0	21.0	20.0

5. Monthly Depression Morbidity

In addition to evaluation of psychiatric status at Boston University, we evaluated self-reported depressive and anxiety episodes on a monthly basis after the second examinations at Boston University. Men were grouped into asymptomatic controls, acute cases, intermittent cases, or chronic cases according to their frequency of depressive or anxiety episodes. These groups were then contrasted in terms of their health history, field measures, and psychological measures at Boston University as well as on the job.

Table 199 displays significant health history, workload, blood pressure, and mild to moderate health change differences among the monthly depression morbidity groups. The use of tranquilizers in the six months prior to intake was significantly different among the depression morbidity groups. Men who became chronic cases of monthly depression had significantly higher use of tranquilizers prior to coming into the study, in spite of the fact that men who had subjective distress difficulties on the PSS evaluations at intake were excluded to prevent circularity in these findings. In addition, men who were acute or chronic cases of depression on a monthly basis used significantly more sleeping pills prior to intake than did those who were intermittent or asymptomatic cases.

The remaining variables on Table 199 are average assessments of field measures over three or more field studies. The results showed that asymptomatic controls had a significantly lower average timeload on the job than men who were acute, intermittent or chronic cases. The case groups did not differ among themselves on this particular variable.

The average psychological response to work was highest among those who became chronic cases, next highest among those who were intermittent cases, and lowest among those who were acute cases of depressive disorders. This result indicated that those who were chronic cases of depressive disorders on a monthly basis tended to feel that their workload on the job was much higher than it was rated according to our objective measures. On the other hand, those men who experienced only a few depressive episodes rated their job difficulty less than the objective difficulty that we assessed.

The average systolic range at work, controlling for average systolic blood pressure at work, over three or more field studies also differentiated between the case groups but not between the case and control groups. Chronic cases of depression and intermittent cases of depression had significantly higher average systolic range at work than did men who were acute cases. The

TABLE 199
Significant Health History, Workload, Blood Pressure
Response To Work And Mild-To-Moderate Health Change
Differences Among Monthly Depression Morbidity Groups*

<u>Predictive Characteristics</u>	Asympto-	Acute	Inter-	Chronic	F	p
	matic Controls N=169 Mean (S.D.)	Cases N=42 Mean (S.D.)	mittent Cases N=18 Mean (S.D.)	Cases N=5 Mean (S.D.)		
Use of tranquilizers in six months prior to intake (0=none, 1=monthly, 2=bi- weekly, 3=weekly, 4=daily)	.02 (.16)	.09 (.43)	.06 (.24)	.60 (1.35)	9.19	.0001
Use of sleeping pills in six months prior to intake (0=none, 1=monthly, 2=bi- weekly, 3=weekly, 4=daily)	.04 (.22)	.16 (.53)	.00 (.00)	.20 (.63)	4.10	.02
Average Timeload over three or more field studies (Timeload = total time on position + maxi- mum consecutive time on position)	13.85 (2.06)	14.58 (1.74)	14.78 (2.32)	14.79 (2.15)	3.36	.02
Average Psychological Re- sponse to Work over three or more field studies (>100=subjective diffi- culty higher than actual objective difficulty; <100 = subjective difficulty less than actual objec- tive difficulty; s.d.=10, Mean = 100)	100.17 (5.09)	98.86 (6.03)	102.54 (4.40)	103.24 (4.32)	3.61	.02
Average Systolic Range at Work, controlling for average systolic S.P. at work, over three or more field studies	.02 (5.72)	-1.32 (5.33)	3.79 (9.37)	.72 (4.06)	3.06	.03
Average Annualized Rate of Mild-to-Moderate In- juries (only for those with at least 1 internal with 5 returned Monthly Health Reviews)-Number of months, on the average, in which an injury was sus- tained out of 12	.48 (.69)	.58 (.70)	.94 (.87)	.73 (.91)	2.91	.03

TABLE 199 cont'd.

Footnotes

cases with Subjective Distress difficulties on the PSS evaluation at intake were excluded (N=20). Classifications of monthly depression were based on the average annual rate of depression episodes between the second and fifth examinations at B.U. The predictive characteristics were assessed at the second examination which preceded the monthly questionnaire evaluations. Symptomatic controls were defined as having an average annual rate of less than 1 monthly episode per year; acute cases had a rate of 1-2.9 monthly episodes per year; intermittent cases had a rate of 3-8.9 monthly episodes per year; chronic cases had 9+ monthly episodes per year. A total of 234 men were included in these analyses after excluding those without health history or three or more field studies.

asymptomatic controls had almost exactly the average systolic range at work of the total study group.

Finally, the average annualized rate of mild to moderate injuries was significantly higher for the intermittent and chronic groups than for the asymptomatic and acute groups. Men with intermittent and chronic depressive episodes had the highest rates of injuries, whereas the asymptomatic controls had the lowest rate of injuries.

Table 200 displays the job specific and life change differences among the monthly depression morbidity groups. The chronic cases were notable by scoring very low on the assertive good controller factor on the ATC Questionnaire, scoring very high on the psychophysiological anxiety reaction factor, scoring very high on the subjective cost factor, scoring very high on the burnout factor, by having very low social coping resource scores and by having an extremely high life change distress total for the six months prior to intake. The results on all of these scales were almost linear and monotonically increasing from low levels for chronics to high levels for controls.

More general job-related attitudes and dispositional variables were assessed by means of the Job Description Inventory, the Kavanagh Life Attitude Profile, and the Jenkins Activity Survey. (Table 201). Chronic cases scored very low on work satisfaction, co-worker satisfaction, and group satisfaction. They were very dissatisfied with FAA management policy, but on the other hand very satisfied with FAA training policy. They tended to score in the Type A speed and impatience direction on the JAS. On the other hand, the asymptomatic controls in particular scored relatively high on JDI work satisfaction and co-worker satisfaction scales, and on the KLAP group satisfaction index. They were also relatively satisfied with managerial and training policies. They scored in the Type B direction on the JAS speed and impatience factor.

Table 202 displays differences among the monthly depression morbidity groups on the California Psychological Inventory scales. There were obviously a large number of highly significant differences between these groups with the chronic cases of depression appearing most abnormal on all scales. And as expected, the asymptomatic controls scored more nearly normal according to the CPI normative statistics. From an overall standpoint, one would say that those who were asymptomatic in depression over the course of the study were most similar to normal comparison groups, and the case groups were deviant.

All of the preceding significant differences among the monthly depression groups were subjected to a multi-variate discriminant

TABLE 200

Job-Specific And Life Change Differences
Among Monthly Depression Morbidity Groups*

<u>Predictive Characteristics</u>	<u>Asymptomatic Controls</u> <u>N=230</u>	<u>Acute Cases</u>	<u>Intermittent Cases</u>	<u>Chronic Cases</u> <u>N=11</u>		
	<u>Mean</u> <u>(S.D.)</u>	<u>Mean</u> <u>(S.D.)</u>	<u>Mean</u> <u>(S.D.)</u>	<u>Mean</u> <u>(S.D.)</u>	<u>F</u>	<u>p</u>
Q Good Controller Factor	47.85 (8.93)	46.34 (10.68)	48.79 (8.28)	38.82 (7.87)	3.75	.02
Q Psychophysiological Safety Reaction Factor	47.08 (7.73)	49.33 (8.88)	51.33 (10.69)	54.64 (7.09)	5.04	.003
Q Subjective Costs Factor	48.44 (9.50)	51.43 (9.03)	52.28 (8.04)	55.27 (8.01)	4.38	.006
Q Bounceback(High)- Bounceback(Low) Factor	50.17 (8.72)	46.69 (9.61)	47.33 (9.98)	41.82 (5.95)	5.54	.002
Q Social Coping Resources Factor	50.12 (9.69)	45.73 (9.18)	45.11 (8.23)	45.46 (9.17)	5.39	.002
Q Life Change Distress Factor	196.96 (188.37)	242.88 (244.98)	254.67 (261.36)	536.46 (436.97)	8.58	.0001

cases with Subjective Distress difficulties on the PSS evaluation at intake were excluded (N=20). Classifications of monthly depression were based on the average annual rate of depression episodes between the second and fifth examinations at B.U. The predictive characteristics were assessed at the second examination which preceded the monthly questionnaire evaluations. Asymptomatic controls were defined as having an average annual rate of less than 1 monthly episode per year; acute cases had a rate of 1-2.9 monthly episodes per year; intermittent cases had a rate of 3-8.9 monthly episodes per year; chronic cases had 9+ monthly episodes per year. A total of 333 cases were included in these analyses.

General Job-Related Attitudinal And Dispositional
Differences Among Monthly Depression Morbidity Groups*

Predictive Characteristics	Asymptomatic	Acute	Inter-	Chronic	F	P
	Controls	Cases	mittent	Cases		
	N=230	N=74	N=18	N=11		
	Mean	Mean	Mean	Mean		
	(S.D.)	(S.D.)	(S.D.)	(S.D.)		
Work Satisfaction	48.44 (9.11)	46.30 (10.05)	43.50 (8.00)	37.82 (12.99)	6.11	.0007
Co-Worker Satisfaction	53.40 (10.23)	50.19 (10.54)	45.28 (9.96)	39.82 (11.94)	9.75	.0001
Group Satisfaction	53.72 (9.13)	52.12 (8.55)	53.83 (8.81)	45.55 (8.31)	3.33	.02
Satisfaction with FAA Management Policy	49.94 (9.14)	46.34 (9.54)	49.39 (7.30)	46.73 (6.84)	3.18	.03
Satisfaction with FAA Training Policy	48.41 (9.89)	51.28 (9.90)	47.39 (9.40)	54.00 (7.13)	2.70	.05
Speed And Impatience Factor	-3.58 (8.81)	-1.27 (9.44)	2.16 (9.24)	1.70 (11.44)	3.90	.01

with Subjective Distress difficulties on the PSS evaluation at intake were excluded (N=20). Classifications of monthly depression were based on average annual rate of depression episodes between the second and fifth evaluations at B.U. The predictive characteristics were assessed at the second examinations which preceded the monthly questionnaire evaluations. Asymptomatic controls were defined as having an average annual rate of less than 1 monthly episode per year; acute cases had a rate of 1-2.9 monthly episodes per year; intermittent cases had a rate of 3-8.9 monthly episodes per year; chronic cases had 9+ monthly episodes per year. A total of 333 were included in these analyses.

TABLE 202
 California Psychological Inventory Differences
 Among Monthly Depression Morbidity Groups*

Active Characteristics	Asymptomatic Controls N=230 Mean (S.D.)	Acute Cases N=74 Mean (S.D.)	Inter- mittent Cases N=18 Mean (S.D.)	Chronic Cases N=11 Mean (S.D.)	F	p
Dominance	57.35 (11.08)	53.01 (12.30)	51.61 (11.88)	46.73 (14.75)	5.88	.001
Capacity for Status	52.64 (8.26)	48.76 (9.39)	51.11 (9.51)	47.18 (13.46)	4.59	.004
Sociability	53.85 (8.65)	49.46 (10.46)	48.11 (10.43)	49.00 (12.20)	6.07	.001
Social Presence	59.90 (9.38)	55.84 (10.44)	57.33 (10.83)	51.46 (14.29)	5.25	.002
Sense of Well-Being	51.96 (9.46)	46.32 (9.03)	48.78 (10.49)	37.91 (11.59)	14.71	.0001
Responsibility	43.18 (9.93)	39.14 (10.40)	36.56 (9.70)	36.73 (11.15)	5.72	.002
Socialization	48.47 (8.64)	45.03 (9.03)	43.83 (8.33)	44.09 (11.63)	4.48	.005
Self-Control	49.78 (8.64)	44.70 (8.18)	46.78 (6.36)	42.82 (11.00)	7.47	.0002
Tolerance	49.87 (8.72)	46.27 (8.47)	47.11 (8.45)	43.55 (10.83)	4.76	.004
Good Impression	46.99 (10.00)	41.19 (9.24)	44.89 (10.20)	39.36 (11.48)	7.81	.0002
Communality	55.48 (6.60)	53.22 (8.33)	52.22 (6.03)	49.09 (10.74)	4.43	.005
Achievement-Conformity	53.88 (8.25)	46.89 (9.72)	48.61 (9.41)	44.73 (11.53)	15.19	.0001
Intellectual Efficiency	50.79 (9.17)	45.84 (9.11)	47.44 (10.33)	44.18 (12.76)	6.65	.0004
Psychological Mindedness	55.47 (8.46)	52.11 (8.94)	53.67 (8.51)	51.91 (14.05)	3.12	.03

Footnotes

* Cases with Subjective Distress difficulties on the PSS evaluation at intake were excluded (N=20). Classifications of monthly depression were based on the average annual rate of depression episodes between the second and fifth examinations at B.U. The predictive characteristics were assessed at the second examination which preceded the monthly questionnaire evaluations. Asymptomatic controls were defined as having an average annual rate of less than 1 monthly episode per year; acute cases had a rate of 1-2.9 monthly episodes per year; intermittent cases had a rate of 3-8.9 monthly episodes per year; chronic cases had 9+ monthly episodes per year. A total of 333 men were included in these analyses.

is. Table 203 displays the most parsimonious and significant discriminants among these groups. Only three variables accounted for the majority of differences between the monthly depression cases. These variables were the CPI sense of well-being, the ROLE life change distress total for the six months prior to intake, and the JDI co-worker satisfaction scales. The asymptomatic controls scored highest on the CPI sense of well being and JDI co-worker satisfaction scales, and lowest on the ROLE life change distress total, whereas the chronic cases scored in exactly the opposite pattern on these three scales.

The discriminant functions derived from these analyses were used to classify subjects predictively. Table 204 displays the classification accuracy of the discriminant functions. The specificity was 57.2% for the asymptomatic controls. Sensitivity, representing the percent of cases correctly identified, was 36.5% for acute cases, 38.9% for intermittent cases, and 45.4% for chronic cases. The overall percent of correct classifications was 51.2%. A very high false positive rate of 42.8% was found and a relatively low rate of 21.4% was found for false negatives. As in previous analyses the major difficulty in making accurate classifications was found in differentiating among the case groups as can be seen in the classification matrix of Table 204. The specificity and sensitivity of these analyses would not be sufficient for implementation in a risk identification program. Further work would need to be done on developing the discriminant functions or one might need to revert to a simple case versus control comparison to improve the predictive classifications sufficiently for an implementation program.

TABLE 203

The Most Parsimonious And Significant
Discriminants Among Monthly Depression Groups*

<u>Discriminant Characteristic</u>	<u>Asymptomatic Controls N=229</u>	<u>Acute Cases N=74</u>	<u>Intermittent Cases N=18</u>	<u>Chronic Cases N=11</u>
Sense of -Being	High	Med. Low	Med.High	Low
Life Total	Low	Med. Low	Med.High	High
Co-Worker Satisfaction	High	Med. High	Med.Low	Low

with Subjective Distress difficulties on the PSS evaluation were included (N=20). Classifications of monthly depression were based on average annual rate of depression episodes between the second and third examinations at B.U. The predictive characteristics were assessed at the second examination which preceded the monthly questionnaire evaluations. Asymptomatic controls were defined as having an average annual rate of less than 1 monthly episode per year; acute cases had a rate of 1-2.9 monthly episodes per year; intermittent cases had a rate of 3-8.9 monthly episodes per year; chronic cases had 9 or more monthly episodes per year. A total of 332 men were included in the analyses.

TABLE 204

Classification Accuracy Of The Most Parsimonious And Significant Discriminants Among Monthly Depression Groups*

	<u>Asymptomatic Controls</u>	<u>Acute Cases</u>	<u>Intermittent Cases</u>	<u>Chronic Cases</u>
Accuracy-% of Controls Classified	57.2%			
Accuracy-% of Correctly Classified		36.5%	38.9%	45.4%

Classification Matrix

	<u>Predicted Groups</u>				<u>Totals**</u>
	<u>Asymptomatic Controls</u>	<u>Acute Cases</u>	<u>Intermittent Cases</u>	<u>Chronic Cases</u>	
<u>Asymptomatic</u>	131	33	44	21	229
<u>Acute</u>	17	27	19	11	74
<u>Intermittent</u>	5	2	7	4	18
<u>Chronic</u>	0	2	4	5	11
					<u>332</u>

Total Percent Correct = 51.2%
 Total False Positives = 42.8%
 Total False Negatives = 21.4%

with Subjective Distress difficulties on the PSS evaluation were included (N=20). Classifications of monthly depression were based on average annual rate of depression episodes between the second and third examinations at B.U. The predictive characteristics were assessed at the second examination which preceded the monthly questionnaire evaluations. Asymptomatic controls were defined as having an average annual rate of less than 1 monthly episode per year; acute cases had a rate of 1-2 monthly episodes per year; intermittent cases had a rate of 3-8.9 monthly episodes per year; chronic cases had 9+ monthly episodes per year. A total of 332 men were included in these analyses.

6. Monthly Anxiety Morbidity

Table 205 displays the significant workload, psychological response to work and mild to moderate health change differences among the monthly anxiety morbidity groups. The asymptomatic controls had a significantly lower average normalized workload over three or more field studies compared to any of the case groups. The highest levels of normalized workload were achieved by the acute and chronic cases. It is not known whether the higher level of workload resulted in the higher rates of depression, or if the men who were depressed worked more in order to avoid focusing on their depressed feelings, since the average normalized workload was computed over the course of the study and is only an associated and not predictive characteristic.

The chronic cases also had a significantly higher average psychological response to work indicating that they perceived their workload as higher than the actual objective workload that we measured. Acute cases estimated their workload at levels significantly lower than what we assessed with our objective difficulty measures. Asymptomatic controls scored exactly at the average.

Table 206 displays job specific and life change differences among the monthly anxiety morbidity groups. On the ATC Questionnaire chronic cases scored significantly higher on the psychophysiological anxiety reaction factor, significantly lower on the tension discharge rate factor, significantly higher on subjective cost, significantly lower on bounceback-burnout factor, significantly lower on the marital coping resources factor, and moderately low on the social coping resource factor. They also scored extremely high on the ROLE life change distress total for the six months prior to intake. The asymptomatic controls scored in exactly the opposite way as the chronic cases, and the acute and intermittent cases scored between these two groups. These results were all predictive in nature as opposed to the prior table of results which were concurrent.

Table 207 displays general job-related and dispositional differences among the monthly anxiety morbidity groups. The JDI work satisfaction, co-worker satisfaction, and pay satisfaction scales were significantly lower among the chronic cases of anxiety than among the asymptomatic controls. The chronic cases also were significantly less satisfied with individual job related characteristics and were significantly less satisfied with group related job characteristics, both as assessed by the Kavanagh Life Attitude Profile. The intermittent and chronic cases also scored significantly lower than the other groups on the satisfaction with FAA managerial and promotional policy scales. Finally, there was a tendency for intermittent and chronic cases to score high on the

TABLE 205

Significant Workload, Psychological Response to Work,
And Mild-To-Moderate Health Change Differences
Among Monthly Anxiety Morbidity Groups*

Associated Character- istics	Asympto- matic Controls N=217	Acute Cases N=60	Inter- mittent Cases N=18	Chronic Cases N=8	F	P
	Mean (S.D.)	Mean (S.D.)	Mean (S.D.)	Mean (S.D.)		
Average Normalized Work- load over three or more field studies	496.01 (22.32)	504.67 (25.30)	500.83 (20.43)	505.13 (22.22)	2.60	.05
Average Psychological Re- sponses to work over 3 or more field studies (> 100= subjective difficulty higher than actual objective difficulty; <100= subjective diffi- culty less than actual objective difficulty; S.D.= 10, Mean = 100	100.26 (5.07)	98.62 (5.96)	100.95 (5.34)	104.77 (4.51)	3.91	.01

* Cases with Subjective Distress difficulties on the PSS evaluation were ex-
cluded (N=20). Classifications of monthly anxiety were based on the average
annual rate of anxiety episodes between the second and fifth examinations
at B.U. The predictive characteristics were assessed at the second exami-
nation which preceded the monthly questionnaire evaluations. Asymptomatic
controls were defined as having an average annual rate of less than 1 monthly
episode per year; acute cases had a rate of 1-2.9 monthly episodes per year;
intermittent cases had a rate of 3-8.9 monthly episodes per year; chronic
cases had 9+ monthly episodes per year. A total of 303 men were included
in these analyses after excluding those without three or more field studies.

TABLE 206
Job-Specific And Life Change Differences
Among Monthly Anxiety Morbidity Groups*

<u>Predictive Characteristics</u>	<u>Asymptomatic Controls</u> N=241 Mean (S.D.)	<u>Acute Cases</u> N=64 Mean (S.D.)	<u>Intermittent Cases</u> N=20 Mean (S.D.)	<u>Chronic Cases</u> N=8 Mean (S.D.)	<u>F</u>	<u>P</u>
Psychophysiological Anxiety Reaction Factor	46.67 (7.44)	50.71 (9.65)	53.80 (8.71)	54.50 (7.60)	9.92	.0001
Tension Discharge Factor	50.87 (9.15)	47.31 (10.41)	41.60 (8.23)	43.75 (7.31)	8.92	.0001
Subjective Costs Factor	48.47 (9.12)	51.84 (10.23)	53.45 (7.93)	56.50 (7.76)	5.09	.003
Bounceback (High)- Bounceout (Low) Factor	50.12 (8.91)	47.57 (9.37)	44.10 (8.58)	41.00 (4.90)	5.79	.001
Marital Coping Resources Factor	49.53 (9.46)	50.07 (9.08)	43.88 (12.56)	44.25 (8.23)	2.64	.05
Social Coping Resources Factor	49.54 (9.33)	47.63 (10.98)	43.30 (7.72)	46.88 (9.72)	3.09	.03
Life Change Stress Total	195.66 (200.76)	278.53 (231.32)	274.75 (298.53)	388.88 (448.51)	4.41	.005

*Cases with Subjective Distress difficulties on the PSS evaluation at Intake were excluded (N=20). Classifications of monthly anxiety were based on the average annual rate of anxiety episodes between the second and fifth examinations at B.U. The predictive characteristics were assessed at the second examination which preceded the monthly questionnaire evaluations. Asymptomatic controls were defined as having an average annual rate of less than one monthly episode per year; acute cases had a rate of 1-2.9 monthly episodes per year; intermittent cases had a rate of 3-8.9 monthly episodes per year; chronic cases had 9+ monthly episodes per year. A total of 333 men were included in these analyses.

TABLE 207

General Job-Related And Dispositional
Differences Among Monthly Anxiety Morbidity Groups*

<u>Predictive Characteristics</u>	<u>Asymptomatic Controls N=241 Mean (S.D.)</u>	<u>Acute Cases N=64 Mean (S.D.)</u>	<u>Inter- mittent Cases N=20 Mean (S.D.)</u>	<u>Chronic Cases N=8 Mean (S.D.)</u>	<u>F</u>	<u>P</u>
Job Description Inventory; KLAP= Kavg- High Life Attitude Profile Jenkins Activity Survey						
Work Satisfaction	47.92 (9.38)	47.95 (9.62)	41.60 (8.39)	39.75 (13.34)	4.54	.005
Co-Worker Satis- faction	53.03 (10.26)	50.88 (10.66)	43.75 (11.22)	42.13 (12.04)	7.55	.0002
Pay Satisfaction	49.42 (9.45)	49.50 (9.98)	47.80 (10.04)	40.00 (8.21)	2.67	.05
Individual Satis- faction	52.74 (8.76)	51.47 (9.01)	42.25 (7.89)	43.63 (6.12)	4.36	.005
Group Satisfaction	53.47 (8.90)	53.66 (9.21)	49.05 (7.37)	47.86 (12.04)	2.48	.05
Satisfaction with FAA Management Policy	49.60 (9.52)	48.63 (8.30)	43.53 (6.84)	47.63 (6.16)	2.84	.04
Satisfaction with FAA Promotional Policy	49.60 (9.37)	48.33 (10.12)	43.45 (6.89)	46.38 (5.37)	3.02	.03
Speed and In- patience Factor	-3.59 (8.80)	-1.30 (9.29)	4.98 (8.38)	-1.35 (12.76)	6.25	.0006

*Men with Subjective Distress difficulties on the PSS evaluation at intake were excluded (N=20). Classifications of monthly anxiety were based on the average annual rate of anxiety episodes between the second and fifth examinations at B.U. The predictive characteristics were assessed at the second examination which preceded the monthly questionnaire evaluations. Asymptomatic controls were defined as having an average annual rate of less than 1 monthly episode per year; acute cases had a rate of 1-2.9 monthly episodes per year; intermittent cases had a rate of 3-8.9 monthly episodes per year; chronic cases had 9+ monthly episodes per year. A total of 333 men were included in these analyses.

JAS Speed and Impatience factor especially as contrasted with the asymptomatic control subjects.

Table 208 displays the California Psychological Inventory differences among the monthly anxiety morbidity groups. The results were very similar to those for the monthly depression morbidity groups inasmuch as the case groups deviated considerably from the norms, whereas the asymptomatic controls were much more similar to the original normative groups on which the CPI scoring was devised.

Finally, we once again submitted the variables which were significantly different between the morbidity groups to a multivariate discriminant analysis. Table 209 displays the most parsimonious and significant discriminants among these groups. Only three variables accounted for all the significant differences between the monthly anxiety morbidity groups. The ATC Questionnaire psychophysiological anxiety reaction factor, the ATC Questionnaire tension discharge rate factor and the ROLE life change distress total accounted for all of the significant differences between these groups. Table 209 also indicates the relative standing of anxiety groups on these three variables.

The discriminant functions using these three variables were then applied in the classification analysis. Table 210 displays the results of the classification analysis.

The results of the classification analysis were not particularly good. The specificity was only 53.1%. Sensitivity was calculated at 15.4% for acute cases, 56.2% for intermittent cases, and 28.6% for chronic cases. The overall percent correct was 45.4%, a very low figure. And conversely, the percentages of false positives and false negatives were very high at 46.9% and 37.3% respectively.

Although statistically significant, these results were not sufficiently good to suggest that an accurate risk identification program could be implemented for persons with varying degrees of anxiety episodes. Again, further analyses and refinements of our methodology might result in a program of implementable risk identification procedures.

TABLE 208
California Psychological Inventory Differences
Among Monthly Anxiety Morbidity Groups*

<u>Predictive Characteristics</u>	<u>Asymptomatic Controls</u> N=241 Mean (S.D.)	<u>Acute Cases</u> N=64 Mean (S.D.)	<u>Intermittent Cases</u> N=20 Mean (S.D.)	<u>Chronic Cases</u> N=8 Mean (S.D.)	<u>F</u>	<u>p</u>
CPI Dominance	57.00 (11.03)	52.86 (12.61)	53.65 (14.18)	45.38 (12.92)	4.61	.004
CPI Capacity for Status	52.51 (8.61)	49.11 (8.36)	48.35 (10.40)	48.75 (13.86)	3.72	.02
CPI Sociability	53.55 (9.03)	49.44 (10.31)	48.80 (9.00)	50.50 (10.46)	4.43	.005
CPI Social Presence	59.85 (9.84)	55.50 (9.55)	55.70 (11.34)	52.00 (10.50)	5.13	.003
CPI Sense of Well-Being	51.99 (8.47)	46.78 (9.34)	42.00 (10.64)	38.75 (11.44)	16.61	.0001
CPI Responsibility	42.75 (10.13)	40.03 (10.13)	37.30 (11.09)	34.75 (7.32)	3.94	.009
CPI Socialization	48.24 (8.29)	45.92 (9.49)	40.80 (10.59)	46.63 (9.02)	5.21	.002
CPI Self-Control	49.13 (8.31)	46.66 (8.08)	40.90 (11.78)	44.50 (9.58)	6.99	.0003
CPI Tolerance	48.90 (8.44)	46.84 (8.84)	43.35 (11.03)	44.13 (7.75)	6.21	.0007
CPI Good Impression	46.18 (10.11)	44.34 (9.63)	40.80 (11.42)	39.13 (10.09)	3.11	.03
CPI Communality	55.48 (6.97)	52.98 (7.41)	51.70 (7.41)	50.25 (9.74)	4.36	.006
CPI Achievement-Conformity	53.35 (8.60)	48.78 (9.49)	44.20 (10.50)	45.75 (9.91)	10.90	.0001
CPI Intellectual Efficiency	50.71 (9.24)	46.30 (8.61)	43.75 (11.71)	44.13 (10.76)	7.24	.0003
CPI Psychological Mindedness	55.43 (8.69)	53.38 (8.35)	52.05 (8.58)	50.00 (14.50)	3.35	.02
CPI Femininity	47.20 (8.10)	50.03 (9.06)	51.65 (5.46)	48.50 (7.39)	3.57	.02

TABLE 208 cont'd.

Footnotes

with Subjective Distress Difficulties on the PSS evaluation at
were excluded (N=20). Classifications of monthly anxiety were
d on the average annual rate of anxiety episodes between the second
fifth examinations at B.U. The predictive characteristics were
ssed at the second examination which preceded the monthly question-
evaluations. Asymptomatic controls were defined as having an
age annual rate of less than 1 monthly episode per year; acute
s had a rate of 1-2.9 monthly episodes per year; intermittent cases
a rate of 3-8.9 monthly episodes per year; chronic cases had 9+
thly episodes per year. A total of 333 men were included in these
lyses.

TABLE 209

The Most Parsimonious And Significant
Discriminants Among Monthly Anxiety Groups*

<u>Discriminant Characteristics</u>	<u>Asympto- matic Controls N=241</u>	<u>Acute Cases N=64</u>	<u>Inter- mittent Cases N=20</u>	<u>Chronic Cases N=8</u>
ATC Questionnaire: Psychophysiological Anxiety Reaction Factor	Low	Med Low	Med High	High
ATC Questionnaire: Tension Discharge Late Factor	High	Med High	Low	Med Low
ROLE Life Change Distress Total	Low	Med High	Med Low	High

cases with Subjective Distress difficulties on the PSS evaluation were excluded (N=20). Classifications of monthly anxiety were based on the average annual rate of anxiety episodes between the second and fifth examinations at B.U. The predictive characteristics were assessed at the second examinations which preceded the monthly questionnaire evaluations. Symptomatic controls were defined as having an average annual rate of less than 1 monthly episode per year; acute cases had a rate of 1-2.9 monthly episodes per year; intermittent cases had a rate of 3-8.9 monthly episodes per year; chronic cases had 9+ monthly episodes per year. A total of 333 men were included in these analyses.

TABLE 210
Classification Accuracy Of The Most Parsimonious
 And Significant Discriminants Among Monthly Anxiety Groups*

	<u>Asympto- matic Controls</u>	<u>Acute Cases</u>	<u>Inter- mittent Cases</u>	<u>Chronic Cases</u>
<u>Specificity</u> --% of controls correctly identified	53.1%			
<u>Sensitivity</u> --% of cases correctly identified		15.4%	56.2%	28.6%

Classification Matrix

		<u>Predicted Groups</u>				
		<u>Asympto- matic Controls</u>	<u>Acute Cases</u>	<u>Inter- mittent Cases</u>	<u>Chronic Cases</u>	<u>Totals**</u>
<u>Actual Groups</u>	<u>Asymptomatic</u>	104	38	31	23	196
	<u>Acute</u>	24	8	15	5	52
	<u>Intermittent</u>	3	0	9	4	16
	<u>Chronic</u>	1	1	3	2	7
						271

Overall Percent Correct = 45.4%

Percent False Positive = 46.0%

Percent False Negative = 37.3%

*
 Cases with Subjective Distress difficulties on the PSS evaluation were excluded (N=20). Classifications of monthly anxiety were based on the average annual rate of anxiety episodes between the second and fifth examinations at B.U. The predictive characteristics were assessed at the second examination which preceded the monthly questionnaire evaluations. Asymptomatic controls were defined as having an average annual rate of less than 1 monthly episode per year; acute cases had a rate of 1-2.9 monthly episodes per year; intermittent cases had a rate of 3-8.9 monthly episodes per year; chronic cases had 9+ monthly episodes per year.

**
 The reduced number of subjects is due to the fact that all subjects must have all variables to permit discriminant and classification analyses.

7. Psychiatric Status vs Other Outcomes

Psychiatric outcomes could be considered one of the softer areas in the study from the standpoint that one might question whether they make a difference to the Agency. Therefore, we investigated whether the psychiatric status classifications of individuals were related to other outcomes. Table 211 displays comparative statistics on psychiatric status assessed in the study and medical disqualifications from the FAA during the three years of the study. The top half of this table shows that only one in 135 asymptomatic controls were medically disqualified, whereas 9.1% of prevalence cases and 8.5% of incidence cases were so disqualified by the Federal Aviation Administration. The lower half of Table 211 shows that this association between psychiatric status in the study and being medically disqualified by the FAA was statistically significant. Of the 20 men who were medically disqualified by the FAA, 19 men had an abnormal psychiatric status as assessed by the study team. One person who was an asymptomatic control was disqualified for reasons not known to the study team. It is important to note that of these twenty cases, half were disqualified by the FAA for psychiatric reasons and half for medical reasons, indicating that psychiatric status was a risk factor for both medical and psychological disorders as assessed by FAA federal air surgeons.

Table 212 displays the relationship of FAA performance awards to other outcomes including the psychiatric outcomes assessed in the study. We found that the highest award group had somewhat fewer psychiatric problems at intake or later, and that men with chronic problems had the fewest awards. The asymptomatic group received more awards in general. However, there was no significant association between the monthly morbidity of depression or anxiety and FAA performance awards. And finally, as indicated in other sections of this report, there was no relationship between mild and moderate health changes or hypertension and FAA performance awards.

Psychiatric Status And Medical Disqualifications From The FAA

Group	Percent Medically Disqualified		
	No Psychiatric Problems Prior To Dropping From Study*	Asymptomatic Controls*	Prevalence Cases*
Number and percent	3/65 = 4.6%	1/135 = 0.7%	9/99 = 9.1%
			10/117 = 8.5%

Cross-tabulation Of Psychiatric Status In Study And Medical Disqualification By FAA

Medically Disqualified By FAA?	Psychiatric Status In Study		Row Totals
	Asymptomatic Controls	Prevalence Cases	
YES	1 Observed (8) Expected	9 (6)	10 (6)
NO	134 (127)	90 (93)	107 (111)
Column Totals	135	99	117 351

$\chi^2 = 10.92$ $df = 1$ $p < .01$

*No Psychiatric Problems Prior To Dropping From Study - these men (N=65) were not evaluated all 5 times and therefore could have developed problems we did not know about.
 Asymptomatic - these men had no abnormalities on the 5 PSS criterion scales at all of their psychiatric evaluations.
 Prevalence cases - these men had one or more symptomatic criterion scales on the PSS at intake.
 Incidence cases - these men had one or more symptomatic criterion scales on the PSS after intake but not at intake.

TABLE 212
Relationship Of FAA Performance
Awards To Other Outcomes

<u>Outcome</u>	<u>Relationship To Performance Awards</u>
Acceptability to Psychiatric Problems	Highest award group had fewest psychiatric problems at intake or later ($p < .10$)
Percent of Psychiatric Problems	Chronic problem group had fewest awards, No problem group more awards ($p < .20$)
Monthly Depression Morbidity	No significant relationships ($p > .50$)
Monthly Anxiety Morbidity	No significant relationships ($p > .50$)
Mild-to-Moderate Health Change Rate	No significant relationship ($p > .50$)
Hypertension	No Significant relationship ($p > .50$)

SUMMARY

Predictors of Work-Related Changes

Analysis of relationships between predictor variables and work-related changes produced the following associations:

- 1) Individuals who later developed burnout showed, at intake or Round 2, more vigor, friendliness and elation (measured by Profile of Mood States), less anxiety regarding work, better tension discharge rate, less coping by drinking and more coping by physical activity, less anxiety with training, and more assertiveness;
- 2) By the end of the study, men who developed burnout had more subjective distress than others;
- 3) Individuals who developed burnout did not show any differences in average amount of work done or time spent on position on the days they were monitored, nor did they show any deterioration in physical health;
- 4) Men who were promoted were generally more satisfied with FAA policies, had more personal job morale, were generally more hard-driving, dominant and job-involved, had more life change just before being promoted, had more peer nominations for competence, were slightly older and had slightly more experience than those not promoted. At the same time, those who were promoted rated themselves as more burned out on the bounceback-burnout question in the ATC Questionnaire;
- 5) Men who were medically disqualified during the course of the study were chosen much less often than others as ideal team members or as among the most competent, were not as invested in the job, had fewer marital resources, scored lower on feelings of well-being, responsibility, tolerance and intellectual efficiency, the last being the most important predictor emerging from a discriminant function analysis;
- 6) Analysis of PSS scores showed that psychiatric symptomatology either at intake or later was highly related to eventual medical disqualification;
- 7) Differences in the amount of work performed were in general not predictable; however, total time on position and time spent consecutively on position was related to age, the older men spending less time on position; those who spent less time on position also had higher rates of impulse control disorders and showed more coping by drinking;
- 8) Men who received more awards were chosen more frequently as ideal team members, as amicable and competent; they

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received high ratings for coping on heavy days, coping with training and overall coping;

- 9) FAA performance awards were generally unrelated to other outcomes.

1. Burnout

After study of the four criterion variables defining burnout over all five rounds of examinations, three groups of men were selected for comparison. The burnout group was made up of those showing significant decline on at least two of the four criterion variables, described in Section III E. The partial burnout group comprised those who had one of four variables reaching criterion values. The comparison group showed no decline on any of these variables. We excluded from all three groups men who were showing significant burnout at the beginning of the study as we were primarily interested in studying predictors of developing burnout.

We were primarily interested in whether or not we could discriminate between those who developed burnout and those who did not, using data collected in our first two rounds of examinations. Psychological variables which did discriminate between these two groups are listed in Table 213. This table shows that those individuals who later developed burnout scored significantly higher at intake on a number of positive factors or variables. They had more vigor, friendliness and elation on the Profile of Mood States (POMS). They showed less anxiety regarding work on Round 1. They had a higher tension discharge rate on Round 1. They coped by drinking less often than the comparison group (Round 1), coped by physical activity more often (Round 2), showed less anxiety with training on Round 2. They also showed more assertiveness on Round 2, a measure of their interest in doing a good job as a controller. Therefore, one would conclude that individuals who later developed burnout showed more psychological distress early in the study than the comparison group. They did not rate out as dissatisfied, as alienated or as having more anxiety, rather were committed, and from their own estimation as well as the estimation of others, (they did not have significantly lower self-nominations in the beginning), were functioning as well or better than others.

We were concerned that some of the differences observed were due to our definition of burnout. That is, men who showed significant declines on various factors later in the study scored higher initially on other factors because they were related to our definition. We therefore reviewed the scores of the four variables used to define burnout, i.e., bounceback-burnout factor, competence nominations, work satisfaction and work role pathology. The men who developed burnout scored significantly higher than the comparison group only on the bounceback-burnout factor on Round 1 or 2, and were no different on the other three. This suggested that the differences observed in the burnout group early in the study were artifacts of the definitions but reflected true differences between these men in comparison to those who remained unchanged throughout the course of the study.

TABLE 213

Psychological Variables Measured in The Beginning Of
The Study That Differentiated Individuals Who Later Developed Burnout
(Round 1 Or Round 2)

<u>Psychological Variable</u>	<u>Comparison Group (N=96)</u>	<u>Burnout Group (N=35)</u>
	Mean \pm S.D.	
MS Vigor	51.5 \pm 8.60	57.7 \pm 9.11
MS Friendly	48.5 \pm 8.55	53.9 \pm 10.60
MS Elation	48.6 \pm 7.98	54.1 \pm 9.22
Anxiety Factor-Rnd 1	51.6 \pm 8.78	48.5 \pm 7.50
Person Discharge Rate-Rnd 1	48.1 \pm 10.3	52.4 \pm 9.38
Stress by Drinking-Rnd 1	51.3 \pm 8.94	48.9 \pm 10.01
Anxiety with Training-Rnd 2	53.7 \pm 8.45	50.7 \pm 10.03
Assertive Factor-Rnd 2	45.3 \pm 9.27	49.8 \pm 9.02
Physical Activity-Rnd 2	47.3 \pm 9.20	51.3 \pm 8.87

The men who developed burnout showed on Round 5 an increased incidence of subjective distress compared to the other two groups. This was impressive as none of these 35 men showed problems in subjective distress on the PSS on Round 1, as presented in Table 214. It was apparent that although they started out feeling good about themselves and scoring low on psychological distress in the beginning, during the course of the study and by Round 5 they were showing increased psychological problems compared to the control group. These observations suggested that some individuals (3/35) who developed burnout began to have behavior and psychological problems that were not present earlier.

It is notable that the individuals who did develop burnout did not show any differences in average amount of work done or time spent on position during the times they were physiologically monitored over the course of the study. Furthermore, they showed no differences in any of the physiological measures taken at work i.e., cortisol and blood pressure, nor did they show a higher incidence of hypertension or a higher incidence of mild to moderate health change. From these data it was apparent that their physical health, at least over the relatively short period of time that they were studied, was not undergoing a rapid deterioration, but their burnout status was associated with increased incidence of psychological problems, which perhaps if followed over a longer period of time, could result in a disruption of their work and place them at risk for future medical disqualification.

In some ways the men who developed burnout showed some of the characteristics observed in the mean at intake of those who were later promoted, and this is discussed in detail in the next section on promotions.

TABLE 214

Appearance Of Subjective Distress In Cases
Of Burnout In The Fifth Round Of Examinations

	<u>Round 1 Exam</u>	<u>Round 5 Exam</u>
ation 46	0.053 ± .224 (n=13)	0.020 ± .141 (n=5)
Comparison Group 6	0.073 ± .261 (n=7)	0.010 ± .102 (n=1)
el Burnout 5	0.052 ± .223 (n=6)	0.009 ± .093 (n=1)
at	0.000 ± .000 (n=0)	0.086 ± .284 (n=3)
	F = 2.73	F = 4.49
	p = .09	p = .012

2. Promotion

As noted in Section III E. on Job Outcomes, 49 ATCs received promotions to supervisor during the course of the study. We reviewed the psychological and other data collected during the first and second visits for factors that would differentiate between men who were promoted in subsequent visits and those remaining journeyman controllers for all three years of the study.

Fifteen variables were found significantly to discriminate between those who were promoted and the comparison group (see Table 215). The comparison group consisted of men who were in the study for the entire 5 rounds and were not medically disqualified or did not drop out for personal reasons. One qualification that should be added is that of the 49 promotions, 7 took place prior to the second round of examinations. Round 2 data were not truly predictive but were associated with their being promoted. In a similar vein individuals might have learned that they were being considered seriously for promotion by the second visit. We were unsure how many men fell into this category, but realized that the situation did in some way reduce the predictive significance of some of the variables that were collected in the second round. Data collected in the first round were not affected.

In general, the men who were promoted were more satisfied with FAA policies, had higher amounts of personal job morale and were generally more hard-driving and more job-involved than those who were not promoted. The individuals who were promoted were also characterized by increased amounts of life change in the period of time prior to being promoted as well as by high scores on the dominance scale of the CPI. They were slightly older than those not promoted (37.8 vs. 35.9 years) and had slightly more years of experience (13.2 vs. 10.8 years).

Two variables that discriminated between these two groups deserve special mention. These are the increased frequency of peer competence nominations collected in Round 1 among those who were promoted as contrasted with the comparison group. Those who were promoted received on Round 1 an average of 2.67 nominations by their peers contrasted with only 1.84 nominations for the comparison group. This difference is highly significant, $F = 16.22$, $p < .0001$. At the same time that the men who were later promoted were receiving more competence nominations from their peers, they also were rating themselves as more burned out on the bounceback-burnout factor also collected on Round 1. The men who were promoted scored lower on the bounceback-burnout factor, indicating they thought themselves less able to bounceback and more likely to burnout. Their average score was 46.3 compared to 51.1, also highly significant, $F = 9.76$, $p < .005$.

TABLE 215

Variables That Differentiate Between Men Who Were Promoted
And Others Remaining In The Study For All 5 Rounds Of Examinations
(Univariate Predictors)

Variable	Comparison Group	Promoted	F	p
		Means		
Peer competence nominations - Rnd 1	1.84	2.67	16.22	.0001
Age	35.90	37.80	5.46	.025
Years of Experience	10.80	13.20	10.75	.005
Investment Factor Rnd 1	49.20	52.50	4.38	.05
Bounceback-burnout Factor - Rnd 1	51.10	46.30	9.76	.005
Pay Satisfaction - Rnd 1	49.00	54.10	10.22	.005
Holmes-Rahe Life Change-Rnd 2	97.50	145.70	14.58	.001
Self Morale - Rnd 2	51.40	58.90	29.75	.0001
Group Morale - Rnd 2	52.88	57.20	8.78	.005
Satisfaction with FAA Management Policy - Rnd 2	48.24	56.65	31.49	.0001
Satisfaction with FAA Promotion Policy - Rnd 2	47.91	57.26	38.14	.0001
PIP Life Change - Rnd 2	29.00	40.02	7.25	.01
Dominance Scale CPI - Rnd 2	55.57	62.11	12.87	.001
Job Involvement Factor (Type A) - Rnd 2	-5.25	-2.04	7.28	.01
Hard Driving Factor (Type A) - Rnd 2	-1.49	2.21	7.21	.01
Number of men	245	46		

Since both the bounceback-burnout factor and the peer nominations remained as significant discriminators between the two groups in the stepwise discriminant function analysis, some discussion of the presence of these two seemingly disparate factors is relevant.

The men who were later promoted did describe themselves early in the study as more burned out at the same time that they were showing more satisfaction with management and higher morale and were receiving significantly more peer nominations for competence. Therefore, one might conclude that these individuals viewed themselves as less able than they had been in the past, less able to bounceback, and more concerned about burnout. This occurred at the same time they were receiving a relatively high frequency of peer nominations for competence by team-mates. This finding, along with the finding that men who developed burnout scored high on many positive areas when they first entered the study, suggests that individuals who do feel more concerned with or more certain that they will burnout, may also be among the more competent individuals.

Further, it suggests that competent controllers can and do experience concerns about burnout, and as a matter of fact, ATCs with such concerns were more frequently represented among individuals who were promoted than among individuals who were not promoted. One might therefore speculate that burnout is not a characteristic of individuals who are poor controllers, but may relate to the concern that one will not be as good as one has been and will fall in the estimation of one's peers. As answers to the four questions comprising the burnout factor (bounceback-burnout) represented self estimations, we might conclude that developing lower scores, having more burnout concerns, may function as self-fulfilling prophecy. What is of note from this analysis of the promotion data is that these individuals did rate themselves as having more concern about burnout while they were still receiving high peer nominations for competence.

The eight variables that accounted for the most significant differences between the group who were promoted and the group not promoted, are noted in Table 216. The most important variable that remained was satisfaction with promotion policy of the FAA as measured at Round 2. For a few men, this finding may in some way have reflected either a recent promotion (9/49) or knowledge of a possible pending promotion. However, the bounceback-burnout factor remained as strong a discriminant variable as did competence nomination by peers. Life change was greater in individuals who were promoted, as were self-morale and dominance as measured on the CPI. The increased level of experience with the FAA remains a significant predictor although it was the weakest discriminator on the list with $F = 4.12$ when the other variables were taken into consideration. The combination of these eight variables in the stepwise discriminant function analysis

TABLE 216

Stepwise Discriminant Function Analysis Of
Men Promoted Versus Those Remaining In Study

<u>Step</u>	<u>Variable</u>	<u>F</u>	<u>p</u>
1	Satisfaction with promotion policy of FAA	38.14	.0001
2	Bounceback-burnout factor	16.90	.0001
3	Peer competence nominations	15.40	.0001
4	Life change (Holmes & Rahe)	15.30	.0001
5	Self Morale	11.50	.001
6	Dominance CPI Scale	7.33	.01
7	Life Change (P & U)	4.25	.05
8	Experience	4.12	.05

Predicted correctly 37/46 - 80.4% promoted.

Predicted correctly 203/245 - 82.9% not promoted.

correctly predicted 80.4% of those promoted and 82.9% of those not promoted.

In summary, men who were promoted were characterized by higher satisfaction with FAA management policy, more peer nominations for competence, more concern (before they were promoted) with the specter of burnout, higher self-morale, and higher dominance scores.

3. Medical Disqualifications

There were 23 men who were medically disqualified during the course of the study. Eleven of these disqualifications were for psychiatric reasons and 12 were attributed to various physical problems. Eight of these men were medically disqualified in the first interval, i.e., between intake examination and the second examination. Fifteen of the 23 men, however, were present at both the intake exam and the second round, and information on their responses to various questionnaires given in these rounds was therefore available.

We examined the responses of these 15 men to see what variables might differentiate them from the individuals who remained in the study. We elected to compare individuals who were medically disqualified both for psychiatric and medical reasons with those who remained in the study but were not promoted. Thus the comparison group was made up of those who remained in the study for the entire time, were not promoted, were not disqualified and did not drop out for personal reasons.

Table 217 lists the variables that significantly discriminated medically disqualified men from ATCs who remained in the study (by one-way analyses of variance). The men who were medically disqualified were chosen much less often by their peers as ideal team choices or as among the most competent. They also were given a lower investment score by the psychologists in the Round 1 interview. On Round 1 they also rated themselves as having less marital resources and scored lower on four scales of the California Psychological Inventory (CPI). They were lower on feelings of well being, responsibility, tolerance, and intellectual efficiency.

Step-wise discriminant function analysis of these eight predictors yielded four that contributed significantly and independently to predict those who were medically disqualified and those who were not, as shown in Table 218. The most important predictor was the CPI intellectual efficiency score, followed by the investment score, ideal team choices and marital resources. By this analysis, we correctly predicted 11 out of 15 men who were disqualified or 73.3%, and 188 of 245 or 76% of those remaining and not disqualified.

Although these variables did significantly discriminate and predict men who were medically disqualified, a more striking prediction came from analysis of the data collected on the Psychiatric Status Schedule (PSS) comparing men who were medically disqualified and those who remained in the study. Table 219 shows the difference in the intake prevalence and later incidence of psychiatric problems between the group who were disqualified and the comparison group. This analysis yielded 135 men who were asymptomatic on the

Variables That Predict Medical Disqualifications
(Univariate)

<u>Variable</u>	<u>Comparison Group</u>	<u>Disqualification</u>	<u>F</u>	<u>p</u>
	(mean)			
Ideal Team Choices	1.96	1.13	6.73	.01
Competence Categories	1.83	1.07	5.02	.025
Investment Score on Round I Interview	4.98	3.53	9.41	.005
Marital Resources	49.92	44.07	4.98	.05
Feeling of Well Being Scale CPI	48.83	40.87	9.16	.005
Responsibility Scale CPI	41.72	34.53	7.24	.01
Tolerance Scale CPI	47.97	41.47	7.52	.01
Intellectual Efficiency Scale CPI	48.93	40.53	10.31	.005
n =	245	15		

TABLE 218

Stepwise Discriminant Function Analyses of Predictors
Of Medical Disqualifications

<u>Variable</u>	<u>F</u>	<u>p</u>
Intellectual Efficiency Scale CPI	10.31	.005
Investment score in Interview-Rnd 1	8.04	.005
Ideal Team Choices	5.74	.025
Marital resources	4.47	.025

Correctly predicted 11/15 or 73.3% of those medically disqualified.

Correctly predicted 128/245 or 76.7% of those remaining - not disqualified.

Group:
 Number and percent 3/65 = 4.6% 1/135 = 0.7% 9/99 = 9.1% 10/117 = 8.5%
 Cross-tabulation Of Psychiatric Status In Study And Medical Disqualification By FAA

Medically Disqualified By FAA?	Psychiatric Status In Study				Row Totals
	Asymptomatic Controls	Prevalence Cases	Incidence Cases	Row Totals	
<u>YES</u>	1 Observed (8) Expected	9 (6)	10 (6)	20	
<u>NO</u>	134 (127)	90 (93)	107 (111)	331	
Column Totals	135	99	117	351	

$\chi^2 = 10.92 \quad df = 2 \quad p < .01$

No Psychiatric Problems Prior To Dropping From Study - these men (N=65) were not evaluated all 5 times and therefore could have developed problems we did not know about.

Asymptomatic - These men had no abnormalities on the 5 PSS criterion scales at all of their psychiatric evaluations.

Prevalence cases - these men had one or more symptomatic criterion scales on the PSS at intake.

Incidence cases - these men had one or more symptomatic criterion scales on the PSS after intake but not at intake.

PSS throughout the course of the study; 99 individuals who had one or more symptomatic criterion scales on the PSS at intake, referred to as prevalence cases; and 117 men free of PSS pathology at intake who had one or more symptomatic criterion scales on the PSS after intake, defined as incidence cases. Twenty out of the total of 23 disqualified men were able to be identified by their psychiatric status category. Of these 20 men who were medically disqualified, 19 were either classified by PSS as a prevalence or an incidence case. Therefore, as indicated in the table, 9 men who were medically disqualified were prevalence cases, or 9.1% of all prevalence cases were eventually medically disqualified, and 10 cases out of 117 incidence cases were medically disqualified or 8.5% of the total incidence cases. This contrasted with the observation that among the 135 rated as asymptomatic on the PSS, only one individual was medically disqualified during the course of the entire study. One may conclude that having difficulties on the PSS either at intake or later in the study was predictive of, or correlated with, medical disqualification from the FAA. Also as noted earlier, the increased incidence and prevalence of psychiatric difficulties was apparent both for men who were disqualified for somatic illnesses and those who were disqualified for psychiatric reasons. These data strongly support the conclusion that mental health changes observed in the controllers had a significant relationship with career longevity.

4. Amount of Work Performed

In general, we were unable to predict differences in the amount of work performed during field work observation. The major work variable, "manwork," was a composite score based on the total number of planes normalized for facility, sector and position, normalized peak numbered planes and normalized range of number of planes. Men who did more work versus less work, using this summary measure as the outcome variable, differed significantly on only a very few of our psychological or interview variables. We did not study this set of psychological predictor variables in terms of the differences in various aspects of work assessed separately, e.g., peak planes, and wish to do this in the future.

We did find that men showing the highest amount of manwork, (greater than one standard deviation above the mean, $N = 57$), also showed significantly more active behavior at work compared to the others, $F = 17.02$, $p < .0001$. This suggests that those who do more work also show more signs of behavioral arousal associated with the increased workload.

There were, however, several significant correlates of the total amount of time and the longest consecutive time that individuals spent on position, summarized as the variable "timeload." Those in the lowest 1/6th of the group (One standard deviation below the mean, $N = 40$) were significantly older, 38.8 years, compared with those spending average time on position, 35.6 years, or more time on position, 35.4 years. This relationship still held when experience was controlled (age with experience controlled). Those with less timeload also had significantly higher rates of impulse disorders, $F = 6.53$, $p < .0043$. They also showed more coping by drinking, $F = 4.35$, $p < .014$. These findings suggest the possibility that the variable "timeload" may be an early identifier of that subgroup of older men who are beginning to experience emotional problems and deterioration of ATC skills.

5. Special Recognitions and Awards

Two main groups of psychological factors predicted the men who received awards during the course of the study. These are listed in Table 220. The first related to the sociometric evaluations or peer nominations. The men who received more awards were consistently chosen more frequently for an ideal team, for amicability and for competence compared with those receiving few or no awards. In a similar way, the interview ratings, made in terms of ability to cope at Round 1 significantly differentiated among men receiving none versus some awards. The men receiving more awards received high ratings for coping on heavy days, coping with training, and overall coping score compared with those who received zero awards. One other factor discriminating among the men was the amount of physical activity engaged in on Round 1, greater physical activity being found in individuals who received more awards.

There were relatively few relationships, however, between FAA performance awards and other outcomes. There was some tendency for individuals who received the most awards to have fewer psychiatric problems at intake, but this was not linear through the ranks of those receiving fewer or zero awards. Similarly, the group of those rated as severe in the extent of psychiatric problems had fewest awards while those with no problem had more awards. There was no significant relationship between awards and the average monthly incidence of anxiety and depression, the development and prevalence of hypertension, or the average annualized illness rate.

These results suggest that the men receiving more awards were recognized for their greater competence and were regarded as more ideal team choices by the controllers as well as recognized by the peers. Similarly, these individuals were judged by interviewers to be better able to cope with life problems. However, these men did not consistently describe themselves as more satisfied with life, or show more bounceback, or score differently on the California Psychological Inventory or a variety of other scales during the first or second rounds of exams, nor did these men differ in the amount of work they did in the course of field studies, the amount of time they spent on position, or in their cortisol or blood pressure responses to work.

TABLE 220

Variables That Differentiate Among Men With
Low, Middle And High Frequency Of Receiving Awards

<u>Variable</u>	<u>Total Awards Category (Mean)</u>				<u>F</u>	<u>p</u>
	<u>0</u>	<u>1-4</u>	<u>5-8</u>	<u>9+</u>		
Team Choices	1.56	1.83	2.23	2.21	4.45	.005
Ability Choices	1.56	1.89	2.14	2.33	3.58	.014
Stance Choices	1.42	1.79	2.11	2.17	3.53	.015
Physical Activity-Rnd 1	46.12	50.04	51.03	51.49	2.62	.05
<u>Review Rating-Rnd 1</u>						
Heavy Day	3.10	3.82	3.92	4.08	3.12	.025
With Training	2.95	3.59	3.91	3.96	4.59	.004
All Coping	3.00	3.73	3.92	3.96	4.61	.004
<hr/>						
<u>Number of Men in Category</u>	41	245	95	22		

SUMMARY

Concordance of Different Categories of Outcomes

In order to determine whether or not men who had one health outcome were more likely to have another, they were divided into two groups by extent and frequency of illness or injury and all groups were cross-tabulated for indications of association.

It was determined that there were no significant associations between any of the major categories of health outcomes.

D. Concordance of Different Categories of Outcomes

We were quite interested in whether or not individuals who had one type of health outcome were any more or less likely to have other types of health outcomes. Since the health outcomes were derived from procedures and on metrics of considerable diversity, we dichotomized the men on each health outcome index and then cross-tabulated the groupings.

Men with severe, Level 3 injuries were divided into those who had none (N=399) and those who had one or more (N=17). Men with severe, Level 3 medical illnesses were similarly grouped into those who had none (N=394) and those who had one or more (N=22). Men who received all 5 Psychiatric Status Schedule examinations (N=351) were divided into two groups also. One group (N=151) had no problems at all (the asymptomatic control) or had only one symptomatic criterion scale at one examination (those with acute problems). The second group (N=200) had moderate or chronic problems (one or more problems at two or more examinations). Men who had at least one scorable health change interval of five Monthly Health Review evaluations (N=378) were divided into two groups, one below and one above the median rate of 2.5 mild-to-moderate health changes per year (low rate, N=216; high rate, N=162). All combinations of these groupings were cross-tabulated and evaluated for significant associations using the chi-square statistic.

Table 221 displays the final results of these analyses. There were no significant associations between any of the health outcomes. That is, men with one type of problem were no more or less likely to have other health outcomes. If our health outcome measures were contaminated by complaint behavior or if the controllers had a predisposition to have several types of health changes when they had any at all, we would have found some associations. Since we did not find any significant associations on these global categorizations of our health outcomes, we concluded that there was no predisposition to respond with general illness - or injury-proneness.

These overall results did not exclude the possibility that certain subtypes of outcomes would have significant associations. For example, as was reported in Section V B., there was a higher rate of respiratory disorders among men who developed psychiatric problems, and more injuries among men with moderate and chronic psychiatric difficulties. Specific types of problems may have an association, but in general, we found no indications of general proneness to illness and injury.

TABLE 221
Concordance of Different Categories
Of Illness Outcomes

1. Severe Injury versus Severe Other Medical Health Change
 $\chi^2 = 1.12, df = 1$ N.S.**
2. Severe Other Medical Health Change versus Extent of Psychiatric Problems
 $\chi^2 = 0.22, df = 1$ N.S.
3. Severe Other Medical Health Change versus Annual Mild-to-Moderate Illness Rate
 $\chi^2 = 0.00, df = 1$ N.S.
4. Severe Injury versus Extent of Psychiatric Problems
 $\chi^2 = 0.00, df = 1$ N.S.
5. Severe Injury versus Annual Mild-to-Moderate Illness Rate
 $\chi^2 = 0.27, df = 1$ N.S.
6. Extent of Psychiatric Problems versus Annual Mild-to-Moderate Illness Rate
 $\chi^2 = 0.05, df = 1$ N.S.

Each outcome variable was dichotomized for these analyses

N.S. = Non-significant.

A. Introduction

In a study as large and comprehensive as the ATC HCS it is difficult to reduce the plethora of data and findings to conclusive fundamental implications for future consideration or action. As there are complexities and perplexities in our developing understanding of the interactions between our subjects and their work, these irregularities manifest themselves in diverse specific findings that do not always have consistent implications. Actions that may ameliorate one kind of problem may not help, and may even exacerbate, another kind of problem. The implications communicated in this section, therefore, are of two kinds: some specific findings, it seemed to us, carried limited implications that would have to be reconciled with other requirements and goals of the FAA; other findings were of a more general nature and had implications that might be more broadly applicable.

Our goals in this study were: 1) to monitor our sample of air traffic controllers sufficiently over a three-year period to be able to determine the frequency, type and severity of their physical and psychological health changes; 2) to establish whether or not we could predict which controllers would later develop problems, by analysis of their performance on a multitude of social, psychological, behavioral, physiological and workload measures; 3) to determine where possible (given the fact that data on other groups is usually not sufficiently comparable to be used) whether they were at excess risk for any health changes by virtue of the nature of their job or the characteristics of the men who enter this occupation or their habits or practices after they enter it.

We attempted to reach these goals by the following major strategies:

- 1) studying the relationship between years on the job (age-controlled) and various pathologies;
- 2) studying the relationship of workload and worktime on position to such biological predictor variables as cardiovascular and endocrine measurements on the job and also to frequency and type of eventual health changes;
- 3) comparing men with differing rates of illness on a large number of additional predictor variables including psychological, biographical and attitudinal measures for which data was gathered at repeated BUMC examinations;

- 4) comparing rates of illness and injury where possible to population norms, and also comparing predictor data where possible to population norms.

Although population norms were not available for comparisons of rates of many types of illnesses, we were fortunately able to make such comparisons in several important areas, including prevalence of hypertension, psychological and psychiatric problems, including alcohol abuse. Our most important findings in this study concerned the increased risk among ATCs of hypertension and certain psychiatric problems, including alcohol abuse, and the associations of mild and moderate illness, and of burnout, with certain psychological, social, work, or physiological factors.

Our findings in these areas suggest some possible courses of action that we think may be ameliorative or preventive. The implications of these findings are organized as answers and comments to questions posed by the FAA under the contract. Although the contract requires only that the data be organized and reported in such a manner as to be "readily addressable" to these questions, we have addressed our findings directly to them, and present whatever ameliorative or preventive suggestions we have within these comments.

Each of the questions posed in the contract is stated and followed by our comments on the meaning of our findings with respect to the particular question.

B. Specific Questions Posed in the Contract

1. What is the nature, derivation, extent, and significance of health changes among air traffic controllers? How do these changes affect performance, career longevity?
2. Do controllers experience stress? If so, what is the nature and extent of the stress? How much is related to the job? What causes it? To what job conditions, including social and psychological forces or factors does it relate?
3. To what extent do management, supervision and manpower management policies, practices, programs or procedures contribute to health changes and especially to the degree of stress present in an air traffic job? E.g., does how work is assigned, work schedules, hours on duty, length of work periods, etc. relate to stress and if so, how?
4. Are there predictive factors or measures that could be applied before employment of air traffic controllers which would indicate to management officials which candidates might be more prone toward deleterious health changes?
5. Are there ways by which individuals can be identified who need counseling or help due to their increased potential risk for illness? Is this risk increased because of their particular personality, family problems or because of the nature of the working environment that they are in?
6. How do the stress levels in the air traffic occupation compare with other occupations, e.g., pilots, business executives, etc.? Although the data collected in this study may not provide for direct comparison of Air Traffic Controllers with other individuals in other occupations, attempts should be made to compare the results that are obtained with those from other investigators studying other occupations.
7. Is there a "burn-out" phenomenon? If so, what is it?
 - a. Can the individuals who are more prone to early physical deterioration be identified?
 - b. Can we identify work situations that are more prone to produce widespread early physical deterioration than other work situations may be, so that early counselling and other career possibilities can be identified and considered.

1. What Is The Nature, Derivation, Extent and Significance of Health Changes Among Air Traffic Controllers? How Do These Health Changes Affect Performance, Career Longevity?

Over the three years of surveillance for health changes, 4,300 diagnoses of illnesses and injuries were rendered. One-third of these were considered trivial inasmuch as they involved isolated symptoms which did not cause loss of function or call for medical care (Level 0). Nearly 60% were minor health changes involving a symptom complex, such as an upper respiratory infection or minor injury, often entailing a day or two of reduced activity but not usually requiring medical attention. Another 6% of diagnoses were more severe than this but they were less disabling and less dangerous in their implications than the 2% of diagnoses (labeled Level 3) that constituted major medical problems.

The most common of the acute minor health changes were respiratory ailments (36% of the total) and injuries (12.5% of the total), of which sprains were the most frequent type. No other major category accounted for more than 10% of the diagnoses. Among the chronic and more serious conditions, the most common was hypertension. This approached an epidemic proportion among air traffic controllers, and is discussed in more detail following this summary of other medical problems. The next most frequent chronic, though usually not serious, conditions were back pain (including low back pain), hemorrhoids, and hay fever.

The rates of acute minor health changes did not seem grossly different from those reported among men of these ages in the general population, where population data was available. It should be noted, however, that general population data are usually derived from cross-sectional surveys, which are not as reliable as the continued surveillance that provided the data on the ATCs. The median number of mild or moderate health changes among our ATC population was 2.5 per year (after annualizing our monthly data). Twenty percent of the men had virtually no health change during a year, but 16% had an average of 5 or more diagnosed illnesses and injuries annually.

Excluding hypertension, other serious illnesses and serious injuries occurred to about 10% of the men over the three years of study. Eighteen men incurred severe injuries calling for hospitalization and more than one month of restricted activity. Twenty-three men (including two who also had serious injuries) incurred disabling or life-threatening conditions spread across specific diagnoses. It is important to note that there was a significant correlation between having hypertension, having a Level 3 health change and having more than the average number of mild and moderate illnesses.

Neither medical disqualifications nor burnout was associated with frequency of mild and moderate health changes. Men with more mild and moderate health change, however, had a higher frequency of psychological health problems.

The serious (Level 3) injuries and illnesses affect performance and career longevity in that they are either life-threatening, such as hypertension, myocardial infarction, bleeding peptic ulcer, or they cause periods of disability of a month or more. There was one death among participants during the study, and this resulted from a Level 3 injury (automobile accident).

The actual causes of most of the major kinds of health changes experienced by ATCs in this study are only partially understood by medical science, and are under intensive investigation in many biological laboratories devoted to specific causal research. One of our major efforts was directed to the determination of predictors of specific types of health changes. The predictors may or may not be causal, but in any event, they provide the foundation for future experimental approaches to prevention of these health problems.

Several categories of predictors of total morbidity (average annual illness rates) among ATCs were identified. Men who had large numbers of life changes, which they identified as distressing, were at high risk of illness and injury. Similarly, those who were the competitive, hurried behavior Type A, particularly if they were deeply involved in their job, and those who were more sociable and dominant but less self-critical, also had more illness. A number of factors related to the job situation were predictive of high illness rates. Those men who had high frequencies of anxiety and tension on the job, who feared the possible problems of air traffic controlling, had more illness. Similarly, those with lowest work group morale, least satisfaction with management, and the greatest feeling that their supervisors were not considerate of them, also had more illness. These same high illness men were least often chosen by co-workers either for their amicability or for their value as ideal team members, at the examination preceding the intervals for which illness rates were averaged.

Several psychosocial variables and job-related factors predicted Level 3 serious injuries and illnesses. Peer selections as being a competent controller, or being most desired for the ideal team seldom went to those men who later incurred a serious injury or illness. It was interesting to note, but contrary to our expectations, that men with later serious health changes had higher work satisfaction at intake and reported a greater amount of social resources to help them cope with problems. In the examination immediately prior to their serious injury or illness, however, their

satisfaction with their pay dropped considerably.

Among the many diagnostic categories of health changes that went into the total morbidity experience, non-specific viral diseases and injuries had large numbers of social and psychological predictors. These are dealt with in the respective sections of this project report. It will suffice to state here that a number of findings have implications for preventive or therapeutic programs.

Hypertension was the most common of all chronic diseases in our study population. If our study group is at all representative of U.S. air traffic controllers, this is an occupation with an extremely high prevalence and incidence of this disease. Epidemiologic studies of hypertension in the U.S. have used a variety of diagnostic criteria. Our ATC HCS data were collected in such a way that they could be evaluated by several of these criteria. Compared to the data for males from the DHEW Health and Nutrition Examination Survey 1971 - 1974 and to men in the Framingham Heart Study, ages 35-39, the ATC sample had 1.5 to 1.6 times the prevalence of definite hypertension of these other two comparison populations. This was true though our ATCs were younger on the average than the two comparison groups, so that the excess risk of the ATCs was probably underestimated.

Another way to compare prevalence of definite hypertension in the ATC HCS is to use a comparison group of men with similar income to perform a linear extrapolation to the age range in our study. This was done using the Western Collaborative Group Study as the comparison population. For their participants, with mean age 43.2 years, the prevalence was 8.4% using the criterion of seated blood pressure reading exceeding 160 sbp or 95 dbp. This was considerably less than observed by other epidemiologic studies. In contrast, the observed prevalence in the ATC using these criteria was 19.5%, more than twice the WCGS rate, despite the fact that the WCGS group was 7 years older than the ATC group.

There is inadequate information on incidence of hypertension in the U.S. However, estimates have been offered by experts in the field based on their reviews of the medical literature (Stanler, age 152; Julius and Schork, 1971). Incidence was estimated to be within the range of 1% to 4% per year among persons aged approximately 30 - 60 years, with lower incidence rates prevailing in younger years. One could extrapolate from these estimates that the rate of new hypertension for males averaging 36 years of age (our ATCs), should be 1% to 1.4% per year.

To make another comparison of the incidence of hypertension in the ATC HCS vs. men of comparable age and geographic region, we

obtained access to the computer printouts from the Framingham Heart Study. This was arranged through the courtesy of Dr. H. Emerson Thomas, Co-principal Investigator of the Framingham Heart Study, Ms. Pat McNamara, Research Associate, and Dr. Bernard E. Kregger who serves as examining physician, both for the Framingham Study and the ATC HCS. Careful review of the printouts revealed 362 men ages 30-39 years who were normotensive at intake into the Framingham Study. Their hypertensive status was followed for 3 biennial examinations, a period of six years. When the observed changes in hypertensive status were converted to annualized rates, the incidence of borderline hypertension was 4.6% per year, of definite hypertension 0.4% per year, for a total hypertension incidence of 5%. In comparison, using the same criteria and annualizing the three years of follow up in the ATC study, the comparable incidence rates were 18.4% borderline hypertension, 3.1% definite hypertension, for a total hypertension incidence of 21.5%. For each category this would represent a relative risk of 4 to 1. However, the comparison is not altogether defensible in that the Framingham incidence might be higher if Framingham men had been at risk of exceeding the 140/90 mm hg cut-off at five examinations rather than only at biennial exams.

Our estimates are that air traffic controllers currently on the job have 50% to 100% higher prevalence of hypertension than "the average man the same age in U.S. communities." In addition, ATCs have an even greater risk than other men of developing new hypertension and this risk may be more than 200% that of other men.

The ATC HCS developed its own criteria for diagnosis of hypertension. These rest upon the presence of elevated blood pressures at two successive medical examinations, usually 9 months apart. By this more stringent criterion, 36 new cases of hypertension were discovered over an average observation period of 2.25 years (as induced by the nature of the criterion above) for an average annualized incidence of 5.7% per year. Our criteria for diagnoses have not been used in other studies, thus precluding exact comparisons. It would seem, however, that this is about 3 times the incidence rate described above as the estimate of expert epidemiologists, but as much as the latter is based on blood pressure readings from a single examination it may represent a more lax criterion and the stated relative risk of 3 to 1 may underestimate ATCs true excessive risk of hypertension.

The predictors of hypertension are discussed at length in Section V. In summary, 86% of the new 36 hypertensive cases (by ATC HCS criteria) were correctly "predicted" by a discriminant function equation incorporating office blood pressures, blood pressure fluctuations while at work and psychological predictors. The best predictors of the development of new hypertension included the excess

of systolic and diastolic blood pressure averages at work above the resting pressures observed by the study physician. In addition, low scores on the hard driving scale of the Jenkins Activity Survey, a good interviewer rating of ability to cope on heavy work days, below average coping resources from one's marriage and below average amounts of distress due to life change were also significant predictors of new hypertension. It thus appears that there is a definite pattern of on-the-job blood pressure responsivity and psychological characteristics which are found in men who later develop hypertension.

Neither the presence of hypertension at intake into the study or its development during the three years of follow up were associated with increased drop-out from the study or with poor performance as a controller as rated by co-workers. Job-related outcomes were just as good for hypertensives as normotensives and the presence of a blood pressure abnormality did not predispose to the concurrent or later development of psychiatric difficulties. The main impact of hypertension on career longevity is that the diagnosis of hypertension or the practice of taking anti-hypertensive medications currently grounds for disqualification from active duty as aorneyman controller. It should be emphasized, however, that the criteria for hypertension differ from those of the HANES, Birmingham Study, or our own Health Change Study. The FAA hypertension criteria calls for blood pressure to be measured while lying, for repeated measurements to be taken with the lowest reading be counted, and for an age adjustment factor allowing higher blood pressures in older ages. The FAA criteria thus yield a lower incidence and prevalence of hypertension for this sample than do other criteria used.

The regulation that use of anti-hypertensive drugs provided grounds for dismissal from active work as an ATC was formulated many years ago when the usual first line anti-hypertensive drugs were barbitol and reserpine, both of which could, in susceptible individuals, cause drowsiness and slowing of response rate. The pharmacopoeia for treatment of hypertension has changed drastically in the last 15 years. Presently the most commonly used drugs for hypertension are the diuretics. The increase kidney output with resultant of excreting sodium, reducing total blood volume and thus lowering blood pressure. The diuretics have no central nervous system effect and therefore do not cause drowsiness, sluggishness, or slowed response rates. For persons whose blood pressure cannot be adequately controlled on diuretics a variety of stepped-care regimens are commonly used. These involve combinations of diuretics and more potent anti-hypertensive drugs. A few of these more potent drugs may cause slowed response rates or drowsiness in susceptible individuals, but many of the more potent drugs do not have such

effects. It is vitally important that the FAA reconsider its criteria for medical disqualification as they involve hypertension. We do not recommend that controllers with hypertension who are concerned about the possible progression of their disease be forced to remain as ATCs, but we feel that mandatory disqualification simply on the grounds of the presence of hypertension or the taking of diuretics or other drugs having no side effects that might influence alertness or controlling skills should not continue to be agency policy.

2. Do Controllers Experience Stress? If So, What is That Nature And Extent Of The Stress? How Much Is Related To The Job? What Causes It? To What Job Conditions, Including Social And Psychological Forces Or Factors Does It Relate?

By the operational measures of stress used in this study, controllers differ in their experience of stress. Primarily physiological and behavioral measurements at work were used in this study to reflect stress on the job. Additionally, self-reports of job difficulty were used to some extent. Stress may be inferred from other data gathered in the study, but its sources are not determinable. Illness outcomes in themselves were not considered to be reflective of stress because the causes of specific illnesses, and illness in general, are multiple, and that part which may be due to stress on the job or elsewhere would be difficult, if not impossible, to isolate. The observations that we used to estimate stress were relatively direct and simple to quantify. They represent only a few of the many possible physiological, psychological or social responses or adaptations that individuals might make to stressful situations.

For this study we hypothesized that stress would be reflected in the differences in blood pressure levels, in cortisol and growth hormone levels and in behavior among and within men while working under conditions of varying difficulties. Further reflection of stress might be obtained, we thought, from the men's own reports of their perception of difficulties during a day's work. Although we knew that these indicators of stress might not be sensitive to all situations, we were interested in observing their relationships to other phenomena.

We knew from the scientific literature on stress that current knowledge in the field was not enough advanced to identify the precise body mechanisms by which stress may be mediated. We also knew that transient or repeated physiological or psychological responses to difficult situations had not yet been shown conclusively to have a causal relationship to the onset of illness in human beings.

Respecting the scientific frontier in this area, we can only state that the relationships that were found between our selected indicators of stress and some few outcomes may implicate work difficulty as having some partial role, when combined with other biological and psychological factors, toward ultimate illness experience. Specifically, the physiological measures at work did significantly predict hypertension and mild and moderate illness.

The same physiological measures did not in general predict psychiatric illness or alcohol abuse although individual responses to the stress of work did correlate with the development of many of the psychiatric or psychological problems.

With respect to hypertension, those ATCs who had higher systolic and diastolic blood pressures during their first field study had a significantly increased rate of developing hypertension during the course of the study. Evidence for a role of stress in development of hypertension was most persuasive in studies of blood pressure variability within the same person. These studies showed that those who were developing hypertension during the course of the study were responding to heavy air traffic with blood pressure increases four to five times greater than the increases of those who remained normotensive. Only a minority of those who responded to increased traffic with higher blood pressure developed hypertension. In general, individuals who showed more variability were at greater risk for developing hypertension. This risk was clear for those who showed the increased blood pressure responses to work.

Interestingly, those ATCs who responded to difficult days on the job with low cortisol or low variability in blood pressure were more prone to have mild or moderate illnesses during the course of the study. We think that there was a suppression of their physiological system, and this may have represented their way of responding to stress.

The fact that ATCs who had more job involvement and who reported more job difficulties, including work dissatisfaction, were at increased risk for developing psychological problems was construed as a consequence of job stress in vulnerable individuals. However, many individuals who were dissatisfied with their work, or with management policies, or those with more distressing life changes could also be said to indicate stressful responses, but often without negative health change.

In summary, while we have little doubt that controllers experience stress, and that their work itself and their attitudes toward their work and the management generates some of this experience of stress, our data suggest that individuals experience stress in differing ways and amounts, and that experience of stress does not necessarily imply illness consequences, although in the case of hypertension, the implication is quite forceful. The psychological expressions of distress were also forcefully related to near-future psychological problems of clinical severity.

3. To What Extent Do Management, Supervision And Manpower Management Policies, Practices, Programs Or Procedures Contribute To Health Changes And Especially To The Degree of Stress Present In An Air Traffic Job? E.g.: How Work Is Assigned, Schedules, Hours On Duty, Length Of Work, etc., Relate To Stress And If So, How?

Our inquiries, by means of questionnaires, regarding the controllers' perspectives, attitudes and satisfaction with various policies and programs brought varied responses. We attempted to determine whether or not the controllers who were more dissatisfied with policies, procedures, shifts, schedules, etc. were more likely to develop health changes during the course of the study.

We concluded that work dissatisfaction was an extremely important predictor of psychiatric problems. Similarly, dissatisfaction with co-workers and reduced ability to discharge tensions were also found to be highly prevalent among those who developed psychiatric problems. Therefore, it can be said that individuals who perceive their work or their co-workers as less satisfactory are at greater risk for developing psychiatric problems, and possibly for eventual medical disqualification on that score. Co-worker dissatisfaction was greater among the controllers than among a comparison group of workers in other industries and occupations. The morale problems that dissatisfaction with co-workers creates would appear to be of sufficient potential seriousness to warrant some study of possible ameliorative or remedial action.

Questions regarding the controllers satisfaction with management and management policies elicited responses indicating dissatisfaction among a large enough group to warrant a review of management policies and practices, and an attempt to arrive at mutually satisfactory revisions where beneficial.

It is worth noting that controllers who showed greater involvement in the job, for whom it was important to be a "good controller," experienced an additional risk for developing psychiatric and psychological problems. In other words, it is not among those who don't care, but among those who care a great deal and are highly invested, that the risk for future psychological problems is more apparent. This finding, together with the reporting of increased subjective costs from air traffic control work suggests that the agency might investigate means by which individuals can discharge their tensions at the end of the work day with greater efficiency and benefit. The use of alcohol to cope with difficulties and to discharge tension increased the risk for psychiatric problems. This finding, too,

addresses the potential benefit of a search for alternative methods of discharging tension and unwinding from the rigors of work. In this regard, it is noteworthy that individuals who reported increased subjective costs associated with frequent shift change were at greater risk for alcohol abuse.

Responses to a questionnaire regarding sleep problems indicated that change of schedule (shifts) was most frequently thought to be the reason for sleep problems among the approximate one-third of controllers who had them on 4 or more times during the month. Controllers also varied in the time of day or night during which they functioned best. These findings suggest that there may be reason to investigate the assigning of shifts on the basis of whether an individual is better able to function at one time or another, and perhaps study optimum shift scheduling with consideration also of the physiological sleep problems associated, for some people, with shift changes.

In summary, management attention might be directed to the dissatisfactions that were reported with co-workers, with management policies, and with schedules. Additionally, more productive and health-promoting methods of discharging tension might be explored.

4. Are There Predictive Measures Or Factors Which Could Be Applied Before Employment Of Air Traffic Controllers Which Would Indicate To Management Officials Which Candidates Might Be More Prone To Deteriorous Health Changes?

Our studies of the antecedent conditions of various disorders resulted in several findings: first, those who scored very low on the sense of well-being, responsibility, socialization, self-control, tolerance and intellectual efficiency scales of the California Psychological Inventory (CPI) were at much higher risk for psychiatric health change and had a much higher rate of medical disqualifications from the FAA for either psychiatric or medical conditions. Men who scored lower on the dominance, sociability and self-acceptance scale of the CPI had more injuries of a mild to moderate nature. While men who were especially young for their experience were at greater risk for psychiatric problems, older men with less experience had more mild, moderate and severe illness and injuries.

The psychological predictors suggested that the California Psychological Inventory might be added to the screening battery currently used for pre-employment selection. Alternatively the correlations between the 16-Personality Factor (16-PF) and the CPI scales could be calculated for air traffic controllers, and if the correlations are sufficiently high, equivalent scores on the CPI might possibly be derived from the 16-PF scale scores. The present study administered the CPI at the second evaluations of 392 men and administered the 16-PF to 388 men at the final exit examinations. Thus the data is available on a sufficiently large sample to attempt to derive these specification equations so that the FAA may not need to add an additional battery to those currently used, but could perhaps derive the predicted scores on the CPI from the 16-PF.

The results on age and experience suggested that men hired at too young an age might not have sufficient maturity and experience with life stresses to cope with the particular stresses and environment of air traffic controlling, and that older men without a great deal of prior experience in air traffic control work might have particular difficulty in adjusting to this work. In combination with the psychological predictive results for both psychiatric and medical outcomes in this study, we would suggest that the selection procedures might be modified to emphasize selection of psychologically mature individuals. The minimum age for beginning training as a controller might be raised to age 25 and the maximum age for beginning training might be reduced to age 30. These suggestions from our relatively limited data should be first bolstered by the FAA's

own personnel and medical disqualification data, to assure that our findings are typical for the whole system.

Two other sets of psychological findings may have predictive value if in fact their use is feasible in pre-employment screening. A history of legal events (more prevalent histories of being arrested, sued, jailed and so forth) was associated with the expression of impulse control disorders, psychiatric problems in general, and eventual disqualification. Similarly we found that exceptional alcohol use was highly related to the development of alcohol abuse problems as well as to all psychiatric problems. This was true not only in terms of quantity of alcohol consumed to cope with the pressure of the job, but also with respect to age at which the individual began to drink. That is, men who reported that they began to drink at earlier ages tended to have more alcohol abuse problems and more psychiatric problems. Such data also might be included in the biographical history information requested prior to employment.

A large number of other pre-employment data may be associated with deleterious health changes. However, time and personnel constraints do not allow us to pursue this investigation. Adoption of any pre-employment screening must, of course, pass the test of appropriateness and adherence to statutory requirements. It is our overall impression that preventive and ameliorative services after employment might be a more appropriate way to reduce health changes among the air traffic controllers.

5. Are There Ways By Which Individuals Can Be Identified Who Need Counseling Or Help Due To Their Increased Potential Risk for Illness? Is This Risk Increased Because Of Their Particular Personality, Family Problems Or Because Of The Nature Of The Working Environment That They Are In?

Our predictive studies of both medical and psychiatric health change indicated a number of risk factors for illness. Although the results were sometimes different, as one might expect for the predictors of these two areas, there was also some commonality in findings and instrumentation which could be used for risk detection procedures.

We found that individuals who had a large amount of life change and distress due to that life change were at risk for physical and psychiatric illness. Men who were more Type A on the Jenkins' Activity Survey also were at greater risk for both medical (other than hypertension) and psychiatric illness. Individuals who had a large number of psychophysiological anxiety symptoms at work, and who had difficulty discharging tension arising from work were at risk for both types of health changes. Those who coped by drinking were at particular risk for psychiatric health change, as were men who had a larger number of legal problems or decreased marital coping resources. Men who were highly dissatisfied with their work and their coworkers, and sometimes those men who were not rated very high by their peers were at increased risk for health change. Men who were highly invested in their job from a personal psychological standpoint were at a particular risk for health change. A number of dimensions from the California Psychological Inventory differentiated among those men with medical health changes, and also among those men with psychiatric health changes, although the particular dimensions were different for the two outcomes. Finally, men who became hypertensive were notable by having a high degree of job involvement, a tendency to avoid hard-driving competitive behavior, fewer distressful life changes, and a high level of cardiovascular reactivity on the job.

These results certainly suggested that individuals can be identified who need counseling or other help due to their increased potential risk of illness. In some cases our predictive validities were exceptionally good; in other cases not quite as good. In most instances, one would be making errors in the direction of false positives rather than false negatives, which is better from the standpoint of preventive care. Those who would be false positives would receive the counseling and assistance which might be ameliorative, whereas men who were false negatives would fail to have

their risk identified and thus would not receive any special counseling or assistance.

The instruments providing our predictive assessment are either published and commonly available, or available from the study team. For example, the California Psychological Inventory and the Jenkins Activity Survey are published instruments available from their commercial producers. The Review of Life Events (ROLE) is available from the investigators, although it would need a number of changes to be useful on the job and to improve the ease of scoring. The Air Traffic Controller Questionnaire also is available from the investigators and would need some revisions for the greatest ease of application and eventual utility. All of these instruments also have the advantage that they are self-administered, and if given in a neutral setting with appropriate validity checks, could be an economic series on which to base an annual risk detection procedure.

The work satisfaction variables of most significance in this study are commercially available in the Job Description Inventory of Dr. Patricia Smith. The Job Description Inventory is simple to use, easy to score, and relatively inexpensive. It is self-administered and could be quite valuable in screening for individuals at risk for either medical or psychiatric illness.

The most prevalent and serious disease among these air traffic controllers was hypertension. Hypertension was predicted by intake systolic blood pressures and from measures of blood pressure reactivity while working on the job. Once the intake blood pressure was taken into account, neither age, experience, nor obesity contributed to the prediction, so they are less useful than intake blood pressure for identifying individuals at risk for hypertension. Men who were already overweight, however, had a much higher prevalence of hypertension. A special evaluation procedure could be conceived for screening and counseling individuals at risk for developing hypertension.

We could foresee the possibility of assessing blood pressure and pulse rates in the way that we did in the study while men were either working live traffic or working on a simulator. However, to change to a simulator condition might require another study to establish comparability. Blood pressure measurements while working live traffic could be made using the same equipment that we used, which is commercially available. This equipment interfered very little, if at all, with the men while they were working. It was a non-intrusive procedure and caused no discomfort to any controller. Individuals who were found to be particularly responsive might be apprised of this fact and might be referred for relaxation training, or perhaps other medical procedures that might assist them in retarding the development of hypertension.

Both of the medical and psychiatric evaluations done in this study were quite good at detecting problems after they had developed. Our self-report measures, which were paper and pencil tests of varying kinds, were quite good at predicting who would develop problems. The particular factors which put men at risk were ones that were not necessarily socially undesirable, and hence information could be requested without causing an individual to feel that he might disqualify himself. This is an important concept for any risk detection program. It is quite unlikely that the same quality of assessment and honesty in evaluation could take place in an everyday work environment as took place in this study, where great importance was placed on maintaining the confidentiality of information given to us. Some type of outside risk screening procedures might therefore be quite useful in conjunction with the Federal Aviation Administration's current medical evaluation program.

Risk detection as opposed to medical disqualification procedures should be confidential and not part of a man's government personnel file. Rather, an individual going through such a program would be surprised of his particular results and of the interventions that were possible. Since most of the interventions would be in the nature of counseling, relaxation training, bio-feedback training, and so forth, they would be relatively innocuous, but useful from the individual's perspective. If any part of a risk detection program were to become part of the medical surveillance and disqualification program, then not only would the quality of answers and assessments be compromised, but any interventions might be seen as punishment or negative consequences.

We did not find that the ATC work environment and the workload within that environment were the most predictive factors for illness. Rather, we found that particular types of people with their own personal psychological and biological reactions were susceptible to illness when placed in the air traffic control environment. Since we did not have any other environment in which to study these men in a comparable group of men, we cannot say whether or not these personality or personal characteristics would predispose to illness in other work settings. There were some elements of the work environment that led individuals to be more or less satisfied and more or less psychophysiological responsive, which factors in turn were related to later illness.

Consequently, the results that we found would be most germane to establishing risk detection and evaluation programs of men already in the agency. As noted in various other sections of this report, the implications for screening prior to employment were less numerous and less generalizable than our implications for men already employed as air traffic controllers. It would be our strong recommendation

that a semi-independent risk detection, prevention, and intervention program be set up for air traffic controllers. The potential benefits both to the individuals concerned and to the agency could be substantial.

6. How Do The Stress Levels In The Air Traffic Occupation Compare With Other Occupations, e.g., Pilots, Business Executives, etc.? Although The Data Collected In This Study May Not Provide For Direct Comparison Of Air Traffic Controllers With Other Individuals In Other Occupations, Attempts Should Be Made To Compare The Results That Are Obtained With Those From Other Investigators Studying Other Occupations.

As the measures used in this study to assess the amount of stress felt by the controllers were devised for this study, it is not possible to compare controllers' responses on these measures with those of men in other occupations.

In our comments regarding Question 2, we indicated that it is not the air traffic control work *per se* that produces indicators of stress, but rather, according to the measures we used to reflect stress. The work appears to provoke the stressful responses in vulnerable persons. Given this finding we cannot compare "stress levels" in the air traffic "occupation" with those in other "occupations." The stress level, we believe, is not altogether dependent on the occupational activity and hazards, but is determined in part by the psychological and physiological "interpreters" of the individual.

However, we can supply some comparisons between the participants in our study and persons in other occupations regarding measures defined as reflections of stress in another study, that of Caplan et al. in 1975. The Caplan group defined stress as "any characteristics of the job environment which pose a threat to the individual," and strain as "any deviation from normal responses in the person." Their measures of stress included: job future ambiguity; social support from supervisors, co-workers, friends, relatives and family; and role conflict.

These Caplan et al. measures were included in our Round 5 data collection for comparison purposes, as was one of the Caplan et al. measures of strain, boredom.

We compared the scores of our controllers not only with the Caplan Study's controllers but also with the study's comparison group from 21 other occupations.

Our controllers were similar to the Caplan group's controllers on the stress measures, but showed significantly greater boredom, a high score reflecting the boredom of controllers in centers.

The tower controllers in our study did not differ from the Caplan group.

When the means of the responses by the ATCs in our study were ranked with the 21 other occupation groups in the Caplan study, the following comparison emerged:

- 1) Job future ambiguity: ATC HCS controllers ranked fifth, indicating that they were relatively more certain about their future in their jobs than most other occupational groups;
- 2) Social support from supervisor: ATCs ranked 15th in terms of their perceptions of the amount of support provided by their supervisors. The only occupational groups reporting lower supervisory support were unskilled and semi-skilled blue collar employees;
- 3) Social support from co-workers: ATCs ranked 17th in terms of perceptions of support provided by co-workers, the only occupational groups reporting less support were blue collar employees;
- 4) Social support from friends, relatives and family: ATCs tied at rank 18. There were only three other occupational groups reporting less perceived support from their friendship and home social networks;
- 5) Role conflict: ATCs tied for 2nd in terms of perception of a low amount of role conflict. The ATC HCS controllers, relative to the persons in these other occupational groups, were experiencing fairly low perceived amounts of role conflict.
- 6) Boredom: ATCs ranked 15th in perception of boredom in their jobs. Our center controllers particularly saw their jobs as more boring, while the tower controllers were less bored.

7. Is there a "burn-out" phenomenon? If so, what is it?
 - a. Can the individuals who are more prone to early physical deterioration be identified?
 - b. Can we identify work situations that are more prone to produce widespread early physical deterioration than other work situations may be, so that early counselling and other career possibilities can be identified and considered?

Our definition of burnout related to whether or not a man:

1. Showed significantly increased work dissatisfaction as the study progressed;
2. Was selected significantly less often by his peers for his competence;
3. Developed work role pathology not previously present;
4. Reported significant decrease in his ability to bounceback and increase in his concern about burnout during the course of the study.

Individuals who had no difficulties in these areas at intake but who experienced negative changes in two or more of these areas during the course of the study were considered cases of burnout.

Thirty-five men, or approximately 15% of the 234 men for whom we had 5 Rounds of data, showed clear signs of burnout over the 3 years of the study.

The phenomenon of burnout relates more to psychological than to physical deterioration, as we have viewed it, and is, by our measures, weighted heavily on individuals' estimation of their own abilities and concerns about their abilities in the future. These two subjective factors were combined with the more objective assessments of work role pathology by means of the P&S interview and of competence by means of nominations from co-workers.

Our definition of burnout required that we follow men throughout the study, and therefore, we were not able to determine the relative risk of burnout cases for medical disqualification. However, the major characteristic of the burnout cases was their

development of psychiatric problems that were not present at intake. Inasmuch as the presence of psychiatric problems represented an increased risk for medical disqualification in the other studies that we made, it is possible that we would find an increased risk for medical disqualification among burnout cases if we were able to continue to follow the men we designated as burned out at the end of the study.

Individuals who developed burnout had average or above average abilities at the beginning of the study, were enthusiastic and vigorous as controllers, had high tension discharge rate, and showed less coping by drinking compared to the control group. The men who became burned out, therefore, were not from a poorer group of controllers and did not have lower peer ratings at intake compared to the control group. It was also noteworthy that those who became burned out by our definition did not show diminished amount of work performed during the days of physiological monitoring over the course of the study nor did they spend less time working.

It was interesting that the men who were promoted (not the same as men who burned out in our study) also showed increased concern about burnout prior to their promotions, although they were receiving high ratings from their peers on competence. Thus, developing burnout does not appear to be associated with doing a poor job as a controller, while concern about developing burnout is actually shared by those who are promoted and those who actually do burnout.

There were not clear-cut psychological characteristics that discriminated men who burned out from those who did not, except for their somewhat increased enthusiasm and vigor on the job, along with increased psychological coping.

We were impressed with the subjective nature of the burnout phenomenon and the relationship with developing psychiatric problems. Since burnout may represent a self-fulfilling prophecy, in which the man with concerns about his future ability becomes thereby less able, we believe that persons manifesting such concerns, other evidence of early burnout, should be afforded an opportunity for counseling and career planning. Provision of counseling services may also help to deal with this subjective phenomenon in a way that would not reinforce malingering.

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EXHIBITS

I. Copyrighted and Published Instruments

- A. California Psychological Inventory - available from Consulting Psychologists Press, Palo Alto, Calif., 94302.
- B. Jenkins Activity Survey - available from Psychological Corporation, attn. Dr. Richard Hanson, 757 Third Ave., N.Y., N.Y., 10017.
- C. Sixteen Personality Factor Questionnaire - available from Institute for Personality and Ability Testing, 1602 Coronado Dr., Champaign, Ill., 61820.
- D. Zung Self-Rating Depression Scale and Zung Self-Rating Anxiety Inventory - published in
 Zung, W.W.K.: A self-rating depression scale. Arch. Gen. Psychiatry, 12: 63-70, 1965.
 Zung, W.W.K.: A rating instrument for anxiety disorders. Psychosomatics, 12: 371-379, 1971.
- E. Psychiatric Status Schedule - available from Robert Spitzer, M.D., or Jean Endicott, Ph.D., Evaluation Unit, Biometrics Research, New York Dept. of Mental Hygiene, New York State Psychiatric Institute, 722 West 168th St., N.Y., N.Y., 10032.
- F. Profile of Mood States - available from Educational and Industrial Testing Service, San Diego, Calif., 92107.
- G. Job Description Inventory - in Smith, P.C., Kendall, L.M. and Hulin, C.L.: The Measurement of Satisfaction in Work and Retirement. Chicago, Rand McNally and Co., 1969.
- H. Kavanagh Life Attitude Profile - in Kavanagh, M.J., MacKinney, A.C., Wolins, L.: Satisfaction and morale of foremen as a function of middle manager's performance. J. Applied Psychol., 54: 145-156, 1970.
- I. Leader Behavior Description Questionnaire - Published as Manual for the Leader Behavior Description Questionnaire Form XII, Columbus, Ohio State University, Bureau of Business Research, 1963.
- J. MMPI Subscales (part of Minnesota Multiphasic Personality Inventory) - available from the Psychological Corporation, 757 Third Ave., N.Y., N.Y., 10017.

II. Instruments Devised by ATC HCS

- A. Physical examination
- B. Medical questionnaire - labelled as "MED 210 - Review of Health History"
- C. Health checklist - labelled "Monthly Health Review"
- D. Headache questionnaire - labelled "ATC Headache Study"
- E. Sleep questionnaire - labelled "Trouble Sleeping?"
- F. Biographical questionnaire - labelled "ATC Biographical Questionnaire"
- G. ATC questionnaire - labelled :Fifth Round, PSY 102: ATC Questionnaire, Career Attitudes and Behavior"
- H. Sociometric questionnaire - labelled "PSY 103 - Sociometric Questionnaire"
- I. Review of Life Experiences (ROLE) - labelled "PSY 131, Fifth Round"
- J. Satisfaction with FAA Policy Questionnaire - labelled "Satisfaction with FAA Policy Questionnaire"
- K. FAA Awards Questionnaire - labelled "FAA Awards Questionnaire"
- L. Subjective Difficulty Questionnaire - labelled "ATCS Subjective Difficulty Questionnaire"

APPENDIX I

SUPPLEMENTARY DATA AND TABLES

Appendix I - 1

11. B.5. Specific ATC Variables

Background: Item selection criteria and factor composition of ATC questionnaire job-specific scales.

The item composition of the ATC questionnaire was analyzed twice to reduce the number and redundancy of questions. The first item reduction analysis was conducted on the results from a pilot study of 55 air traffic controllers at the Oakland (Calif.) Air Route Traffic Control Center. The second item reduction analysis was conducted on the results from the first testing of all 416 controllers in the present health change study. In both analyses the same criteria for item retention were used.

Criteria for item retention were devised prior to any analyses to avoid confounding criteria to results. Items were retained if they met all of the following criteria:

1. At least 85% of the respondents answered a question.
2. Item standard deviations were no less than 0.80 units.
3. Item response distributions were approximately normal with no worse than 80%-20% split between any two of seven response categories.
4. Item-total correlations would exceed 0.30 after excluding the given item from a total score.

On the basis of these criteria, 147 items were retained in the first item reduction.

147 items composed the ATC questionnaire that was administered to the participants of the ATC HCS during their intake examinations.

After the administration of the questionnaire (147 item version) to all 416 controllers in the first round, another item reduction analysis was performed. The analysis allowed us to shorten the questionnaire to 95 items for repeated use in the Health Change Study.

After the first administration of the ATC questionnaire to all 416 controllers, it became apparent that we had neglected two important constructs -- anxiety due to having training on the job and anxiety due to having incidents (violations

of legal separation standards). Two sets of six new items were developed to assess these additional constructs. However, since these two scales were developed and implemented at the second evaluation, they were not included in our other psychometric work on the ATC questionnaire.

The above procedures utilized rational, intuitive, and empirical methods for scale construction. These methods have been found equivalent or superior to other methods such as factor analysis in terms of predictive validity (Haase and Goldberg, 1967). Compared to factor analytic methods, this procedure yields greater content specificity and face validity.

However, since factor analysis was likely to yield fewer scales with tighter psychometric properties, we also conducted a common factors analysis with varimax rotation (Nie, Bent, and Hull, 1970; Harmon, 1960). Harmon's (1960) suggestion of retaining and interpreting only those items with loading greater than .35 was used to determine the items comprising the factor scales. Items which had significant loadings on more than one factor were retained in the factor on which their loading was highest.

The next series of tables (Appendix Tables III.B.5.a.-1-11) display the results of the common factors analysis: the item loadings, item content, factor name, and the percentage of common variance accounted for. Some items introduced the original scales by a general question, such as "considering an average weekday for you, indicate how each of the following...", were separated by the analysis and became items in other scales. For example, a drinking behavior that was originally part of a question asking about methods of coping on bad days may have loaded onto a "drinking to cope" factor while a sports activity under the original question may have become an item in the "coping by physical activity" factor. The original questions are repeated in the following tables wherever they are necessary to the understanding of the response item.

nally, Appendix Table III.8.5.a.-12 displays the correlations between factor scales and their most nearly related a priori scales. It was found that the factor scales were primarily condensations and minor recombinations of the a priori scales.

Appendix 1-4

Appendix Table III.8.5.a.-1

Factor Name: Psychophysiological Anxiety Reactions

Eigenvalue = 14.3
variance = 32.3

Scoring: High scores mean a large number and frequent occurrences of anxiety symptoms before, during and after work.

Loading	Item
.37	How long does it take to get back to your peak after changing shifts? (1 = no time at all...7 = over a week)
.41	Even though Air Traffic Control may be a very exciting and rewarding job, to what extent do you feel it has "cost" you personally to be an ATC? (1 = much less than most...7 = much more than most things)
.56	Before going to work when weather and/or traffic conditions were bad, how often did you have: a) Difficulty getting to sleep and staying asleep? (1 = never...7 = nearly every time)
.69	b) Uptight, fidgety, and tense feeling (1 = never...7 = nearly every time)
.62	c) Loss of appetite? (1 = never...7 = nearly every time)
.55	d) Upset stomach? (1 = never...7 = nearly every time)
.53	e) Wishes that it was not your shift? (1 = never...7 = nearly every time)
.5	f) Thoughts about calling in sick but not actually doing it? (1 = never...7 = nearly every time)
	While working difficult traffic in the last six months how often have you felt or experienced
	a) A lot of perspiration? (1 = never...7 = nearly every time)
	b) Your muscles tensing up? (1 = never...7 = nearly every time)
	c) Feeling uncomfortably warm? (1 = never...7 = nearly every time)

Appendix 1-5

- d) A dry mouth?
(1 = never...7 = nearly every time)
- e) Feeling "put on the spot?"
(1 = never...7 = nearly every time)
- f) Tense and worried feelings?
(1 = never...7 nearly every time)
- g) Getting more irritable with other controllers?
(1 = never...7 = nearly every time)

Now please indicate how often you have felt or experienced the following after you have been relieved from a long period of heavy traffic. How often have you felt or experienced:

- a) The realization that your muscles were very tense?
(1 = never...7 = nearly every time)

- b) A backache?
(1 = never...7 = nearly every time)

- c) Your heart beating very hard or fast?
(1 = never...7 = nearly every time)

- d) A headache?
(1 = never...7 = nearly every time)

- e) A total lack of appetite?
(1 = never...7 = nearly every time)

- f) Feeling exhausted and in need of rest?
(1 = never...7 = nearly every time)

Considering an average work day for you, indicate how accurately each of the following statements describe usual things you do to unwind at the end of the day.

- a) I prefer to be alone to recuperate.
(1 = extremely inaccurate...7 = extremely accurate)

When you are having a poor day, such as described above, how often do you use each of the following ways to cope with it at work?

- a) Drink more coffee or other stimulants.
(1 = never...7 = nearly always)

Appendix 1-6

Appendix Table III.B.5.a.-2

Eigenvalue = 8.1
variance = 18.3

Factor Name: Good Controller

Meaning: High scores mean a controller endorses answers of a socially desirable (for controllers) nature.

Loading	Items
.40	How is the quality of your work affected immediately after changing onto your "least" preferred shift? (1 = work quality becomes much worse...7 = work quality becomes much better)
.56	Once you come back from a week or more of annual leave, how long does it take you to get up to peak again? (1 = a month or more...7 = a day or less)
.40	My own standards of performance are higher than those in the FAA rules. (1 = completely false...7 = completely true)
.35	I am constantly reviewing my performance throughout a shift against my own set of standards. (1 = completely false...7 = completely true)
.40	I try to get assigned to technically challenging sectors so that I won't get bored. (1 = completely false...7 = completely true)
.39	Compared to other controllers, I keep my cool better in very difficult situations. (1 = completely false...7 = completely true)
	People can easily tell from my words and actions how I really feel about them: (1 = completely false...7 = completely true)
	Compared to other controllers, I can easily return to peak performance after a bad time on the boards. (1 = completely false...7 = completely true)
	Considering an average work day for you, indicate how accurately each of the following statements describe usual things you do to unwind at the end of the day. a) I just do whatever's handy. (1 = never...7 = nearly every time)
	Overall, considering only those things which you do to unwind, which you rated above, how helpful are they in assisting you to unwind at the end of a day? (1 = extremely unhelpful...7 = extremely helpful)

Appendix 1-7

.54

Most controllers have days when they feel on top of the world, like they could handle traffic of four sectors at once and master every situation that arises (well, almost). In an average working month of about 20 days how often do you feel really topnotch?
(1 = 0-2 days...7 = 18-20 days)

54

Given those activities which you pursue, how much overall gratification and reward do you get from these activities?
(1 = very ungratifying and quite overextended... 7 = very gratifying and rewarding)

Appendix 1-8

Appendix Table III.8.5.a.-3

Factor Name: Coping by Drinking

Mean Value = 3.8
Variance = 8.6

Interpretation: High scores mean that an ATC depends on drinking alcoholic beverages for relaxation and coping.

Item

Item

73

I find I have to drink more to get the same relief.
(1 = completely false...7 = completely true)

78

If I'm not able to drink, I find it extremely difficult to unwind.
(1 = completely false...7 = completely true)

Considering an average work day for you, indicate how accurately each of the following statements describes usual things you do to unwind at the end of the day.

a) I go out with the guys for a drink.
(1 = extremely inaccurate...7 = extremely accurate)

Given the twenty working days in an average month, indicate how many days (out of twenty) you would usually do each of the following:

a) I drink alone at home.
(1 = 0-2 days...7 = 18-20 days)

b) I drink with a few friends.
(1 = 0-2 days...7 = 18-20 days)

c) I don't drink.
(1 = 0-2 days...7 = 18-20 days)

On the whole, how helpful is drinking in helping to unwind and relax at the end of a working day.
(1 = not helpful at all...7 = the best thing)

People often pursue other interests outside their jobs. We would like to know if you have pursued any of the following activities in the last six months. Use the scale below for indicating how much time, on the average, you give to the following activities.

a) Dating, drinking, or partying.
(1 = 0-2 hours a week...7 = 18-20 hours a week)

Appendix 1-9

Appendix Table III.B.5.a.-4

Factor Name: Social Coping Resources

Mean Value = 3.0
Standard Deviation = 6.7

Interpretation: High scores mean a high level of social coping resources.

Item

Items

If you or your family were struck by a crisis or tragedy, how many persons of the following categories could you really count on to help you? For these purposes, count a married couple or a family unit as "1".

a) Among relatives.

(1 = none...7 = 10 or more)

b) Among friends.

(1 = none...7 = 10 or more)

c) Among people at work.

(1 = none...7 = 10 or more)

How many people do you consider close friends who live within an hour's drive of your home?

(1 = none...7 = 10 or more)

Appendix 1-10

Appendix Table III.B.5.a.-5

Factor Name: Work Avoidance on Bad Days

Mean Value = 1.4
Standard Deviation = 3.2

Interpretation: High scores mean a controller avoids work on difficult days.

Rating

Items

When you are having a poor day, such as described above, how often do you use each of the following ways to cope with it at work?

- a) Try to get assigned to a sector with a light load
(1 = never...7 = nearly always)
- b) Take longer breaks.
(1 = never...7 = nearly always)
- c) Take more breaks.
(1 = never...7 = nearly always)
- d) Find a work partner that understands and can help out.
(1 = never...7 = nearly always)
- e) Find a friend or diversion to take your mind off the problem.
(1 = never... 7 = nearly always)

Appendix 1-11

Appendix Table III.B.5.a.-6

Factor Name: Subjective Costs

Mean Value = 1.9

Variance = 4.3

Interpretation: High scores mean a high level of subjective costs.

Heading

Items

ATC work may affect many other areas in your life. Use the scale below for indicating how each of the following areas have been affected for you.

a) Friendships.

(7 = ATC work has interfered tremendously in this area...
1 = ATC work has helped tremendously in this area)

b) Social Life.

(7 = ATC work has interfered tremendously in this area...
1 = ATC work has helped tremendously in this area)

c) Relationships with wife or girlfriend.

(7 = ATC work has interfered tremendously in this area...
1 = ATC work has helped tremendously in this area)

d) Family life and relations with children.

(7 = ATC work has interfered tremendously in this area...
1 = ATC work has helped tremendously in this area)

e) Physical health.

(7 = ATC work has interfered tremendously in this area...
1 = ATC work has helped tremendously in this area)

f) Peace of mind.

(7 = ATC work has interfered tremendously in this area...
1 = ATC work has helped tremendously in this area)

Appendix 1-12

Appendix Table III.B.5.a.-7

Factor Name: Bounceback-Burnout

1.0

2.1

High scores on this factor mean high bounceback. Low scores on this factor mean high burnout and low bounceback

Items

In the past six months it has been becoming more difficult for me to bounce back to peak performance when I've been away from the boards.
(7 = completely false... 1 = completely true)

In the last six months, I've been finding it harder to shift between peak and slow periods.
(7 = completely false... 1 = completely true)

How often do you find yourself worrying about your own "burnout"?
(1 = never... 7 = constantly)

At the present time, how close to "burnout" do you feel?
(7 = extremely close... 1 = extremely distant)

Appendix 1-13

Appendix Table III.B.5.a.-8

Factor Name: Investment

Eigenvalue = 1.6
 Variance = 3.6

Scoring: High scores mean a high level of investment in activities characteristic of "Super-Controllers"

Loading

Items

- | | |
|-----|---|
| .57 | I greatly dislike having to restrict aircraft prior to their entering my sector.
(1 = completely false...7 = completely true) |
| .43 | When working a combined sector well, I don't like to have anyone suggest decombining it.
(1 = completely false...7 = completely true) |
| .42 | Even when I'm under IFR pressure, I don't feel I'm doing a complete job unless I provide VFR advisories.
(1 = completely false...7 = completely true) |
| .57 | It is extremely important to me to try and fill pilot requests even when their requests will cause me extra work.
(1 = completely false...7 = completely true) |
| .56 | I try to do something extra in every shift so that I'll end each shift with a sense of accomplishment.
(1 = completely false...7 = completely true) |
| .42 | I try to get assigned to technically challenging sectors so that I won't be bored.
(1 = completely false...7 = completely true) |

Appendix 1-14

Appendix Table III.8.5.a.-9

Eigenvalue = 2.3
 % Variance = 5.3
 Factor Name: Tension Discharge Rate

Scoring: Each item was scored in reverse such that a high score meant a high tension discharge rate.

Loading	Items
.51	After I have left the boards I continue thinking about all the possible conflicts and work them through again in my mind. (1 = completely false...7 = completely true)
.50	I stay in "high gear" and have trouble relaxing once I leave work. (1 = completely false...7 = completely true)
.36	Over the past few months, I find it is becoming increasingly difficult to unwind at the end of a shift. (1 = completely false...7 = completely true)
.55	When I get home after work, I am so preoccupied with what happened on the job that I can't talk with my wife or friends. (1 = completely false...7 = completely true)
.64	Even when I'm away from Air Traffic Controlling I spend much of my time thinking about ATC work. (1 = completely false...7 = completely true)
.56	In describing me, my friends would say that I eat, drink and think ATC. (1 = completely false...7 = completely true)

Appendix 1-15

Appendix Table III.B.5.a.-10

Factor Name: Physical Activities

Eigenvalue: = 1.3

Variance = 2.9

Interpretation: High scores mean more use of physical activities for coping

Loading

Items

Considering an average work day for you, indicate how accurately each of the following statements describes usual things you do to unwind at the end of the day.

a) I take a walk to relax.
(1 = extremely inaccurate...7 = extremely accurate)

b) I do strenuous exercise or some physical sport.
(1 = extremely inaccurate...7 = extremely accurate)

c) I start doing a hobby.
(1 = extremely inaccurate...7 = extremely accurate)

People often pursue other interests outside their jobs. We would like to know if you have pursued any of the following activities in the last six months. Use the scale below for indicating how much time, on the average, you give to the following activities.

a) Physical sports, such as baseball, basketball, bowling, hockey, fishing.
(1 = 0-2 hours a week...7 = 18-20 hours a week)

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Appendix Table III.B.5.a.-11

Factor Name: Marital Coping Resources

Eigenvalue = 1.2

% Variance = 2.6

Scoring: High scores mean high marital resources. Unmarried men received no score.

Loading

Items

- | | |
|-----|--|
| .78 | How much support do you feel your wife provides you in coping with the pressures of your job?
(1 = she criticizes me tremendously...7 = she supports me tremendously) |
| .62 | How often do you talk with your wife about your feelings that are a consequence of your work?
(1 = never or extremely rarely...7 = more than once a day) |
| .63 | How do you feel about your wife sharing her trials and tribulations of the day when you arrive home?
(1 = I hate it...7 = I really like her to share her problems with me.) |
| .79 | How understanding is your wife of your need to unwind at the end of a day's work?
(1 = completely lacks such an understanding...7 = extremely understanding) |

Appendix 1-17

Appendix Table III.B.5.a.-12

Correlations Between Factors and
the Most Nearly-Related a priori Scales

	<u>Correlation</u> with	<u>Most Nearly-Related a priori Scale(s)</u>
Psychophysiological Anxiety Reactions	.92 .87 .80	During Work Anxiety Symptoms After Work Anxiety Symptoms Before Work Anxiety Symptoms
Controller	.50 .45 -.38	Investment Bounceback Burnout Concerns
Coping by Drinking	.97	Drinking to Cope
Avoidance on Bad Days	.96	Tension Discharge Mechanisms on Bad Days
Subjective Costs	.95	Subjective Costs
Bounceback-Burnout	.79 -.77	Bounceback Burnout Concerns
Investment	.95	Investment
Tension Discharge Rate	.99	Tension Discharge Rate
Coping by Physical Activities	.88	Coping by Physical Activities
Marital Coping Resources	1.00	Marital Coping Resources
Social Coping Resources	1.00	Social Coping Resources

Appendix I-18

III.B.5. Peer Nominations for Competence: Background

General Validity of Sociometric Ratings

Using sociometric (peer) ratings to predict future performance behaviors has been successful in the evaluation of naval officers (Hollander, 1956a, 1965), in the selection of life insurance salesmen (Mayfield, 1970; Weitz, 1958), and in predicting managerial success (Kraut, 1975; Roadman, 1964). In fact, in terms of prediction of managerial performance over time, Korman (1968) concluded his review of the literature by noting that peer ratings are better predictors of performance than psychometric procedures, and better than most tests (p. 319). Two extensive reviews on sociometric nomination studies (Lindzey and Byron, 1969; Lewin and Zwany, 1976) reached the same conclusion as Korman. Thus, the ATC peer nominations could be expected to have a strong relationship to actual ATC job performance.

General Reliability of Sociometric Nomination Ratings

Peer nominations also have demonstrated good internal consistency and test-retest reliabilities across a variety of situations (Lewin and Zwany, 1976). Perhaps more importantly, high reliabilities have been reported after relatively short interaction times with peers. Hollander (1956b, 1957) found uncorrected split-half reliabilities of approximately .90 for peer nominations after only two to five days of interaction. Furthermore, these split-half reliabilities did not change significantly over time, and the reliabilities across sessions (test-retest reliability) were just as high. In his later study, Hollander (1957) suggested that "...by the third week (of interaction) -- and perhaps earlier, had we taken a sounding then -- the nomination score is stabilized..." (p. 16). Thus, previous studies indicated that sociometric nominations are reliable and stable.

General Relationship of Peer Nomination Ratings to Health

Although specific indices, e.g., group cohesiveness and within-group status, have been derived from the nominations, specific empirical evidence of relationships of these variables to health change has been somewhat meager. Izard (1959) found that peer nominations of Naval Air Training Cadets were related to psychosomatic complaints. Trainees who received significantly lower peer evaluations expressed significantly more psychosomatic complaints. This study is highly suggestive and unfortunately is the only study that examined the relationship between peer nominations to a health-related criterion. After an extensive review, however, Korman (1968) concluded that peer nominations assess a person's ability to function adequately in a complex, dynamic environment. In this study, we examined this ability in terms of how it predicted, or moderated, health changes in the air traffic environment.

Relationship Between Expected and Observed Choices

We thought that the number of names on lists from which a man could be chosen would affect the frequency of being chosen. In fact one can calculate the expected frequency of being chosen if all choices were random. Each crew must be considered separately since the number of men is different in each crew. Let P_1 equal the number of men on crew A who can choose a member of that crew. Let P_2 and P_3 be the number of men on each of the sister crews that can choose a member on crew A. Let T_1 , T_2 , and T_3 be the total number of names on the lists for crew A and the sister crews respectively. Then the probability of a man on crew A being chosen randomly by men on crew A is P_1/T_1 . Similarly, the probabilities of a man in each of the sister crews being chosen from his-sister crew are P_2/T_2 and P_3/T_3 . Furthermore, each of these P_1 , P_2 , and P_3 men has 3 votes (3 choices for each of three questions). Thus the total expected

Appendix 1-20

number of choices of any one man by chance would be $9 (P1/T1 + P2/T2 + P3/T3)$ across all three questions.

To test the possible influence of randomly expected scores, we computed all the relevant figures for Logan Tower (N = 35). We found a non-significant relation of .006 between the randomly expected total number of times a man might be chosen and the total number of times a man was actually chosen by his peers. In addition a non-significant correlation ($r = .07$) was found between the number of men who could choose an ATC and the number of times the same ATC was chosen. Finally, if we adjusted the raw total number of times a given ATC was chosen by the expected number of times he would be chosen at random, the correlation between the adjusted number of choices and the actual number of choices was .99.

These results clearly indicated that an adjustment for expected choices was not needed. We could use the uncorrected number of times a man was chosen by his peers as the variable of interest for each question. However, the question arises as to whether or not the above results may have been due to restricted standard deviations, and/or ranges in the variables. Appendix Table III.8.5.a.v.-1 shows that this was not the case. The results in the table show a good distribution and reasonable variability for these scores.

Appendix Table III.8.5.a.v.-1
Statistics on Sociometric Total
Choices at Logan Tower
 (N = 35)

	<u>Number of Times Selected by Other ATC</u>	<u>Number Who Could Choose ATC</u>	<u>Expected Number of Choices for An ATC</u>
Mean	9.0	10.5	8.5
Standard Deviation	9.26	5.7	0.9
	0.41	7.14	6.5 - 9.8

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further check on the validity of using the uncorrected number of choices possible. For the Logan Tower ATCs, the number of men who could choose a ATC was very highly correlated with the number of men from which the given could make his choices ($r = .91$). Thus, we could use the latter as an estimate of the actual number who could choose an ATC in order to study all 416

the correlation between the estimated number of men who could choose an ATC number of times that ATC was chosen by those men was .01 across all 416. Therefore, we were confident in using the uncorrected number of times an ATC was chosen for each question and for the total score. The theoretically required adjustments for the probability of being chosen were not necessary.

As some possible sociometric variables could be based on the number of ATC choices of an ATC, the same probability of choice problem could have been applied. We applied the same procedures and statistics to determine if adjustments were needed for the scores based on choices by team members. We found no relationship between the randomly expected number of choices and the number of choices made by team members and, once again, there was a very significant relationship between the theoretically adjusted score and the number of team member selections of an ATC ($r = .88$). Consequently, we do not pursue any adjustments for these kinds of scores either.

of the SPRQ

Internal consistency reliabilities are not pertinent to our sociometric data since everyone did not rate everyone else. Consequently these reliabilities were not computed. For our SPRQ, test-retest reliability was a more important reliability since it indicates the stability of the measured variable

Appendix 1-22

The three main scores we derived from the SPRQ were ideal team choices, amicability choices, and competence choices of a given ATC by his peers. Appendix Table III.B.5.a.v.-2 displays the test-retest reliability coefficients for these three scores over two separate intervals which averaged nine months between test and re-test.

Appendix Table III.B.5.a.v.-2
Test-Retest Reliability Over
Two Successive Intervals

	<u>Interval 1 - N=377</u>	<u>Interval 2 - N=353</u>
ideal team choices	.77	.69
amicability choices	.70	.71
competence choices	.76	.79

The results shown in the table above indicate that the number of times an ATC was chosen by his peers for three different characteristics was very stable over two successive nine-month intervals.

The eighteen month reliability coefficients (obtained by combining the two nine-month intervals) were .64, .63, and .72 for Ideal, amicability and competence choices respectively. Even over this very long period of time, controllers' choices of one another remained relatively stable, further indicating the value these measures in the study.

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Appendix Table III.B.7.-1

Peak Traffic Statistics Used To Obtain Normalized Workload Measures

Facility NYARTCC
 Mean 4.383
 S.D. 2.647
 Total Observations 12998

Factor Type	Arrival Departure	Transition High	Enroute Low	Transition Low	Enroute High	Row Summary
and	3.636 2.236 547	4.785 2.527 390	5.114 2.599 185	4.099 2.533 525	5.027 3.010 696	4.472 2.683 2343
nd	3.961 2.416 2611	4.686 2.457 1777	4.681 2.690 640	4.151 2.452 1690	4.565 3.283 1470	4.326 2.647 8190
de	3.278 1.602 13	3.091 1.814 11	4.765 2.538 17	*	2.583 1.621 12	3.585 2.053 65
	4.243 2.275 808	4.745 2.675 443	5.177 2.718 220	3.984 2.094 564	5.247 3.499 364	4.513 2.615 2400
	3.982 2.366 3984	4.704 2.504 2621	4.861 2.681 1062	4.107 2.398 2786	4.780 3.251 2542	

Applicable in this facility

ent data -- column summary statistics were used as the best estimates; if
 summary was not available row summary statistics were used; if both column
 statistics could not be calculated the overall facility statistics were used.

ds in the following way: Mean
 Standard Deviation
 Number of observations

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Appendix Table III.B.7.-2

Peak Traffic Statistics Used to Obtain Normalized Workload Measures

Facility BOSARTCC
 Mean 2.630
 S.D. 1.836
 Number of Observations 5333

Sector Type	Arrival Departure	Transition High	Enroute Low	Transition Low	Enroute High	Row Summary
Off and Control	*	2.502 1.715 305	1.560 1.387 25	2.384 1.793 777	2.799 2.013 273	2.477 1.823 1389
and Control	2.481 1.514 54	2.925 1.793 920	1.912 1.755 91	2.493 1.805 1968	2.523 1.960 530	2.654 1.836 3563
Aide Control	*	*	*	*	*	4.188 2.198 16
ing	*	3.161 1.876 318	2.900 1.668 30	2.712 1.719 156	3.074 1.989 54	2.921 1.812 365
	2.471 1.511 70	2.850 1.792 1344	2.055 1.729 146	2.479 1.801 2908	2.906 1.982 865	X

Not applicable in this facility

Efficient data -- column summary statistics were used as the best estimates; if
 column summary was not available row summary statistics were used; if both column
 and row statistics could not be calculated the overall facility statistics were used.

Reads in the following way: Mean
 Standard Deviation
 Number of Observations

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Appendix Table III.B.7.-3

Peak Traffic Statistics Used to Obtain Normalized Workload Measures

City NYCIFR
 Mean 3.111
 S.D. 1.755
 Number of Observations 2836

Factor Type	Arrival Departure	Transition High	Enroute Low	Transition Low	Enroute High	Row Summary
and	3.090 1.720 321	N/A	*	*	*	3.087 1.718 322
d	3.080 1.763 2007	N/A	3.484 2.153 64	3.088 1.324 68	3.176 2.767 17	3.093 1.774 2156
	*	N/A	*	*	*	*
	3.239 1.675 355	N/A	*	*	*	3.237 1.669 358
	3.102 1.747 2683	N/A	3.462 2.144 65	3.085 1.307 71	3.176 2.767 17	X

Applicable in this facility

ent data -- column summary statistics were used as the best estimates; if
 mary was not available row summary statistics were used; if both column
 statistics could not be calculated the overall facility statistics were used.

s in the following way: Mean
 Standard Deviation
 Number of observations

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Appendix Table III.B.7.-4

Peak Traffic Statistics Used to Obtain Normalized Workload Measures

Facility LOGAN
 Grand Mean 2.444
 Grand S.D. 1.757
 Number of Observations 1310

Sector Type	Arrival Departure	Transition High	Enroute Low	Transition Low	Enroute High	Row Summary
Handoff and Ground Control	2.807 2.142 238	N/A	*	N/A	N/A	2.807 2.142 238
Order and Fuel Control	2.373 1.702 868	N/A	*	N/A	N/A	2.378 1.697 875
Peak Ride Director	*	N/A	*	N/A	N/A	*
Training	2.299 1.427 197	N/A	*	N/A	N/A	2.299 1.427 197
Personnel Entry	2.441 1.761 1303	N/A	*	N/A	N/A	X

Not applicable in this facility

Insufficient data -- column summary statistics were used as the best estimates; if
 column summary was not available row summary statistics were used; if both column
 row statistics could not be calculated the overall facility statistics were used.

Row summary statistics read in the following way: Mean
 Standard Deviation
 Number of observations

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Appendix Table III.8.7.-5

Peak Traffic Statistics Used To Obtain Normalized Workload Measures

Facility BRADLEY
Grand Mean 1.622
Grand S.D. 1.234
Number of Observations 508

Sector Type Position	Arrival Departure	Transition High	Enroute Low	Transition Low	Enroute High	Row Summary
Man.Off and Ground Control	1.854 1.476 41	N/A	*	N/A	*	1.884 1.451 43
Radar and Local Control	1.600 1.199 402	N/A	*	N/A	*	1.580 1.192 414
Check Ride Monitor	*	N/A	*	N/A	*	*
Training	1.745 1.354 51	N/A	*	N/A	*	1.745 1.354 51
Column Summary	1.636 1.240 494	N/A	*	N/A	1.273 .905 11	X

* Not applicable in this facility

Insufficient data -- column summary statistics were used as the best estimates; if column summary was not available row summary statistics were used; if both column and row statistics could not be calculated the overall facility statistics were used.

Data reads in the following way: Mean
Standard Deviation
Number of observations

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Appendix Table III.8.7.-6

Peak Traffic Statistics Used to Obtain Normalized Workload Measures

Facility QUONSET
 Grand Mean 1.782
 Grand S.D. 1.382
 Number of Observations 377

Sector Type Position	Arrival Departure	Transition High	Enroute Low	Transition Low	Enroute High	Row Summary
Handoff and Ground Control	1.919 1.505 146	*	N/A	N/A	*	1.900 1.505 150
Radar and Local Control	1.728 1.289 217	*	N/A	N/A	*	1.705 1.292 227
Check Ride Monitor	*	*	N/A	N/A		*
Training	*	*	N/A	N/A	*	*
Column Summary	1.805 1.382 365	*	N/A	N/A	*	X

* Not applicable in this facility

Insufficient data -- column summary statistics were used as the best estimates; if column summary was not available row summary statistics were used; if both column and row statistics could not be calculated the overall facility statistics were used.

Data reads in the following way: Mean
 Standard Deviation
 Number of observations

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Appendix Table III.B.7.-7

Peak Traffic Statistics Used To Obtain Normalized Workload Measures

ty OTIS
 Mean 2.070
 S.D. 1.491
 of Observations 328

ector Type	Arrival Departure	Transition High	Enroute Low	Transition Low	Enroute High	Row Summary
and	2.054 1.548 111	N/A	N/A	N/A	N/A	2.054 1.548 111
nd	2.136 1.479 177	N/A	N/A	N/A	N/A	2.136 1.479 177
de	*	N/A	N/A	N/A	N/A	*
	1.825 1.394 40	N/A	N/A	N/A	N/A	1.825 1.394 40
	2.070 1.491 328	N/A	N/A	N/A	N/A	X

applicable in this facility

ent data -- column summary statistics were used as the best estimates; if
 mary was not available row summary statistics were used; if both column
 statistics could not be calculated the overall facility statistics were used.

ds in the following way: Mean
 Standard Deviation
 Number of observations

Appendix 1-30

Appendix Table III.B.7.-8

Peak Traffic Statistics Used To Obtain Normalized Workload Measures

Facility PROVIDENCE
 Grand Mean 1.175
 Grand S.D. 1.171
 Number of Observations 63

Sector Type Position	Arrival Departure	Transition High	Enroute Low	Transition Low	Enroute High	Row Summary
Handoff and Ground Control	0.778 1.060 18	N/A	N/A	N/A	N/A	0.778 1.060 18
Radar and Local Control	1.333 1.187 45	N/A	N/A	N/A	N/A	1.333 1.187 45
Check Ride Monitor	*	N/A	N/A	N/A	N/A	*
Training	*	N/A	N/A	N/A	N/A	*
Column Summary	1.175 1.171 65	N/A	N/A	N/A	N/A	X

* Not applicable in this facility

Insufficient data -- column summary statistics were used as the best estimates; if
 column summary was not available row summary statistics were used; if both column
 and row statistics could not be calculated the overall facility statistics were used.

Data reads in the following way: Mean
 Standard Deviation
 Number of observations

Appendix 1-31

Appendix Table III.B.7.-9

Conversion of Normalized Workload To Raw Planes For Facility Islip¹

Normalized Workload Range	N ²	Raw Planes		
		Sum of Peak Traffic Mean (S.D.)	Maximum Peak Traffic Mean (S.D.)	Range in Peak Traffic Mean (S.D.)
363-395	18	17.39 (7.43)	3.44 (1.10)	3.33 (1.24)
407-423	41	23.29 (7.62)	4.29 (.91)	3.88 (1.00)
425-436	58	25.90 (7.24)	4.81 (1.05)	4.10 (1.40)
439-449	72	29.08 (8.37)	5.40 (1.07)	4.74 (1.32)
450-462	117	31.23 (10.05)	5.86 (1.13)	4.83 (1.53)
463-474	111	33.66 (8.86)	6.49 (1.22)	5.30 (1.72)
475-487	139	39.55 (9.63)	6.96 (1.12)	5.45 (1.65)
488-512	215	43.84 (9.92)	7.82 (1.36)	6.20 (1.68)
514-526	103	49.74 (9.13)	8.41 (1.10)	6.33 (1.56)
527-540	81	54.00 (10.48)	9.32 (1.41)	7.14 (1.75)
541-553	66	56.17 (9.35)	9.97 (1.45)	7.77 (1.81)
554-567	67	60.97 (10.92)	10.79 (1.70)	8.21 (2.31)
568-580	48	66.29 (13.90)	11.08 (1.75)	8.15 (2.61)
591-594	29	70.97 (9.89)	11.76 (1.64)	9.28 (2.24)
595-607	25	74.28 (15.06)	12.96 (1.88)	9.76 (2.20)
608-621	21	81.24 (13.02)	13.19 (1.81)	10.43 (2.54)
622-634	14	82.07 (12.78)	12.93 (1.49)	9.64 (1.82)
635-717	18	91.72 (10.75)	15.44 (3.28)	11.72 (3.97)
Total	1243	45.11 (18.33)	7.96 (2.77)	6.28 (2.46)

Normalized workload is the sum of normalized peak traffic, normalized maximum peak traffic, and normalized range in peak traffic. Normalized workload was calculated on 2632 man-days of observation and put on a scale where the mean is 500 and the standard deviation is 50.

¹Man who were never on a working position are excluded.

Conversion of Normalized Workload to Raw Planes for Facility Nashua 1

Normalized Workload Range	N ²	Raw Planes		
		Sum of Peak Traffic Mean (S.D.)	Maximum Peak Traffic Mean (S.D.)	Range in Peak Traffic Mean (S.D.)
395	-	--	--	--
423	8	7.88 (3.60)	2.50 (.54)	2.50 (.54)
436	18	10.11 (3.48)	2.56 (.78)	2.50 (.86)
449	37	9.78 (4.82)	2.70 (.84)	2.62 (.95)
462	70	11.64 (5.32)	3.01 (.96)	2.66 (1.21)
474	79	13.95 (6.01)	3.52 (.80)	3.04 (1.17)
487	77	17.14 (6.11)	4.17 (.70)	3.51 (1.13)
512	173	19.06 (6.62)	4.97 (.82)	4.20 (1.32)
526	57	24.61 (6.20)	5.75 (.87)	4.53 (1.34)
540	47	26.70 (6.80)	6.55 (.95)	5.36 (1.85)
563	40	31.20 (5.29)	6.72 (1.06)	5.50 (1.36)
577	22	33.59 (7.67)	7.46 (1.06)	5.91 (1.54)
590	13	35.00 (10.89)	7.85 (1.07)	6.23 (1.48)
604	13	38.62 (7.78)	8.46 (1.51)	7.08 (1.38)
617	7	45.71 (10.06)	8.57 (.79)	6.29 (1.38)
630	4	48.00 (9.31)	8.00 (1.41)	6.00 (1.83)
643	4	43.00 (2.94)	10.00 (.82)	8.25 (1.50)
656	8	54.25 (7.02)	10.75 (1.16)	8.38 (1.92)
677	677	20.52 (11.01)	4.93 (1.93)	4.11 (1.91)

Normalized workload is the sum of normalized peak traffic, normalized maximum peak traffic, and normalized range in peak traffic. Normalized workload was based on 2632 man-days of observation and put on a scale where the mean is 50 and the standard deviation is 50.

Persons who were never on a working position are excluded.

Appendix 1-33
 Appendix Table III.8.7.-11

Conversion of Normalized Workload to Raw Planes for Facility IFR¹

Normalized Workload Range	N ²	Raw Planes		
		Sum of Peak Traffic Mean (S.D.)	Maximum Peak Traffic Mean (S.D.)	Range in Peak Traffic Mean (S.D.)
363-395	1	3.00 (**)	1.00 (**)	1.00 (**)
407-423	7	13.71 (5.74)	3.43 (.54)	3.29 (.76)
425-436	11	12.91 (8.25)	2.82 (1.33)	2.64 (1.36)
439-449	11	16.73 (5.53)	3.46 (.69)	3.00 (.89)
450-462	26	16.04 (7.80)	3.50 (.81)	2.96 (1.22)
463-474	37	20.86 (8.26)	4.40 (.80)	3.68 (1.44)
475-487	41	22.20 (7.98)	4.73 (.78)	3.85 (1.41)
488-512	65	27.03 (6.89)	5.38 (.91)	4.25 (1.45)
513-526	37	30.14 (7.42)	6.08 (.68)	4.46 (1.24)
527-540	24	33.83 (6.06)	6.62 (1.01)	5.29 (1.49)
541-553	19	36.63 (7.57)	7.00 (1.11)	5.05 (1.78)
554-567	11	41.00 (8.54)	7.00 (1.18)	5.46 (1.70)
568-580	13	45.15 (6.63)	7.69 (.75)	5.62 (1.32)
581-594	3	38.00 (8.54)	9.00 (1.73)	6.33 (2.31)
595-607	9	47.89 (4.70)	8.56 (.73)	6.67 (1.58)
608-621	1	62.00 (**)	9.00 (**)	6.00 (**)
622-634	--	--	--	--
635-647	2	63.00 (7.07)	9.50 (.71)	6.50 (.71)
648-660	318	27.28 (11.86)	5.40 (1.70)	4.25 (1.67)

Normalized workload is the sum of normalized peak traffic, normalized maximum peak traffic, and normalized range in peak traffic. Normalized workload was based on 2632 man-days of observation and put on a scale where the mean is 50 and the standard deviation is 50.

Those who were never on a working position are excluded.

Appendix 1-34
 Appendix Table III.B.7.-12

Conversion of Normalized Workload to Raw Planes for Facility Logan!

Normalized Workload Range	N ²	Raw Planes		
		Sum of Peak Traffic Mean (S.D.)	Maximum Peak Traffic Mean (S.D.)	Range in Peak Traffic Mean (S.D.)
0-395	-	--	--	--
423	1	11.00 (**)	2.00 (**)	2.00 (**)
436	2	8.50 (3.54)	1.50 (.71)	1.50 (.71)
449	3	14.33 (8.02)	2.67 (.58)	2.67 (.58)
462	14	12.50 (6.22)	3.21 (1.48)	2.86 (1.70)
474	24	14.12 (5.28)	3.75 (.85)	3.46 (1.18)
487	30	14.70 (5.67)	3.87 (.94)	3.40 (1.30)
512	40	20.18 (6.25)	4.60 (.81)	3.90 (1.30)
526	13	24.08 (6.98)	5.62 (.96)	4.54 (1.45)
540	8	29.62 (6.44)	6.38 (.92)	5.25 (1.28)
553	4	28.50 (4.80)	7.00 (1.41)	6.25 (2.36)
567	6	30.83 (5.60)	7.50 (1.05)	6.67 (1.37)
580	3	40.67 (7.10)	7.00 (1.00)	5.00 (1.00)
594	2	39.00 (8.48)	8.50 (.71)	7.50 (2.12)
607	2	34.50 (3.54)	7.50 (.71)	4.00 (0.00)
	1	41.00 (**)	8.00 (**)	6.00 (**)
	1	39.00 (**)	8.00 (**)	8.00 (**)
	2	59.00 (7.07)	14.00 (4.24)	14.00 (4.24)
	156	20.19 (10.22)	4.76 (1.20)	4.10 (2.06)

Normalized workload is the sum of normalized peak traffic, normalized peak traffic, and normalized range in peak traffic. Normalized workload was calculated on 2632 man-days of observation and put on a scale where the mean is 500 and the standard deviation is 50.

Persons who were never on a working position are excluded.

Appendix 1-35
 Appendix Table III.B.7.-13

Conversion of Normalized Workload to Raw Planes for The Smaller Facilities¹

Normalized Load	N ²	Raw Planes		
		Sum of Peak Traffic Mean (S.D.) (**)	Maximum Peak Traffic Mean (S.D.) (**)	Range in Peak Traffic Mean (S.D.) (**)
5	1	3.00 (**)	1.00 (**)	1.00 (**)
3	3	5.33 (2.31)	1.33 (.58)	1.33 (.58)
4	4	5.75 (2.22)	1.75 (.96)	1.75 (.96)
9	9	6.11 (3.02)	1.89 (.60)	1.89 (.60)
19	19	7.53 (4.07)	2.00 (.74)	2.00 (.74)
11	11	8.73 (4.92)	2.36 (.81)	2.18 (.87)
17	17	12.06 (4.98)	3.12 (.70)	3.06 (.75)
47	47	13.66 (5.01)	3.49 (.72)	3.0 (1.03)
13	13	18.15 (4.78)	4.00 (.82)	3.23 (1.17)
9	9	18.11 (3.79)	4.76 (1.09)	4.44 (1.01)
8	8	22.12 (5.46)	4.62 (1.06)	3.62 (1.51)
4	4	23.50 (7.59)	5.25 (.96)	4.75 (1.50)
4	4	22.50 (7.33)	5.00 (1.41)	4.50 (1.29)
6	6	29.67 (5.99)	5.83 (1.17)	4.00 (.63)
3	3	27.67 (9.71)	6.33 (1.53)	4.67 (2.52)
-	-	--	--	--
1	1	20.00 (**)	8.00 (**)	6.00 (**)
-	-	--	--	--
159	159	14.00 (7.73)	3.43 (1.47)	3.01 (1.31)

¹Workload is the sum of normalized peak traffic, normalized peak traffic, and normalized range in peak traffic. Normalized range in peak traffic is calculated on 2632 man-days of observation and put on a scale where the mean is 500 and the standard deviation is 50.

²Facilities are Quonset, Otis, and Providence. Facilities that are never on a working position are excluded.

Appendix I-36

Appendix Table III.B.9.-1

ATC

FIELD STUDY

CARDIOVASCULAR MEASURES

Maximum Systolic At Work

ALL SUBJECTS

MAXIMUM SYSTOLIC	MEAN			STD. DEVIATION			MAXIMUM			MINIMUM			N V I S I T
	VISIT 1	VISIT 2	VISIT 3	VISIT 1	VISIT 2	VISIT 3	VISIT 1	VISIT 2	VISIT 3	VISIT 1	VISIT 2	VISIT 3	
DAILY	151.42	148.35	146.75	17.11	17.08	17.64	200.00	200.00	200.00	113.00	110.00	105.00	382 340 288
ON POSITION	147.44	144.84	144.00	17.07	17.50	17.95	200.00	200.00	200.00	108.00	105.00	103.00	375 338 286
OFF POSITION	143.55	140.55	138.70	17.02	16.63	17.14	200.00	200.00	200.00	109.00	98.00	95.00	376 336 287

EXCLUDING SUBJECTS ON ANTI-HYPERTENSIVE MEDICATIONS

MAXIMUM SYSTOLIC	MEAN			STD. DEVIATION			MAXIMUM			MINIMUM			N V I S I T
	VISIT 1	VISIT 2	VISIT 3	VISIT 1	VISIT 2	VISIT 3	VISIT 1	VISIT 2	VISIT 3	VISIT 1	VISIT 2	VISIT 3	
DAILY	151.63	148.41	146.99	17.26	17.24	17.82	200.00	200.00	200.00	113.00	110.00	105.00	360 320 269
ON POSITION	147.58	144.76	144.28	17.23	17.69	18.18	200.00	200.00	200.00	108.00	105.00	105.00	353 318 268
OFF POSITION	143.75	140.70	138.78	17.08	16.82	17.17	200.00	200.00	200.00	109.00	98.00	95.00	354 316 268

Appendix Table III.B.9-3

ATC
FIELD STUDY
CARDIOVASCULAR MEASURES
Maximum Diastolic At Work

ALL SUBJECTS

MAXIMUM DIASTOLIC	VISIT			STD. DEVIATION			MAXIMUM			MINIMUM			R V I S I T
	1	2	3	1	2	3	1	2	3	1	2	3	
DAILY	100.94	100.03	99.43	10.27	9.28	8.93	137.00	131.00	125.00	69.00	75.00	74.00	382 340 288
ON POSITION	98.87	97.83	97.80	10.51	9.91	9.40	130.00	131.00	125.00	69.00	71.00	73.00	375 338 266
OFF POSITION	95.35	94.95	93.29	10.56	10.41	9.87	137.00	122.00	119.00	60.00	69.00	69.00	376 336 287

EXCLUDING SUBJECTS ON ANTI-HYPERTENSIVE MEDICATIONS

MAXIMUM DIASTOLIC	VISIT			STD. DEVIATION			MAXIMUM			MINIMUM			R V I S I T
	1	2	3	1	2	3	1	2	3	1	2	3	
DAILY	100.98	106.01	99.49	10.31	9.40	9.02	137.00	131.00	125.00	69.00	75.00	74.00	360 320 269
ON POSITION	98.94	97.90	97.22	10.45	10.01	9.52	130.00	131.00	125.00	69.00	71.00	73.00	353 318 268
OFF POSITION	95.45	94.86	93.30	10.67	10.41	9.71	137.00	122.00	119.00	60.00	69.00	69.00	354 316 268

Appendix Table III.8.9-3
ATC

FIELD STUDY

CARDIOVASCULAR MEASURES

Average Heart Rate At Work

ALL SUBJECTS

AVERAGE HEART RATE	MEAN			STD. DEVIATION			MAXIMUM			MINIMUM			N		
	VISIT 1	VISIT 2	VISIT 3	VISIT 1	VISIT 2	VISIT 3	VISIT 1	VISIT 2	VISIT 3	VISIT 1	VISIT 2	VISIT 3		VISIT 1	VISIT 2
DAILY	78.61	77.68	76.37	10.70	9.44	9.66	112.20	105.20	114.86	52.00	53.00	53.14	382	340	288
ON POSITION	78.74	77.51	76.06	11.01	9.70	9.82	112.32	110.40	113.33	52.89	51.00	52.00	375	338	266
OFF POSITION	78.68	78.13	77.24	11.47	9.81	10.40	123.00	106.50	118.00	48.00	48.00	51.00	376	336	287

EXCLUDING SUBJECTS ON ANTI-HYPERTENSIVE MEDICATIONS

AVERAGE HEART RATE	MEAN			STD. DEVIATION			MAXIMUM			MINIMUM			N		
	VISIT 1	VISIT 2	VISIT 3	VISIT 1	VISIT 2	VISIT 3	VISIT 1	VISIT 2	VISIT 3	VISIT 1	VISIT 2	VISIT 3		VISIT 1	VISIT 2
DAILY	78.74	77.62	76.42	10.70	9.51	9.61	112.20	105.20	114.86	52.00	53.00	53.14	360	320	269
ON POSITION	78.84	77.47	76.07	10.95	9.78	9.79	112.81	110.40	113.33	52.89	51.00	52.00	353	318	268
OFF POSITION	79.09	78.02	77.27	11.39	9.21	10.41	123.00	106.50	118.00	50.40	48.00	51.00	354	316	269

Appendix Table III.B.3.-4

ATC
FIELD STUDY
CARDIOVASCULAR MEASURES
Maximum Heart Rate At Work

MAXIMUM HEART RATE	MEAN VISIT			STD. DEVIATION VISIT			MAXIMUM VISIT			MINIMUM VISIT			N VISIT
	1	2	3	1	2	3	1	2	3	1	2	3	
DAILY	92.32	90.39	87.48	13.54	13.23	12.10	134.00	146.00	120.00	60.00	60.00	60.00	382 325 288
ON POSITION	89.33	87.30	84.83	13.77	12.77	11.81	132.00	146.00	120.00	60.00	60.00	60.00	375 328 286
OFF POSITION	87.48	86.31	84.05	13.47	12.91	12.43	134.00	137.00	120.00	48.00	48.00	60.00	376 336 287

EXCLUDING SUBJECTS ON ANTI-HYPERTENSIVE MEDICATIONS

MAXIMUM HEART RATE	MEAN VISIT			STD. DEVIATION VISIT			MAXIMUM VISIT			MINIMUM VISIT			N VISIT
	1	2	3	1	2	3	1	2	3	1	2	3	
DAILY	92.51	90.23	87.70	13.60	13.43	11.97	134.00	146.00	120.00	60.00	60.00	60.00	360 305 269
ON POSITION	89.47	87.24	84.99	13.78	12.99	11.66	132.00	146.00	120.00	60.00	60.00	60.00	353 318 268
OFF POSITION	87.71	86.16	84.21	13.50	13.01	12.48	134.00	137.00	120.00	55.00	48.00	60.00	354 316 268

Appendix Table III.0.9.-5

ATC

FIELD STUDY

CARDIOVASCULAR MEASURES

Range Of Heart Rate At Work

RANGE - HEART RATE	MEAN			STD. DEVIATION			MAXIMUM			MINIMUM			N		
	VISIT 1	VISIT 2	VISIT 3	VISIT 1	VISIT 2	VISIT 3	VISIT 1	VISIT 2	VISIT 3	VISIT 1	VISIT 2	VISIT 3		VISIT 1	VISIT 2
DAILY	24.58	22.57	19.23	9.15	9.49	8.75	72.00	69.00	54.00	9.00	7.00	0	380	324	288
ON POSITION	19.14	17.82	15.85	9.57	9.83	7.98	72.00	69.00	42.00	0	0	0	375	338	286
OFF POSITION	16.33	15.12	12.65	9.79	10.23	9.41	46.00	53.00	48.00	0	0	0	376	336	287

ALL SUBJECTS

EXCLUDING SUBJECTS ON ANTI-HYPERTENSIVE MEDICATIONS

RANGE - HEART RATE	MEAN			STD. DEVIATION			MAXIMUM			MINIMUM			N		
	VISIT 1	VISIT 2	VISIT 3	VISIT 1	VISIT 2	VISIT 3	VISIT 1	VISIT 2	VISIT 3	VISIT 1	VISIT 2	VISIT 3		VISIT 1	VISIT 2
DAILY	24.58	22.55	19.40	9.16	9.62	8.77	72.00	69.00	54.00	9.00	7.00	0	358	304	269
ON POSITION	19.22	17.68	15.96	10.00	10.02	7.94	72.00	69.00	42.00	0	0	0	353	318	268
OFF POSITION	16.32	14.97	12.83	9.77	10.27	9.55	46.00	53.00	48.00	0	0	0	354	316	268

Appendix 1 - 41

Appendix Table III.B.9.-6

Correlations Among On-Position Cardiovascular

Measurements of Air Traffic Controllers at Work: First Study

N* = 349 - 353

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
1. Average	1.00											
2. Range	.24	1.00										
3. Maximum	.89	.62	1.00									
Standard 4. Deviation	.30	.91	.62	1.00								
5. Average	.59	.05	.48	.11	1.00							
6. Range	.12	.42	.27	.28	.06	1.00						
7. Maximum	.56	.23	.55	.23	.88	.47	1.00					
Standard 8. Deviation	.19	.30	.27	.30	.13	.90	.49	1.00				
9. Average	.28	.18	.31	.20	.17	.06	.18	.13	1.00			
10. Range	.09	.37	.23	.23	.10	.20	.18	.07	.30	1.00		
11. Maximum	.26	.30	.34	.26	.18	.14	.22	.14	.89	.65	1.00	
Standard 12. Deviation	.11	.22	.18	.18	.14	.08	.15	.05	.35	.92	.65	1.00

*Excluded subjects on anti-hypertensive medications. The subjects who were never on-position are also excluded. For some subjects the requisite data-points for calculating a given variable were not available due to measurement difficulties.

Appendix 1-42

Appendix Table III.B.9.-7

Correlations Among On-Position Cardiovascular
Measurements of Air Traffic Controllers at Work: Second Study

N* = 306-318

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
1. Average	1.00											
2. Range	.42	1.00										
3. Maximum	.92	.71	1.00									
4. Standard Deviation	.45	.89	.68	1.00								
5. Average	.50	.19	.45	.18	1.00							
6. Range	.24	.37	.33	.19	.12	1.00						
7. Maximum	.53	.33	.54	.26	.89	.50	1.00					
8. Standard Deviation	.21	.25	.26	.16	.09	.91	.43	1.00				
9. Average	.21	.17	.22	.22	.29	-.01	.25	.01	1.00			
10. Range	.13	.27	.20	.20	.12	.15	.17	.07	.35	1.00		
11. Maximum	.22	.24	.26	.25	.28	.06	.26	.04	.87	.71	1.00	
12. Standard Deviation	.07	.17	.10	.18	.09	.01	.10	.00	.38	.91	.69	1.00

Excluded subjects on anti-hypertensive medications. The subjects who were never on-position are also excluded. For some subjects the requisite datapoints for calculating a given variable were not available due to measurement difficulties.

Appendix 1-43

Appendix Table III.B.9.-2

Correlations Among On-Position Cardiovascular
Measurements of Air Traffic Controllers at Work: Third Study

N* = 258-268

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
1. Average	1.00											
2. Range	.43	1.00										
3. Maximum	.91	.73	1.00									
Standard												
4. Deviation	.43	.93	.70	1.00								
5. Average	.52	.18	.47	.78	1.00							
6. Range	.15	.32	.23	.25	.11	1.00						
7. Maximum	.51	.29	.50	.26	.87	.52	1.00					
Standard												
8. Deviation	.14	.28	.21	.28	.08	.90	.47	1.00				
9. Average	.30	.19	.33	.22	.27	-.10	.16	-.13	1.00			
10. Range	.11	.32	.24	.28	.06	.13	.09	.10	.20	1.00		
11. Maximum	.29	.31	.38	.32	.24	.00	.17	-.05	.88	.57	1.00	
Standard												
12. Deviation	.08	.25	.18	.27	.09	.65	.07	.06	.23	.88	.54	1.00

excluded subjects on anti-hypertensive medications. The subjects who were never on-position are also excluded. For some subjects the requisite data-points for calculating a given variable were not available due to measurement difficulties.

Appendix 1-44

Appendix Table III.8.9.-9

Correlations Among On-Position Cardiovascular

Measurements of Air Traffic Controllers at Work: Across Three Studies

N* = 258-311

	Visit 1 vs Visit 2	Visit 1 vs Visit 3	Visit 2 vs Visit 3
Average	.58	.54	.49
Range	.08	.23	.14
Maximum	.48	.49	.40
Standard Deviation	.00	.20	.11
Average	.60	.46	.48
Range	.23	.09	.15
Maximum	.54	.39	.33
Standard Deviation	.18	.05	.11
Average	.53	.44	.47
Range	.13	.06	.08
Maximum	.41	.36	.39
Standard Deviation	.09	.04	.13

*Excluded subjects on anti-hypertensive medications. The subjects who were never on-position are also excluded. For some subjects the requisite data-points for calculating a given variable were not available due to measurement difficulties. In addition, the correlations could only be calculated for subjects having a particular measure for all three studies.

Appendix I-45

Appendix Table III.8.9.-10

Correlations Among Off-Position Cardiovascular
Measurements of Air Traffic Controllers at Work: First Study

N* = 354

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
1. Average	1.00											
2. Range	.19	1.00										
3. Maximum	.86	.65	1.00									
** Standard 4. Deviation	-	-	-	-								
5. Average	.51	.02	.40	-	1.00							
6. Range	.12	.46	.31	-	-.01	1.00						
7. Maximum	.50	.26	.51	-	.86	.46	1.00					
** Standard 8. Deviation	-	-	-	-	-	-	-	-	-	-	-	-
9. Average	.17	.09	.17	-	.19	-.02	.15	-	1.00			
10. Range	.00	.39	.20	-	.01	.33	.17	-	.18	1.00		
11. Maximum	.14	.23	.22	-	.17	.12	.20	-	.90	.55	1.00	
** Standard 12. Deviation	-	-	-	-	-	-	-	-	-	-	-	-

*Excluding subjects on anti-hypertensive medications. The subjects who were never off-position are also excluded. For some subjects the requisite data-points for calculating a given variable were not available due to measurement difficulties.

**Not calculated.

Appendix 1-47

Appendix Table III.B.9.-12

Correlations Among Off-Position Cardiovascular
Measurements of Air Traffic Controllers at Work: Third Study

N* = 264-269

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
1. Average	1.00											
2. Range	.35	1.00										
3. Maximum	.91	.68	1.00									
**Standard 4. Deviation	-	-	-	-								
5. Average	.42	.02	.35	-	1.00							
6. Range	.19	.38	.29	-	.07	1.00						
7. Maximum	.43	.19	.43	-	.87	.51	1.00					
** Standard 8. Deviation	-	-	-	-	-	-	-	-	-	-	-	-
9. Average	.24	.15	.26	-	.16	.04	.15	-	1.00			
10. Range	.01	.22	.10	-	-.06	.32	.09	-	.19	1.00		
11. Maximum	.18	.22	.24	-	.08	.18	.15	-	.88	.61	1.00	
Standard Deviation	-	-	-	-	-	-	-	-	-	-	-	-

Excluded subjects on anti-hypertensive medications. The subjects who were never off-position are also excluded. For some subjects the requisite data-points for calculating a given variable were not available due to measurement difficulties.

Not calculated.

Appendix 1-48

Appendix Table III.B.9.-13

Correlations Among Off-Position Cardiovascular Measurements of Air Traffic Controllers at Work: Across Three Studies

N* = 264-310

	Visit 1 vs Visit 2	Visit 1 vs Visit 3	Visit 2 vs Visit 3
Average	.48	.48	.43
Range	.02	.04	.02
Maximum	.32	.30	.30
**Standard Deviation	-	-	-
Average	.51	.41	.40
Range	.08	.12	.06
Maximum	.43	.36	.31
**Standard Deviation	-	-	-
Average	.50	.40	.46
Range	.06	.02	.15
Maximum	.37	.29	.43
Standard Deviation	-	-	-

Excluded subjects on anti-hypertensive medications. The subjects who were never off-position are also excluded. For some subjects the requisite data-points for calculating a given variable were not available due to measurement difficulties. In addition, the correlations could only be calculated for subjects having a particular measure for all three studies.

Not calculated

Appendix 1-49

Appendix Table III.B.9.-14

Correlations Among Daily Cardiovascular Measurements of
Air Traffic Controllers at Work: First Study

N=358-360

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Age	1.00											
Sex	.35	1.00										
Income	.86	.73	1.00									
Standard Deviation	.36	.94	.71	1.00								
Age	.57	.08	.44	.11	1.00							
Sex	.25	.26	.28	.26	.15	1.00						
Income	.57	.23	.50	.26	.86	.54	1.00					
Standard Deviation	.27	.26	.28	.28	.13	.93	.49	1.00				
Age	.25	.22	.26	.22	.18	.06	.17	.08	1.00			
Sex	.07	.26	.19	.26	.13	-.01	.11	-.01	.35	1.00		
Income	.23	.27	.27	.27	.21	.06	.19	.07	.89	.68	1.00	
Standard Deviation	.05	.18	.13	.19	.13	.03	.13	.02	.40	.89	.68	1.00

subjects on anti-hypertensive medications; some correlations are based on subjects than others because for some subjects there were too few observations to make a measure. (e.g. There is no range when only one measurement was made).

Appendix 1-50

Appendix Table III.B.9.-15

Correlations Among Daily Cardiovascular Measurements of
Air Traffic Controllers at Work: Second Study

N=304-320

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
1. Average	1.00											
2. Range	.43	1.00										
3. Maximum	.91	.73	1.00									
Standard 4. Deviation	.47	.95	.73	1.00								
5. Average	.50	.16	.44	.15	1.00							
6. Range	.32	.26	.35	.25	.11	1.00						
7. Maximum	.54	.28	.52	.27	.87	.49	1.00					
Standard 8. Deviation	.31	.28	.35	.27	.09	.90	.44	1.00				
9. Average	.25	.15	.24	.18	.32	.12	.31	.08	1.00			
10. Range	.17	.23	.21	.26	.13	-.04	.09	-.05	.45	1.00		
11. Maximum	.25	.20	.27	.24	.29	.05	.26	.02	.86	.77	1.00	
Standard 12. Deviation	.11	.19	.16	.21	.13	.00	.13	-.02	.47	.88	.74	1.00

Excluding subjects on anti-hypertensive medications; some correlations are based on fewer subjects than others because for some subjects there were too few observations to calculate a measure. (e.g. There is no range when only one measurement was made).

Appendix 1-51

Appendix Table III.B.9.-16

Correlations Among Daily Cardiovascular Measurements of
Air Traffic Controllers at Work: Third Study

N* = 256-270

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
1. Average	1.00											
2. Range	.46	1.00										
3. Maximum	.90	.76	1.00									
Standard												
4. Deviation	.49	.95	.75	1.00								
5. Average	.51	.13	.43	.14	1.00							
6. Range	.23	.24	.28	.22	.17	1.00						
7. Maximum	.51	.21	.48	.21	.88	.53	1.00					
Standard												
8. Deviation	.26	.24	.29	.25	.16	.90	.47	1.00				
9. Average	.31	.26	.36	.25	.26	-.05	.16	-.07	1.00			
10. Range	.09	.15	.15	.13	.00	.09	-.01	.10	.19	1.00		
11. Maximum	.28	.28	.36	.27	.20	.02	.12	.00	.84	.62	1.00	
Standard												
12. Deviation	.04	.13	.11	.12	.01	.06	.00	.07	.21	.86	.56	1.00

Excluding subjects on anti-hypertensive medications; some correlations are based on fewer subjects than others because for some subjects there were too few observations to calculate a measure. (e.g. There is no reange when only one measurement was made).

Appendix 1-52

Appendix Table III.B.9.-17

Correlations Among Daily Cardiovascular Measurements of
Air Traffic Controllers at Work: Across Three Studies

N* = 256-320

	First vs Second Study	First vs Third Study	Second vs Third Study
Average	.59	.57	.49
Range	-.02	.14	.24
Maximum	.41	.44	.39
Standard Deviation	.03	.20	.25
Average	.61	.47	.52
Range	.00	.12	.04
Maximum	.46	.30	.36
Standard Deviation	.04	.15	.09
Average	.54	.47	.51
Range	.04	.10	.25
Maximum	.40	.36	.44
Standard Deviation	.08	.07	.19

Excluding subjects on anti-hypertensive medications; some correlations are based on fewer subjects than others because for some subjects there were too few observations to calculate a measure. (e.g. There is no range when only one measurement was made). In addition, the correlations could only be calculated for subjects having a particular measure for all three studies.

APPENDIX II

DIAGNOSTIC SUMMARIES SCORING ALGORITHMS

II. A-1

AIR TRAFFIC CONTROLLER STUDY

B.U.M.C.

PHYSICAL EXAMINATION FORM

Label

VITAL SIGNS:

HEIGHT: _____ in.

WEIGHT: _____ lb.

PULSE: _____ per min.

RESP: _____ per min.

BLOOD PRESSURE:

	1st observation	2nd observation	3rd observation
RIGHT: standing	/	/	/
sitting	/	/	/
supine	/	/	/
LEFT: standing	/	/	/
sitting	/	/	/
supine	/	/	/

COLOR:

BLACK _____

WHITE _____

OTHER (describe): _____

II. A-2

Place label here (Vitalometer)

FEV₁ (tenths of Liters) _____

FVC (tenths of Liters) _____

EKG reading:

Rate/min _____

Left ventricular hypertrophy _____

Ventricular extrasystoles (number/min.) _____

Supraventricular extrasystoles (number/min.) _____

Other arrhythmia:

Other abnormalities:

II. A-3

HAIR DISTRIBUTION:

EXCESSIVE.....020411 ()
DECREASED.....020421 ()
LOCATION 020430:

RASH:

Size 020510: _____ cm.

DESCRIPTION:

Macular.....020521 ()
Papular.....020522 ()
Vesicular.....020523 ()
Ulcerative.....020524 ()
Scaling.....020525 ()
OTHER 020520:

LOCATION 020530:

SPECIFIC ABNORMALITY:

ACNE.....020611 ()
Location 020610:

CHERRY ANGIOMA.....020621 ()
Location 020620:

SPIDER ANGIOMA.....020631 ()
Location 020630:

SPLINTER HEMORRHAGE.....020641 ()
Location 020640:

PETECHIAE.....020651 ()
Location 020650:

ECCHYMOSES.....020661 ()
Location 020660:

PURPURA.....020671 ()
Location 020670:

PALMAR ERYTHEMA.....020681 Bilac ()
Rt.....020682 () Lt.....020683 ()
OTHER 020690:

MOLES.....020721 ()
Location 020720:

WARTS.....020731 ()
Location 020730:

SCARS.....020741 ()
Location 020740:

OTHER 020710:

HEAD:

ABNORMALITY 030110: _____

II. A-4

GENERAL CONDITION:

APPEARANCE:

NUTRITION & HYDRATION:

- Obese:
- Mildly.....010111 ()
 - Moderately.....010112 ()
 - Extremely.....010113 ()
 - Thin.....010114 ()
 - Cachectic.....010115 ()
 - Anasarca.....010116 ()
 - Dehydrated.....010117 ()
- NOT STATED AGE:
- Appears older.....010121 ()
 - Appears younger.....010122 ()
- ILL:
- Acutely.....010131 ()
 - Chronically.....010132 ()
- IN DISTRESS:
- Mild.....010141 ()
 - Moderate.....010142 ()
 - Acute.....010143 ()
- OTHER 010150

01 GENERAL NE()ML()ABN()

02 SKIN NE()ML()ABN()

03 HEAD NE()ML()ABN()

STATE OF CONSCIOUSNESS:

NOT ALERT:

- Drowsy.....010211 ()
 - Lethargic.....010212 ()
 - Obtunded.....010213 ()
 - Unresponsive.....010214 ()
- DISORIENTED:
- To person.....010221 ()
 - To place.....010222 ()
 - To time.....010223 ()
- OTHER 010230:

TEMPERAMENT:

- DEPRESSED.....010311 ()
 - ANXIOUS.....010321 ()
 - WITHDRAWN.....010331 ()
 - AGGRESSIVE.....010341 ()
 - UNCOOPERATIVE.....010351 ()
 - PASSIVE AGGRESSIVE.....010361 ()
- OTHER 010370:

OTHER 010410:

SKIN:

TEMPERATURE:

- WARM.....020111 ()
 - COLD.....020121 ()
- HYDRATION:
- DRY.....020211 ()
 - MOIST.....020221 ()
 - OILY.....020231 ()
 - DECREASED TURGOR.....020241 ()
- COLORATION:
- PALE.....020311 ()
 - RUDDY.....020321 ()
 - CYANOTIC.....020331 ()
 - ICTERIC.....020341 ()
 - HYPERPIGMENTED.....020351 ()
 - HYPOPIGMENTED.....020361 ()
 - FRECKLED.....020371 ()
- OTHER 020370:

II. A-5

EARS:

AUDITORY TESTING:

DECREASED ACUITY:

Rt.....040111 () Lt.....040112 ()
Comment..040120:

04 EARS NE()NL()ABN()

05 EYES NE()NL()ABN()

BONE CONDUCTION > AIR:

Rt.....040131 () Lt.....040132 ()

WEBER LATERALIZES TO THE:

Rt.....040141 () Lt.....040142 ()

OTHER 040150:

AURICLE:

ABNORMALITY 040210:

AUDITORY CANAL:

EXCESSIVE CERUMEN.....040313 Both ()
Rt.....040311 () Lt.....040312 ()

INFLAMMATION.....040323 Both ()
Rt.....040321 () Lt.....040322 ()

DISCHARGE.....040333 Both ()
Rt.....040331 () Lt.....040332 ()

TYMPANIC MEMBRANES:

NOT VISUALIZED:
Rt.....040411 () Lt.....040412 ()

INJECTED:
Rt.....040421 () Lt.....040422 ()

SCARRED:
Rt.....040431 () Lt.....040432 ()

PERFORATED:
Rt.....040441 () Lt.....040442 ()

RETRACTED:
Rt.....040451 () Lt.....040452 ()

BULGING:
Rt.....040461 () Lt.....040462 ()

OTHER 040470:

OTHER 040510:

EYES:

LIDS:

EXOPHTHALMOS.....050113 Both ()
Rt.....050111 () Lt.....050112 ()

XANTHELASMA.....050123 Both ()
Rt.....050121 () Lt.....050122 ()

PTOSIS.....050133 Both ()
Rt.....050131 () Lt.....050132 ()

LID LAG.....050143 Both ()
Rt.....050141 () Lt.....050142 ()

OTHER 050150:

CONJUNCTIVA:

PALE.....050213 Both ()
Rt.....050211 () Lt.....050212 ()

CONJUNCTIVITIS.....050223 Both ()
Rt.....050221 () Lt.....050222 ()

OTHER 050230:

CLERA:

CTERIC.....050313 Both ()
Rt.....050311 () Lt.....050312 ()

OPHTHALMOPATHY.....050323 Both ()
Rt.....050321 () Lt.....050322 ()

OTHER 050330:

II. A-6

CORNEA:

ARCUS SENILIS.....050413 Both ()
Rt.....050411 () Lt.....050412 ()
OPACIFIED.....050423 Both ()
Rt.....050421 () Lt.....050422 ()
OTHER 050430:

IRIS:

NEOVASCULARIZATION.....050513 Both ()
Rt.....050511 () Lt.....050512 ()
OTHER 050520:

LENS:

OPACIFIED.....050613 Both ()
Rt.....050611 () Lt.....050612 ()
REMOVED.....050623 Both ()
Rt.....050621 () Lt.....050622 ()
OTHER 050630:

PUPILS:

NOT EQUAL (Note larger one).....050711 Rt () 050712 Lt ()
NOT ROUND.....050721 Rt () 050722 Lt ()
NOT REACTIVE TO LIGHT.....050731 Rt () 050732 Lt ()
NOT ACCOMMODATIVE.....050741 Rt () 050742 Lt ()
OTHER 050750:

FUNDOSCOPIC:

DISC:

Pallor.....050811 Rt () 050812 Lt ()
Atrophy.....050821 Rt () 050822 Lt ()
Papilledema.....050831 Rt () 050832 Lt ()
Pulsation of Retinal Vein.....050841 Rt () 050842 Lt ()
OTHER 050850:

ARTERIOLES:

Narrowing.....050911 Rt () 050912 Lt ()
Straightening.....050921 Rt () 050922 Lt ()
A/V nicking.....050931 Rt () 050932 Lt ()
Copper wiring.....050941 Rt () 050942 Lt ()
Tortuosity.....050951 Rt () 050952 Lt ()
OTHER 050960:

VENULES:

Tortuosity.....051011 Rt () 051012 Lt ()
Engorgement.....051021 Rt () 051022 Lt ()
OTHER 051030:

RETINA:

Chorioretinitis.....051111 Rt () 051112 Lt ()
Hemorrhages:
Flame.....051121 Rt () 051122 Lt ()
Dot.....051131 Rt () 051132 Lt ()
Exudates:
Soft.....051141 Rt () 051142 Lt ()
Hard.....051151 Rt () 051152 Lt ()
OTHER 051160:

OTHER 051210:

VISUAL FIELDS 051310:

OTHER 051410:

II. A-7

NOSE:

SEPTUM ASYMMETRICAL.....060111 ()
 DISCHARGE:
 Mucus.....060211 Rt () 060212 Lt ()
 Pus.....060221 Rt () 060222 Lt ()
 Blood.....060231 Rt () 060232 Lt ()
 OBSTRUCTION...060311 Rt () 060312 Lt ()
 OTHER 060410:

06 NOSE NE () NL () ABN ()
 07 MOUTH & THROAT NE () NL () ABN ()
 08 NECK NE () NL () ABN ()
 09 THORAX NE () NL () ABN ()
 10 BREASTS NE () NL () ABN ()

MOUTH & THROAT:

TEETH & GUMS:

CARIES.....070111 ()
 DENTURES.....070121 ()
 EDENTULOUS.....070131 ()
 CALCULUS.....070141 ()
 GINGIVITIS.....070151 ()
 OTHER 070160:

TONGUE:

ABNORMALITY 070210:

PALATE:

INFLAMMATION.....070311 ()
 EDEMA.....070321 ()
 PETECHIAE.....070331 ()
 OTHER 070340:

PHARYNX:

INFLAMED.....070411 ()
 EDEMATOUS.....070421 ()
 OTHER 070430:

TONSILS:

HYPERTROPHIED.....070511 ()
 RED.....070521 ()
 EXUDATIVE.....070531 ()
 OTHER 070540:

OTHER 070610:

NECK:

RIGID.....080111 ()
THYROID:
 ENLARGED.....080211 Rt () 080212 Lt ()
 NODULAR.....080221 Rt () 080222 Lt ()
 TENDER.....080231 Rt () 080232 Lt ()
 BRUIT.....080241 Rt () 080242 Lt ()
 OTHER 080250:

JVP elevated 080310: _____ cm at _____ degrees

HEPATO-JUGULAR REFLUX.....080411 ()

CAROTID PULSES:

NOT PALPABLE.....080511 Rt () 080512 Lt ()
 UNEQUAL WITH PREDOMINANCE.....080521 Rt () 080522 Lt ()
 BRUIT.....080531 Rt () 080532 Lt ()
 OTHER 080540:

OTHER 080610:

II. A-8

THORAX:

INCREASED A-P DIAMETER.....090111 ()
ASYMMETRY (Describe) 090210:

OTHER 090310:

BREASTS:

MASSES.....100111 Rr () 100112 Lr ()
DESCRIPTION 100120:

RETRACTED NIPPLE.....100211 Rr () 100212 Lr ()
ENLARGED.....100311 Rr () 100312 Rr ()
INCREASED PIGMENTATION.....100411 ()
GLANDULAR HYPERTROPHY.....100511 ()
LACTATING.....100611 ()
TENDER.....100711 ()
OTHER 100810:

II. A-9

HEART:

RHYTHM:

- Regular Irregularity.....1101111 ()
- Irregular Irregularity.....1101211 ()
- Bigeminy.....1101311 ()
- Occasional Extrasystoles.....1101411 ()
- OTHER 1101510: _____

HEART NE () ML () ABN ()

PALPATION:

- PMI: localized....1102111 () diffuse....1102112 ()
- Duration: Sustained....1102121 () Brief....1102122 ()
- OTHER 1102120: _____
- Amplitude: Tapping....1102131 () Heave....1102132 ()
- OTHER 1102130: _____
- Location: Epigastric....1102141 () parasternal....1102142 ()
- 1102140: _____ cm Lt of MSL in the _____ ICS
- OTHER IMPULSES 1102210 (Describe): _____

PALPABLE HEART SOUNDS:

- S1...1102311 () S2...1102321 () S3...1102331 () S4...1102341 ()
- THRILLS: Systolic...1102411 () Diastolic...1102421 ()
- Comment 1102430: _____
- OTHER 1102510: _____

AUSCULTATION:

HEART SOUNDS & GALLOPS:

- S1: Accentuated...1103111 () Distant...1103112 () Split...1103113 ()
- OTHER 1103110: _____
- S2: Accentuated...1103121 () Distant...1103122 ()
- Split: Paradoxically...1103123 () Fixed...1103124 ()
- S2A > S2P.....1103125 ()
- S2A = S2P.....1103126 ()
- S2A < S2P.....1103127 () OTHER 1103120: _____
- S3 gallop.....1103131 ()
- Comment on location 1103130: _____
- S4 gallop.....1103141 ()
- Comment on location 1103140: _____
- OTHER 1103150: _____

MURMURS:

- | | |
|---|---------------------------------|
| Systolic...110321 | Diastolic.....110322 |
| (Plus digit(s) for each of the following categories): | |
| Grade: | Grade: |
| 1-2...1 () | 1-2...1 () |
| 3-4...2 () | 3-4...2 () |
| 5-6...3 () | 5-6...3 () |
| Timing: | Timing: |
| Early...1 () | Early...1 () |
| Mid....2 () | Mid....2 () |
| Late...3 () | Late...3 () |
| Holo...4 () | Holo...4 () |
| Duration: | Duration: |
| Long...1 () | Long...1 () |
| Short...2 () | Short...2 () |
| Holo...3 () | Holo...3 () |
| Character: | Character: |
| High pitched...1 () | High pitched...1 () |
| Low pitched...2 () | Low pitched...2 () |
| Location: | Location: |
| Aortic Area...01 () | Aortic Area...01 () |
| Pulmonic Area...02 () | Pulmonic Area...02 () |
| 3rd & 4th LICS...03 () | 3rd & 4th LICS...03 () |
| Apex.....04 () | Apex.....04 () |
| Lt Sternal Border...05 () | Lt Sternal Border...05 () |
| Rt Sternal Border...06 () | Rt Sternal Border...06 () |
| All over pre-cordium.....07 () | All over pre-cordium.....07 () |
| Radiation: | Radiation: |
| Neck.....08 () | Neck.....08 () |
| Lt Sternal Border...09 () | Lt Sternal Border...09 () |
| Apex.....10 () | Apex.....10 () |
| Axilla.....11 () | Axilla.....11 () |
| Back.....12 () | Back.....12 () |
| All over pre-cordium.....13 () | All over pre-cordium.....13 () |
| OTHER 1103210: _____ | OTHER 1103220: _____ |

- OTHER 1103230: _____
- EJECTION SOUND 1103310 () and Location: _____
- SYSTOLIC CLICK 1103410 () and Location: _____
- FRICTION Rub 1103510 () and Location: _____
- OTHER 1103610: _____
- OTHER 1104110: _____

LUNGS

II. A-10

RESPIRATION:

- Cheyne-Stokes.....120111 ()
- Kussmaul.....120121 ()
- Labored.....120131 ()
- Shallow.....120141 ()
- Prolonged Expiratory Phase.....120151 ()
- OTHER 120160:

12 LUNGS NB () NL () ABN ()

PERCUSSION:

DULL:

- | | |
|---------------------|---------------------|
| Right anterior: | Left anterior: |
| Apex 120211....1() | Apex 120213....1() |
| Mid.....2() | Mid.....2() |
| Base.....3() | Base.....3() |
| Hemithorax....4() | Hemithorax....4() |
| Right posterior: | Left posterior: |
| Apex 120212....1() | Apex 120214....1() |
| Mid.....2() | Mid.....2() |
| Base.....3() | Base.....3() |
| Hemithorax....4() | Hemithorax....4() |

FLAT:

- | | |
|---------------------|---------------------|
| Right anterior: | Left anterior: |
| Apex 120221....1() | Apex 120223....1() |
| Mid.....2() | Mid.....2() |
| Base.....3() | Base.....3() |
| Hemithorax....4() | Hemithorax....4() |
| Right posterior: | Left posterior: |
| Apex 120222....1() | Apex 120224....1() |
| Mid.....2() | Mid.....2() |
| Base.....3() | Base.....3() |
| Hemithorax....4() | Hemithorax....4() |

OTHER 120230:

AUSCULTATION:

INCREASED BREATH SOUNDS:

- | | |
|---------------------|---------------------|
| Right anterior: | Left anterior: |
| Apex 120311....1() | Apex 120313....1() |
| Mid.....2() | Mid.....2() |
| Base.....3() | Base.....3() |
| Hemithorax....4() | Hemithorax....4() |
| Right posterior: | Left posterior: |
| Apex 120312....1() | Apex 120314....1() |
| Mid.....2() | Mid.....2() |
| Base.....3() | Base.....3() |
| Hemithorax....4() | Hemithorax....4() |

DECREASED BREATH SOUNDS:

- | | |
|---------------------|---------------------|
| Right anterior: | Left anterior: |
| Apex 120321....1() | Apex 120323....1() |
| Mid.....2() | Mid.....2() |
| Base.....3() | Base.....3() |
| Hemithorax....4() | Hemithorax....4() |
| Right posterior: | Left posterior: |
| Apex 120322....1() | Apex 120324....1() |
| Mid.....2() | Mid.....2() |
| Base.....3() | Base.....3() |
| Hemithorax....4() | Hemithorax....4() |

ABSENT BREATH SOUNDS:

- | | |
|---------------------|---------------------|
| Right anterior: | Left anterior: |
| Apex 120331....1() | Apex 120333....1() |
| Mid.....2() | Mid.....2() |
| Base.....3() | Base.....3() |
| Hemithorax....4() | Hemithorax....4() |
| Right posterior: | Left posterior: |
| Apex 120332....1() | Apex 120334....1() |
| Mid.....2() | Mid.....2() |
| Base.....3() | Base.....3() |
| Hemithorax....4() | Hemithorax....4() |

II. A-11

RALES

Right anterior:
Apex 120341...1{ }
Mid.....2{ }
Base.....3{ }
Hemithorax....4{ }
Right posterior:
Apex 120342...1{ }
Mid.....2{ }
Base.....3{ }
Hemithorax....4{ }

RHONCHI:

Right anterior:
Apex 120351...1{ }
Mid.....2{ }
Base.....3{ }
Hemithorax....4{ }
Right posterior:
Apex 120352...1{ }
Mid.....2{ }
Base.....3{ }
Hemithorax....4{ }

WHEEZES:

Right anterior:
Apex 120361...1{ }
Mid.....2{ }
Base.....3{ }
Hemithorax....4{ }
Right posterior:
Apex 120362...1{ }
Mid.....2{ }
Base.....3{ }
Hemithorax....4{ }

FRICITION RUB:

Right anterior:
Apex 120371...1{ }
Mid.....2{ }
Base.....3{ }
Hemithorax....4{ }
Right posterior:
Apex 120372...1{ }
Mid.....2{ }
Base.....3{ }
Hemithorax....4{ }

OTHER 120380:

OTHER 120410:

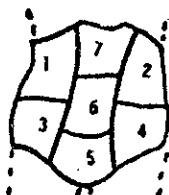
left anterior:
Apex 120343...1{ }
Mid.....2{ }
Base.....3{ }
Hemithorax....4{ }
Left posterior:
Apex 120344...1{ }
Mid.....2{ }
Base.....3{ }
Hemithorax....4{ }

Left anterior:
Apex 120353...1{ }
Mid.....2{ }
Base.....3{ }
Hemithorax....4{ }
Left posterior:
Aper 120354...1{ }
Mid.....2{ }
Base.....3{ }
Hemithorax....4{ }

Left anterior:
Apex 120363...1{ }
Mid.....2{ }
Base.....3{ }
Hemithorax....4{ }
Left posterior:
Apex 120364...1{ }
Mid.....2{ }
Base.....3{ }
Hemithorax....4{ }

Left anterior:
Apex 120373...1{ }
Mid.....2{ }
Base.....3{ }
Hemithorax....4{ }
Left posterior:
Apex 120374...1{ }
Mid.....2{ }
Base.....3{ }
Hemithorax....4{ }

II. A-12



ABDOMEN:
 RETRACTED.....130111 ()
 DISTENDED.....130211 ()

8 R CVA ABDOMEN NE() ML() ABN() 13
 9 L CVA BACK NE() ML() ABN() 14
 Entire GENITAL NE() ML() ABN() 15
 RECTAL NE() ML() ABN() 16
 EXTREMITIES NE() ML() ABN() 17

TENDERNESS:

TO LIGHT PALPATION 130311 () () () () () () () () () ()
 COMMENT 130310:
 TO DEEP PALPATION 130321 () () () () () () () () () ()
 COMMENT 130320:
 REBOUND.....130411 () () () () () () () () () ()
 COMMENT 130410:
 GUARDING.....130511 () () () () () () () () () ()
 COMMENT 130510:
 MASS PALPABLE.....130611 () () () () () () () () () ()
 COMMENT 130610:
 SCAR.....130711 () () () () () () () () () ()
 COMMENT 130710:

ASCITES.....130811 ()
 ORGANOMEGALY:
 LIVER: Palpable...130911 () Other 130910: _____
 SPLEEN: Palpable...130921 () Other 130920: _____
 OTHER 130930: _____

BOWEL SOUNDS:
 HYPERACTIVE.....131011 ()
 INFREQUENT.....131021 ()
 DISTANT.....131031 ()
 OTHER 131040: _____

HERNIA:
 UMBILICAL.....131111 ()
 INCISIONAL.....131121 ()
 COMMENT 131120: _____

INGUINAL:
 Rt: Reducible...131131 () Nonreducible 131132 ()
 Comment 131130: _____
 Lt: Reducible...131141 () Nonreducible 131142 ()
 Comment 131140: _____
 Other 131150: _____
 OTHER 131210: _____
 OTHER 131310: _____

BACK:
 LORDOSIS.....140111 () SCOLIOSIS.....140311 ()
 KYPHOSIS.....140211 () OTHER 140410: _____

GENITAL:
 PENIS:
 PHIMOSIS...150111 () PARAPHIMOSIS...150121 () CIRCUMCISED.....150171 ()
 HYPOSPADIAS 150131 () SMEGMA.....150141 () DISCHARGE.....150151 ()
 OTHER 150160: _____

TESTICLES:
 MASS.....150211 Rt () 150212 Lt ()
 OTHER 150220: _____

SCROTUM:
 HYDROCELE...150311 Rt () 150312 Lt ()
 VARICOCELE 150321 Rt () 150322 Lt ()
 OTHER 150330: _____

II. A-13

RECTAL:

DECREASED SPHINCTER TONE.....16011 ()
 TENDERNESS.....16021 ()
 HEMORRHOIDS.....16031 ()
 HEMORRHOIDAL SKIN TAGS.....16041 ()

PROSTATE:

ENLARGED.....16051 Rt () 16052 Lt () 16053 Diffuse ()
 TENDER.....16052 Rt () 16052 Lt () 160523 Diffuse ()
 NODULAR.....16053 Rt () 16053 Lt () 160533 Diffuse ()
 OTHER 160540: _____

ABNORMAL FECES ON GLOVE:

GUAIAC POSITIVE.....16061 ()
 OTHER 160610: _____
 OTHER 16070: _____

EXTREMITIES:

EDEMA:

HAND.....17011 Rt () 17012 Lt () 17013 Both ()
 LEG TO KNEE 17012 Rt () 17012 Lt () 17013 Both ()
 ANKLE.....17013 Rt () 17013 Lt () 17013 Both ()

CLUBBING:

FINGERS.....17021 ()
 TOES.....17022 ()

VARICOSITIES.170310 (Describe site): _____

PULSES: (Carotid -- see NECK)

	NONPALPABLE		WEAK		BRUIT	
	RE	LT	Rt	Lt	RE	Lt
RADIAL 17041.....1 () 2 ()			3 ()	4 ()	5 ()	6 ()
Comment 170410: _____						
BRACHIAL 17042.....1 () 2 ()			3 ()	4 ()	5 ()	6 ()
Comment 170420: _____						
FEMORAL 17043.....1 () 2 ()			3 ()	4 ()	5 ()	6 ()
Comment 170430: _____						
DORSALIS PEDIS 17044.....1 () 2 ()			3 ()	4 ()	5 ()	6 ()
Comment 170440: _____						
POSTERIOR TIBIAL 17045.....1 () 2 ()			3 ()	4 ()	5 ()	6 ()
Comment 170450: _____						
OTHER 170460: _____						

JOINTS:

	SWELLING		REDNESS		PAIN ON MOTION		REDUCED MOTION	
FINGER 17051.....1 () 2 ()			3 ()	4 ()	5 ()	6 ()	7 ()	8 ()
WRIST 17052.....1 () 2 ()			3 ()	4 ()	5 ()	6 ()	7 ()	8 ()
ELBOW 17053.....1 () 2 ()			3 ()	4 ()	5 ()	6 ()	7 ()	8 ()
SHOULDER 17054.....1 () 2 ()			3 ()	4 ()	5 ()	6 ()	7 ()	8 ()
HIP 17055.....1 () 2 ()			3 ()	4 ()	5 ()	6 ()	7 ()	8 ()
KNEE 17056.....1 () 2 ()			3 ()	4 ()	5 ()	6 ()	7 ()	8 ()
ANKLE 17057.....1 () 2 ()			3 ()	4 ()	5 ()	6 ()	7 ()	8 ()
TOES 17058.....1 () 2 ()			3 ()	4 ()	5 ()	6 ()	7 ()	8 ()
OTHER 170590: _____								

OTHER 170610: _____

II. A-14

LYMPH NODES:

ANTERIOR CERVICAL:

TENDER.....	180111 ()	Rt	180112 ()	Lt
NOTTENDER.....	180121 ()		180122 ()	
FIXED.....	180131 ()		180132 ()	
MOBILE.....	180141 ()		180142 ()	
OTHER 180150:	_____			

18 LYMPH NODES NE() NL() ABN()

19 NEUROLOGICAL EXAM NE() NL() ABN()

POSTERIOR CERVICAL:

TENDER.....	180211 ()	Rt	180212 ()	Lt
NOTTENDER.....	180221 ()		180222 ()	
FIXED.....	180231 ()		180232 ()	
MOBILE.....	180241 ()		180242 ()	
OTHER 180250:	_____			

SUPRACLAVICULAR:

TENDER.....	180311 ()	Rt	180312 ()	Lt
NOTTENDER.....	180321 ()		180322 ()	
FIXED.....	180331 ()		180332 ()	
MOBILE.....	180341 ()		180342 ()	
OTHER 180350:	_____			

AXILLARY:

TENDER.....	180411 ()	Rt	180412 ()	Lt
NOTTENDER.....	180421 ()		180422 ()	
FIXED.....	180431 ()		180432 ()	
MOBILE.....	180441 ()		180442 ()	
OTHER 180450:	_____			

INGUINAL:

TENDER.....	180511 ()	Rt	180512 ()	Lt
NOTTENDER.....	180521 ()		180522 ()	
FIXED.....	180531 ()		180532 ()	
MOBILE.....	180541 ()		180542 ()	
OTHER 180550:	_____			

OTHER 180610: _____

NEUROLOGICAL EXAMINATION:

MENTAL STATUS (State of Consciousness -- See GENERAL section)

INAPPROPRIATE EXPRESSION.....190111 ()

Comment 190110: _____

DISTURBED THOUGHT CONTENT....190121 ()

Comment 190120: _____

INAPPROPRIATE MOOD.....190131 ()

Comment 190130: _____

IMPAIRED MEMORY.....190141 ()

Comment 190140: _____

INAPPROPRIATE SPEECH.....190151 ()

Comment 190150: _____

OTHER 190160: _____

CRANIAL NERVES (Describe Abnormality):

OLFACTORY (1).....190210 () _____

OPTIC (2).....190220 () _____

OCULOMOTOR, TROCHLEAR, ABDUCENS (3,4,6).....190230 () _____

TRIGEMINAL (5).....190240 () _____

FACIAL (7).....190250 () _____

VESTIBULOCOCLEAR (8).....190260 () _____

GLOSSOPHARYNGEAL (9,10).....190270 () _____

SPINAL ACCESSORY (11).....190280 () _____

HYPOGLOSSAL (12).....190290 () _____

II. A-15

CEREBELLAR FUNCTION.....190310 () _____
 MOTOR:

	ARMS		LEGS	
	Rt	Lt	Rt	Lt
MUSCLE WEAKNESS 19041.....1() 2() Comment 190410: _____			3()	4()
HYPERTONIA 19042.....1() 2() Comment 190420: _____			3()	4()
FLACCID 19043.....1() 2() Comment 190430: _____			3()	4()
IMPAIRED GAIT 19044.....1() 2() Comment 190440: _____			3()	4()
LACK OF COORDINATION 19045 1() 2() Comment 190450: _____			3()	4()

OTHER 190460: _____

SENSORY:

	ARMS		LEGS	
	Rt	Lt	Rt	Lt
DECREASED PAIN SENSE 19051.....1() 2() Comment 190510: _____			3()	4()
DECREASED TEMPERATURE SENSE 19052...1() 2() Comment 190520: _____			3()	4()
DECREASED VIBRATORY SENSE 19053.....1() 2() Comment 190530: _____			3()	4()

OTHER 190540: _____

REFLEXES:

	ABSENT		DECREASED		INCREASED	
	Rt	Lt	Rt	Lt	Rt	Lt
KNEE 19061.....1() 2() Other 190610: _____			3()	4()	5()	6()
ANKLE 19062.....1() 2() Other 190620: _____			3()	4()	5()	6()
BICEPS 19063.....1() 2() Other 190630: _____			3()	4()	5()	6()
TRICEPS 19064.....1() 2() Other 190640: _____			3()	4()	5()	6()

BABINSKY 19065.....1 Rt () 2 Lt ()
 Comment 190650: _____

OTHER 190660: _____

OTHER 190710: _____

COMMENT 190810: _____

II. B-1

MED 210: REVIEW OF HEALTH HISTORY
SECOND ROUND

PLEASE INDICATE IF ANY OF YOUR BLOOD RELATIVES HAS DEVELOPED ANY OF THE FOLLOWING HEALTH CONDITIONS SINCE YOUR LAST REGULAR VISIT HERE TO THE ATC STUDY. INCLUDE BOTH NEW EVENTS AND PAST CONDITIONS THAT YOU LEARNED ABOUT SINCE YOUR LAST VISIT HERE.

PLEASE WRITE THE NUMBER OR NUMBERS (SEPARATED BY COMMAS) INDICATING WHICH RELATIVE(S) HAD CONDITION.

WRITE '9' IF YOU DON'T KNOW OR DON'T UNDERSTAND
WRITE '0' IF NO BLOOD RELATIVE DEVELOPED THIS CONDITION (OR YOU DID NOT LEARN ABOUT THE CONDITION) DURING THIS TIME PERIOD.

IN ALL OTHER CASES, USE THE NUMBERS LISTED BELOW:

0. NO RELATIVE HAD THIS CONDITION
1. FATHER
2. MOTHER
3. GRANDPARENT(S), UNCLE(S), OR AUNT(S) IF BLOOD RELATIVE
5. BROTHER(S) OR SISTER(S)
7. SON(S) OR DAUGHTER(S)
9. DON'T KNOW

- 101 HEART ATTACK OR ANGINA? _____
- 102 STROKE? _____
- 103 HIGH BLOOD PRESSURE? _____
- 104 ASTHMA, HAYFEVER, HIVES, OR ECZEMA? _____
- 105 DIABETES (SUGAR DISEASE)? _____
- 106 NERVOUS DISORDER? _____
- 107 LIVER DISEASE (JAUNDICE)? _____
- 108 ANEMIA OR BLEEDING DISEASE? _____
- 109 KIDNEY DISEASE? _____
- 110 CANCER OR LEUKEMIA? _____
- 111 SUICIDE? _____
- 112 PEPTIC ULCER? _____
- 113 EMPHYSEMA OR OTHER CHRONIC LUNG DISEASE? _____

FOR THE FOLLOWING QUESTIONS, YOU ARE TO MAKE A CHOICE AMONG POSSIBLE ANSWERS OR CONDITIONS.

CIRCLE THE NUMBER CORRESPONDING TO YOUR ANSWER CHOICE:

119 IN WHICH CATEGORY OF "SMOKING HISTORY" DO YOU FIT?

0. I CURRENTLY SMOKE
1. I NEVER SMOKE ON A REGULAR BASIS
2. I HAVE STOPPED SMOKING SINCE MY LAST VISIT (PHYSICAL EXAM) HERE.
3. I STOPPED SMOKING BEFORE MY LAST VISIT HERE.

IF '1, 2 OR 3' SKIP TO QUESTION 130.
IF '0' GO TO QUESTION 125

125 A) PLEASE INDICATE HOW MUCH TOBACCO OF EACH KIND LISTED BELOW YOU USE EACH DAY. MAKE ONE ANSWER FOR EACH KIND OF TOBACCO.

CIGARETTES/DAY

1. NONE
2. UP TO 1/2 PACKS

II. B. 2 -

3. MORE THAN 1/2, UP TO 1 PACK
4. MORE THAN 1, UP TO 2 PACKS
5. MORE THAN 2, UP TO 3 PACKS
6. MORE THAN 3 PACKS

B) CIGARS/DAY

7. NONE
8. 1 TO 3
9. 4 TO 5
10. MORE THAN 5

C) PIPES/DAY

11. NONE
12. 1 TO 3
13. 4 TO 5
14. MORE THAN 5

130 A) HOW OFTEN DO YOU EAT BREAKFAST (I.E., MORE THAN A BEVERAGE) AFTER ARISING FROM YOUR MAIN SLEEPING PERIOD, IRRESPECTIVE OF CLOCK TIME?

1. ALMOST EVERY DAY
2. ABOUT HALF THE TIME
3. RARELY OR NEVER

B) ABOUT HOW MANY 'REGULAR MEALS' DO YOU EAT IN AN AVERAGE WEEK? (INCLUDE 'BROWN BAG' LUNCHES)

4. 14 OR LESS
5. 15 TO 19
6. 20 OR 21
7. MORE THAN 21

C) IN ADDITION TO REGULAR MEALS, HOW OFTEN DO YOU EAT BETWEEN MEALS? (INCLUDE ALL SNACKS AT WORK, BUT DON'T COUNT TIMES WHEN YOU HAVE ONLY BEVERAGES)

8. RARELY
9. ABOUT 3 TIMES A WEEK
10. ALMOST EVERY DAY
11. MORE THAN ONCE A DAY

ON THE AVERAGE WORKING DAY, HOW MUCH OF EACH OF THE FOLLOWING DO YOU DRINK? (INCLUDE THE FULL DAY, HOME AND ELSEWHERE - WRITE IN NUMBERS PLEASE)

A) CUPS OF COFFEE CUPS _____

B) BOTTLES OR CANS (12 OZ.) OF COLA DRINKS _____

C) GLASSES OR CARTONS (1/2 PINT) OF MILK AND DAIRY DRINKS _____

IN THE AVERAGE 24 HR. DAY, HOW MANY HOURS OF SLEEP DO YOU GET? PLEASE WRITE THE AVERAGE NUMBER TO THE NEAREST HOUR, FOR EACH SHIFT LISTED BELOW. IF YOU NEVER WORK A CERTAIN SHIFT, WRITE IN '0'.

A) HOW MUCH DO YOU SLEEP WHEN YOU ARE ON DAY SHIFT (7-3)?

B) HOW MUCH DO YOU SLEEP WHEN YOU ARE ON AFTERNOON SHIFT (3-11)?

C) HOW MUCH DO YOU SLEEP WHEN YOU ARE ON NIGHT (11-7)?

16C. PLEASE INDICATE HOW OFTEN (ON THE AVERAGE) YOU HAVE TAKEN EACH OF THE FOLLOWING PREPARATIONS OR MEDICINES SINCE YOUR LAST VISIT HERE. USE THIS CODE TO MAKE AN ANSWER TO EACH LINE:

- 0. NOT AT ALL
- 1. ONCE A MONTH OR LESS
- 2. A FEW TIMES A MONTH
- 3. WEEKLY OR MORE OFTEN
- 4. DAILY OR MORE OFTEN

- A) VITAMINS _____
- B) ANTACIDS (SUCH AS TUMS, MAALOX, AMPHOJEL) _____
- C) HEADACHE AND PAIN RELIEVERS (SUCH AS ASPIRIN, BUFFERIN, APC, EXCEDRIN) _____
- D) ENERGIZERS (TO KEEP YOU AWAKE OR ACTIVE, SUCH AS NO-DOZ) _____
- E) TRANQUILLIZERS _____
- F) SLEEPING PILLS _____
- G) OTHER NON-PRESCRIPTION PREPARATIONS (PILLS, CAPSULES, LIQUIDS) _____
- H) OTHER PRESCRIPTION MEDICINES _____

**** THROUGHOUT THIS INTERVIEW THE TERM "RECENTLY" APPLIES TO THE PERIOD OF TIME SINCE YOUR LAST REGULAR VISIT HERE TO THE ATC STUDY ****

206. INDICATE WHICH OF THE FOLLOWING APPLY (APPLIES) TO YOU:

- 3) YOU ARE ON WEIGHT REDUCING DIET
- 4) YOU ARE ON ANOTHER SPECIAL DIET
- 5) NONE OF THE ABOVE

07. INDICATE WHETHER YOU HAVE HAD ANY OF THE FOLLOWING RECENTLY (I.E., SINCE YOUR LAST VISIT HERE):

- 1) DOUBLE VISION
- 2) BLURRING EYESIGHT WHICH LASTED MORE THAN A FEW MINUTES
- 3) PAIN IN EITHER OR BOTH OF YOUR EYES
- 4) TEMPORARY BLINDNESS IN EITHER EYE
- 5) HALOES AROUND LIGHTS
- 6) TEMPORARY LOSS OF VISION
- 7) NONE OF THE ABOVE

8. INDICATE WHICH OF THE FOLLOWING APPLY (APPLIES) TO YOU:

- 1) YOUR TEETH (OR DENTURES) ARE CAUSING YOU SIGNIFICANT TROUBLE, OR THEY ARE IN POOR CONDITION
- 2) YOUR HEARING HAS DETERIORATED RECENTLY
- 3) YOUR VOICE HAS CHANGED (BECOME ROUGH, SCRATCHY OR HOARSE) RECENTLY OTHER THAN WHEN YOU HAD A COLD OR A MINOR THROAT INFECTION
- 4) NONE OF THE ABOVE

CIRCLE ALL OF THE FOLLOWING THAT APPLY TO YOU:

- 1) YOU USUALLY HAVE A COUGH
- 2) YOU BRING UP MATERIAL (SUCH AS SPUTUM, PHLEGM OR MUCUS) WHEN COUGHING
- 3) YOU SOMETIMES COUGH UP BLOOD
- 4) NONE OF THE ABOVE

210. PLEASE INDICATE WHICH PHRASES DESCRIBE YOUR CURRENT SITUATION (CIRCLE ALL THAT APPLY):

- 1) YOU DO NOT HAVE SHORTNESS OF BREATH
- 2) YOU GET SHORTNESS OF BREATH WHEN WALKING ON LEVEL GROUND
- 3) YOU GET SHORTNESS OF BREATH WHEN CLIMBING A SINGLE FLIGHT OF STAIRS
- 4) YOU GET SHORTNESS OF BREATH WHEN SHOVELING SNOW
- 5) YOU GET SHORTNESS OF BREATH WHICH CAUSES YOU TO WAKE FROM SLEEPING
- 6) YOU GET SHORTNESS OF BREATH WHEN LYING QUIETLY
* * * * *
- 7) YOU GET PERIODS OF WHEEZING OR WHISTLING IN YOUR CHEST

212. INDICATE WHETHER YOU HAD ANY OF THE FOLLOWING CONDITIONS SINCE YOUR LAST VISIT (CIRCLE ALL THAT APPLY):

- 1) FREQUENT NIGHT SWEATS THAT DRENCH YOUR BED CLOTHES
- 2) HAY FEVER OR FREQUENT SNEEZING SPELLS
- 3) PNEUMONIA
- 4) FREQUENT BRONCHITIS
- 5) PLEURISY (PAIN IN THE CHEST WHEN BREATHING)
- 6) BRONCHIAL ASTHMA
- 7) EMPHYSEMA
- 8) YOU HAVE BEEN TOLD THAT YOUR CHEST X-RAY WAS ABNORMAL
- 9) NONE OF THE ABOVE

213. INDICATE WHETHER YOU HAVE HAD ANY OF THE FOLLOWING RECENTLY:

- 1) TUBERCULOSIS
- 2) CLOSE CONTACT WITH PEOPLE WHO HAVE HAD TUBERCULOSIS (INCLUDING ANYONE IN YOUR FAMILY)
- 3) A POSITIVE TUBERCULOSIS SKIN TEST
- 4) NONE OF THE ABOVE

214. YOU GET PAIN, DISCOMFORT, TIGHTNESS OR PRESSURE IN YOUR CHEST

- 0) NO
- 1) YES

IF NO SKIP TO QUESTION 220

215. INDICATE WHICH PHRASES DESCRIBE YOUR PAIN OR DISCOMFORT (CIRCLE ALL THAT APPLY):

- 1) OCCURS EVERY DAY
- 2) OCCURS MORE THAN ONCE A WEEK
- 3) OCCURS EVERY 2 OR 3 WEEKS
- 4) OCCURS ONCE A MONTH
* * * * *
- 5) IS LOCATED ON BOTH SIDES
- 6) IS LOCATED ON THE LEFT SIDE ONLY
- 7) IS LOCATED ON THE RIGHT SIDE ONLY
- 8) IS LOCATED ON THE MIDDLE OF THE CHEST, UNDER THE BRESTBONE
* * * * *
- 9) NONE OF THE ABOVE

216. INDICATE WHICH PHRASES DESCRIBE YOUR PAIN OR DISCOMFORT
(CIRCLE ALL THAT APPLY IN EACH SECTION)

- 1) IS MADE WORSE BY BREATHING DEEPLY
- 2) IS MADE WORSE BY SWALLOWING

- 3) COMES ON AFTER YOU EAT A LARGE MEAL
- 4) COMES ON AFTER YOU BECOME ANGRY OR EXCITED
- 5) COMES ON AFTER YOU DO STRENUOUS WORK OR WALK RAPIDLY
- 6) COMES ON AFTER YOU TURN FROM SIDE TO SIDE, LEAN FORWARD OR LIE DOWN

- 7) IS USUALLY SO PAINFUL THAT YOU ARE IN GREAT DISTRESS

- 8) NONE OF THE ABOVE

217. INDICATE WHICH PHRASES DESCRIBE FACTORS THAT RELIEVE YOUR CHEST PAIN
OR DISCOMFORT (CIRCLE ALL THAT APPLY IN EACH SECTION)

- 1) RESTING RELIEVES IT IMMEDIATELY
- 2) RESTING RELIEVES IT IN LESS THAN 5 MINUTES
- 3) RESTING RELIEVES IT IN 5-15 MINUTES
- 4) RESTING RELIEVES IT IN MORE THAN 15 MINUTES
- 5) RESTING DOES NOT RELIEVE THE PAIN

- 6) NITROGLYCERIN RELIEVES IT
- 7) NITROGLYCERIN DOES NOT RELIEVE THE PAIN
- 8) I DO NOT TAKE NITROGLYCERIN

- 9) ANTACIDS RELIEVE IT

220. INDICATE WHETHER ANY OF THE FOLLOWING APPLY (APPLIES) TO YOU:

- 1) YOU GET POUNDING, SKIPPING, THUMPING OR RACING OF YOUR HEART
(PALPITATIONS AND/OR FLUTTERING) WHILE YOU ARE AT REST
- 2) YOU FIND IT NECESSARY TO SLEEP PROPPED UP (WITH EXTRA PILLOWS
OR IN A CHAIR) TO HELP YOU BREATHE EASILY
- 7) NONE OF THE ABOVE

23. INDICATE WHICH OF THE FOLLOWING APPLY (APPLIES) TO YOU IN EACH SECTION
(CIRCLE ALL THAT APPLY IN EACH SECTION)

- 1) YOU GET SWELLING OF YOUR FEET OR ANKLES THAT DOES NOT
DISAPPEAR OVERNIGHT
- 2) YOU GET PAINS CONSISTENTLY IN YOUR CALVES OR LOWER LEGS WHEN
YOU WALK ANY DISTANCE
- 3) THE PAINS IN YOUR CALVES OR LOWER LEGS MAKE YOU STOP WALKING
- 4) THE PAINS IN YOUR CALVES OR LOWER LEGS GO AWAY AFTER A SHORT
REST (5-10 MINUTES)

- 5) YOU HAVE BULGING (VARICOSE) VEINS IN YOUR LEGS
- 6) YOUR FINGERS ARE EXCESSIVELY SENSITIVE TO COLD SO THAT THEY BECOME
VERY PAINFUL, COMPLETELY WHITE OR DARK BLUE, WHEN ONLY SLIGHTLY COLD
- 7) YOU HAD SKIN ULCERS ON YOUR ANKLES THAT TOOK MANY MONTHS TO HEAL

- 8) NONE OF THE ABOVE

226. SINCE YOUR LAST VISIT HAVE YOU TAKEN MEDICINE:

- 1) FOR YOUR HEART
- 2) FOR HIGH BLOOD PRESSURE
- 3) TO HELP THIN YOUR BLOOD
- 4) FOR THE PURPOSE OF LOSING WATER
- 5) NEVER FOR THE ABOVE REASONS

227. INDICATE WHETHER A DOCTOR HAS RECENTLY TOLD YOU THAT YOU HAD:

- 1) HEART MURMUR
- 2) ENLARGED HEART
- 3) HIGH BLOOD PRESSURE
- 4) A HEART ATTACK
- 5) RHEUMATIC FEVER
- 6) ANGINA OR ANGINA PECTORIS
- 7) PHLEBITIS, OR THROMBOPHLEBITIS OR "MILK LEG"
- 8) TROUBLE WITH YOUR CIRCULATION
- 9) NONE OF THE ABOVE

228. INDICATE WHETHER YOU HAVE HAD ANY OF THE FOLLOWING RECENTLY:

- 1) A PERSISTENT SORE TONGUE
- 2) BLEEDING GUMS THAT HAVE BEEN VERY TROUBLESOME
- 3) A CHOKING FEELING OR A LUMP IN THE THROAT WHEN NOT EATING
- 4) TROUBLE SWALLOWING FOOD OR LIQUIDS
- 5) FOOD OR LIQUIDS STICKING IN YOUR THROAT WHILE SWALLOWING
- 6) NONE OF THE ABOVE

229. YOU GET AN UPSET STOMACH OR ABDOMINAL DISTRESS MORE THAN ONCE A WEEK

- 0) NO
- 1) YES

IF NO SKIP TO QUESTION 332

230. INDICATE WHICH PHRASES DESCRIBE YOUR ABDOMINAL PAINS (CIRCLE ALL THAT APPLY IN EACH SECTION)

- 1) OCCUR EVERY DAY
- 2) OCCUR EVERY FEW DAYS
- 3) OCCUR EVERY WEEK OR TWO
- 4) OCCUR OCCASIONALLY

- 5) ARE LOCATED ABOVE THE NAVEL
- 6) ARE LOCATED BELOW THE NAVEL
- 7) ARE LOCATED ON THE RIGHT SIDE
- 8) ARE LOCATED ON THE LEFT SIDE
- 9) ARE LOCATED THROUGHOUT THE STOMACH

- 10) THEY FEEL DULL
- 11) THEY FEEL SHARP
- 12) THEY FEEL CRAMPY
- 13) THEY GIVE OTHER KIND OF FEELING

- 14) DO NOT HAVE PAIN

231. INDICATE WHICH PHRASES DESCRIBE YOUR ABDOMINAL PAINS OR DISTRESS (CIRCLE ALL THAT APPLY IN EACH SECTION)

- 1) THEY COME ON AT THE TIME OF, OR DIRECTLY AFTER, EATING A MEAL
- 2) THEY COME ON ONE OR 2 HOURS AFTER EATING
- 3) THEY COME ON AT NO PARTICULAR TIME
- 4) THEY KEEP YOU FROM GOING TO SLEEP
- 5) THEY AWAKE YOU FROM SLEEP
- 6) THEY COME ON AFTER EATING FRIED OR FATTY FOOD

- 7) THEY ARE RELIEVED BY TAKING MILK, SODA, TUMS OR MAALOX (ANTACIDS)
- 8) THEY ARE RELIEVED BY EATING
- 9) THEY ARE RELIEVED BY BOWEL MOVEMENT

- 10) NONE OF THE ABOVE

332. INDICATE WHETHER ANY OF THE FOLLOWING APPLY (APPLIES) TO YOU:

- 1) YOU HAVE ATTACKS OF NAUSEA OR VOMITING MORE THAN ONCE A MONTH
- 2) YOU HAVE VOMITED BLOOD OR MATERIAL THAT LOOKED LIKE COFFEE GROUNDS
- 3) YOUR SKIN OR EYES HAVE BEEN YELLOW OR YOU HAVE BEEN TOLD BY A DOCTOR THAT YOU HAD JAUNDICE OR HEPATITIS
- 4) NONE OF THE ABOVE

333. PLEASE INDICATE WHICH OF THE FOLLOWING YOU HAVE MORE THAN ONCE A MONTH:

- 1) CONSTIPATION
- 2) DIARRHEA
- 3) RECTAL PAIN
- 4) STRAINING ON EXPELLING BOWEL MOVEMENT
- 5) ANY OTHER ABNORMALITY WITH YOUR BOWEL MOVEMENT
- 6) NONE OF THE ABOVE

334. INDICATE WHETHER ANY OF THE FOLLOWING HAVE BEEN TRUE FOR YOU RECENTLY:

- 1) YOU USE A LAXATIVE FREQUENTLY
- 2) YOU HAVE HAD BOWEL MOVEMENTS THAT WERE AS BLACK AS COAL OR TAR
- 3) YOU WERE TAKING IRON OR VITAMINS AT THE TIME OF THE BLACK BOWEL MOVEMENTS
- 4) YOU WERE NOT TAKING IRON OR VITAMINS AT THE TIME OF THE BLACK BOWEL MOVEMENTS
- 5) YOU HAVE HAD BLOOD IN YOUR BOWEL MOVEMENTS
- 6) NONE OF THE ABOVE

337. INDICATE WHETHER A DOCTOR HAS RECENTLY TOLD YOU THAT YOU HAD:

- 1) AN ULCER (STOMACH OR DUODENAL)
- 2) GALLSTONES OR GALL BLADDER DISEASE
- 3) CIRRHOSIS, HEPATITIS OR SOME OTHER LIVER DISEASE
- 4) INFLAMED STOMACH (GASTRITIS)
- 5) NERVOUS STOMACH
- 6) PANCREATITIS
- 7) INTESTINAL DISEASE (INCLUDING COLITIS, ENTERITIS, OR ILEITIS)
- 8) HEMORRHOIDS OR PILES
- 9) WORMS OR PARASITES
- 10) DYSENTERY OR SERIOUS DIARRHEA
- 11) NONE OF THE ABOVE

440. INDICATE WHETHER YOU RECENTLY HAD ANY OF THE FOLLOWING X-RAYS:

- 1) STOMACH
- 2) GALLBLADDER
- 3) INTESTINES (UPPER GASTROINTESTINAL SERIES, BARIUM ENEMA)
- 4) NONE OF THE ABOVE

443. INDICATE WHICH OF THE FOLLOWING APPLY TO YOU RECENTLY:

- 1) YOU BROKE A BONE
- 2) YOUR JOINTS ARE STIFF WHEN YOU WAKE UP
- 3) THE DOCTOR TOLD YOU THAT YOU HAVE "ARTHRITIS"
- 4) NONE OF THE ABOVE

444. DO YOU GET SEVERE BACK PAINS?

- 0) NO
- 1) YES

IF NO SKIP TO QUESTION 448

445. HOW OFTEN DO YOU GET THESE BACK PAINS?

- 1) FREQUENTLY (EVERY DAY)
- 2) OCCASIONALLY (SOME TIME EACH WEEK)
- 3) AFTER DOING HEAVY WORK
- 4) RARELY

446. DO THESE PAINS USUALLY START IN YOUR LOWER SPINE AND PASS DOWN THE BACK OF EITHER OR BOTH LEGS?

- 0) NO
- 1) YES

448. INDICATE WHETHER ANY OF THE FOLLOWING APPLY (APPLIES) TO YOU:

- 1) THE DOCTOR TOLD YOU THAT YOU HAD A GOUT
- 2) YOU RECENTLY HAD AN OPERATION ON YOUR BONES OR JOINTS
- 3) YOU RECENTLY HAD RED, TENDER OR SWOLLEN JOINTS
- 4) NONE OF THE ABOVE

449. DO YOU GET PAINS IN YOUR BONES OR JOINTS?

- 0) NO
- 1) YES

IF NO SKIP TO QUESTION 548

450. INDICATE WHICH PHRASES DESCRIBE YOUR PAINS (CIRCLE ALL THAT APPLY)

- 1) THEY ARE OFTEN SO SEVERE THAT THEY PREVENT YOU FROM MOVING SATISFACTORILY YOUR ARM OR LEG
- 2) THEY INVOLVE MANY JOINTS

- 3) WALKING INCREASES THE PAINS
- 4) WALKING RELIEVES THE PAINS
- 5) ASPIRIN, BUFFERIN, ANACIN OR OTHER MILD MEDICATION RELIEVE THE PAIN

- 6) NONE OF THE ABOVE

548. INDICATE WHETHER YOU RECENTLY HAVE HAD

- 1) BURNING OR PAIN ON URINATION
- 2) DIFFICULTY IN STARTING OR STOPPING URINATION
- 3) UNEXPECTED LOSS OF URINE WHEN YOU COUGH, SNEEZE, LAUGH, ETC.
- 4) BLOOD IN YOUR URINE
- 5) DARK URINE
- 6) PUS IN YOUR URINE
- 7) NONE OF THE ABOVE

549. DO YOU USUALLY GET UP AT NIGHT TO URINATE?

- 0) NO
- 1) YES

IF NO SKIP TO QUESTION 551

550. INDICATE WHICH PHRASES DESCRIBE YOUR PROBLEM (LIST ALL THAT APPLY):

- 1) YOU USUALLY GET UP ONCE PER NIGHT
- 2) YOU USUALLY GET UP 2 OR MORE TIMES PER NIGHT

- 3) YOU HAVE BEEN GETTING UP FOR LESS THAN 6 MONTHS
- 4) YOU HAVE BEEN GETTING UP FOR ABOUT 6 MONTHS TO 1 YEAR
- 5) YOU HAVE BEEN GETTING UP FOR MORE THAN 1 YEAR

- 6) NONE OF THE ABOVE

551. INDICATE WHETHER A DOCTOR RECENTLY TOLD YOU THAT YOU HAD:

- 1) PROSTATE TROUBLE
- 2) KIDNEY OR BLADDER INFECTION THAT WAS VERY DIFFICULT TO CLEAR UP OR WHICH RECURRED FREQUENTLY
- 3) KIDNEY OR BLADDER STONES (GRAVEL)
- 4) VENEREAL DISEASE ("VD")
- 5) HERNIA
- 6) PROTEIN (ALBUMIN) IN THE URINE
- 7) NONE OF THE ABOVE

553. INDICATE WHETHER ANY OF THE FOLLOWING HAVE HAPPENED TO YOU RECENTLY:

- 1) YOU HAD A BLADDER OR A KIDNEY OPERATION
- 2) YOU HAD A KIDNEY X-RAY (INTRAVENOUS PYELOGRAM)
- 3) SOMETIMES YOU FEEL THAT YOU HAVE TO URINATE BUT FIND THAT YOU CANNOT PASS ANY URINE
- 4) YOUR URINE OFTEN COMES OUT IN DRIBBLES, RATHER THAN IN A STRONG STREAM
- 5) NONE OF THE ABOVE

INDICATE WHICH OF THE FOLLOWING APPLY (APPLIES TO YOU):

- 1) YOU HAVE BEEN TOLD THAT YOU WERE ANEMIC
- 2) YOU HAVE BEEN TAKING IRON OR OTHER MEDICATION FOR ANEMIA

- 3) YOU OFTEN GET MANY BLACK OR BLUE SPOTS WITHOUT APPARENT REASON
- 4) YOU BLEED FOR VERY LONG TIME WITHOUT STOPPING WHEN YOU INJURE YOURSELF OR WHEN YOU HAVE SURGERY OR TOOTH EXTRACTION

- 5) NONE OF THE ABOVE

555. SINCE YOUR LAST VISIT HERE, HAVE YOU EXPERIENCED ENLARGED GLANDS OR LYMPH NODES:

- 1) IN YOUR NECK?
- 2) IN YOUR ARMPIT?
- 3) IN YOUR GROIN?
- 4) ELSEWHERE IN YOUR BODY?
- 5) NOT AT ALL

556. HAVE ANY OF THE FOLLOWING HAPPENED RECENTLY?:

- 1) YOU RECEIVED A BLOOD TRANSFUSION
- 2) YOU HAD A RASH OR OTHER REACTION TO THE BLOOD TRANSFUSION
- 3) YOU HAD VITAMIN B-12 INJECTIONS
- 4) NONE OF THE ABOVE

557. INDICATE ALL THE PHRASES THAT APPLY TO YOU:

- 1) YOUR SKIN HAS RECENTLY BECOME DARKER (OTHER THAN SUNTAN)
- 2) YOUR SKIN HAS RECENTLY BECOME LIGHTER OR MORE PALE
- 3) YOUR SKIN HAS RECENTLY BECOME YELLOW
- 4) YOUR SKIN HAS SHOWN SOME OTHER TYPE OF CHANGE IN COLOR
- 5) THE TEXTURE OF YOUR SKIN HAS CHANGED
- 6) NO CHANGE AT ALL

666. INDICATE WHETHER OR NOT YOUR DOCTOR HAS RECENTLY TOLD YOU THAT YOU HAD:

- 1) DIABETES (SUGAR DISEASE)
- 2) OVERACTIVE THYROID
- 3) LOW METABOLISM OR UNDERACTIVE THYROID
- 4) GOITER (ENLARGED THYROID)
- 5) HIGH CHOLESTEROL
- 6) NONE OF THE ABOVE

668. INDICATE WHETHER ANY OF THE FOLLOWING HAS HAPPENED SINCE YOUR LAST VISIT HERE

- 1) YOU HAVE EXPERIENCED EXTREME DISCOMFORT IN HOT WEATHER
- 2) YOU HAVE EXPERIENCED EXTREME DISCOMFORT IN COLD WEATHER
- 3) YOU HAVE NOTICED THAT YOUR EYES BULGED FORWARD
- 4) YOU HAVE BEGUN TO DRINK MUCH MORE WATER OR LIQUIDS THAN YOU USED TO
- 5) YOUR HANDS SOMETIMES TREMBLE OR SHAKE
- 6) YOU HAVE HAD SUGAR IN YOUR URINE
- 7) NONE OF THE ABOVE

669. PLEASE INDICATE WHETHER ANY OF THE FOLLOWING OCCURRED TO YOU RECENTLY:

- 1) ANNOYING SKIN RASHES WHICH LASTED FOR ONE MONTH OR LONGER
- 2) FREQUENT SKIN INFECTIONS OR BOILS
- 3) HIVES, WELTS OR SWELLING OF YOUR SKIN
- 4) A STUFFY NOSE, RASH, HIVES, ECZEMA, OR THROAT SWELLING THAT OCCURS ONLY AT CERTAIN SEASONS OF THE YEAR
- 5) NONE OF THE ABOVE

72. INDICATE WHETHER YOU HAVE RECENTLY NOTICED:

- 1) NEW GROWTHS ON YOUR SKIN
- 2) MOLES WHICH BECAME DARKER OR LARGER
- 3) SORES THAT WILL NOT HEAL
- 4) NOTHING AT ALL

73. ARE YOU ALLERGIC TO OR HAVE YOU RECENTLY DEVELOPED A RASH, ECZEMA, WHEEZING OR NASAL BLOCKADE FROM ANY OF THE FOLLOWING:

- 1) DETERGENTS, SOAPS, SHAMPOOS, OR TOILETRIES
- 2) SEAFOODS, SPICES OR OTHER FOODS (CAUSING SKIN RASHES)
- 3) PENICILLIN
- 4) PHENOBARBITAL OR BARBITURATES
- 5) CODEINE, MORPHINE, OR DEMEROL
- 6) ASPIRIN, EMPIRIN, OR BUFFERIN
- 7) UNKNOWN STIMULUS
- 8) NO SUCH ALLERGIC REACTION

HAVE YOU RECENTLY WORKED NEAR OR OFTEN BEEN AROUND ANY OF THE FOLLOWING:

- 1) CHEMICALS, CLEANING FLUIDS OR SOLVENTS
- 2) INSECT OR PLANT SPRAYS
- 3) AMMONIA, CHLORINE, OZONE OR NITROUS GASES
- 4) PLASTIC OR RESIN FUMES
- 5) LEAD OR METAL FUMES
- 6) X-RAYS, RADIOACTIVITY OR ULTRAVIOLET RADIATION
- 7) BERYLLIUM, ASBESTOS OR POLYURETHANES
- 8) NONE OF THE ABOVE

SINCE YOUR LAST VISIT HERE, HAVE YOU HAD VERY BAD HEADACHES MORE THAN ONCE A WEEK?

- 0) NO
- 1) YES

IF NO SKIP TO QUESTION 679

INDICATE WHETHER ANY OF THE FOLLOWING APPLY (APPLIES) TO YOU:

- 1) YOU FEEL THESE HEADACHES HAVE BEEN GETTING WORSE
- 2) YOU HAVE BEEN TOLD THAT YOU HAVE MIGRAINE HEADACHES
- 3) YOU RELATE THE HEADACHES TO TENSION
- 4) THE HEADACHES ARE RELIEVED BY: ASPIRIN, BUFFERIN, ANACIN, EXCEDRIN, DARVON, OR OTHER MILD HEADACHE REMEDIES
- 5) NONE OF THE ABOVE

DO YOU OFTEN HAVE DIZZY SPELLS THAT INTERFERE WITH YOUR WORK IN OUR NORMAL DAY'S ACTIVITY?

- NO
- YES

NO SKIP TO QUESTION 685

680. INDICATE WHETHER ANY OF THE FOLLOWING ARE ASSOCIATED WITH YOUR DIZZY SPELLS:

- 1) LIGHTEADEDNESS
- 2) WHIRLING OR SPINNING SENSATIONS
- 3) OBJECTS ROTATING OR MOVING ABOUT
- 4) DEAFNESS
- 5) RINGING IN YOUR EARS, OR NOISES
- 6) NAUSEA OR VOMITING
- 7) STAGGERING OR DIFFICULTY WALKING
- 8) NONE OF THE ABOVE

691. INDICATE ALL THE PHRASES THAT APPLY TO YOU:

- 1) THE DIZZINESS IS BROUGHT ON BY MOVING YOUR HEAD
- 2) THE DIZZINESS IS BROUGHT ON BY CHANGING POSITION, FOR EXAMPLE STANDING UP

- 3) THE ATTACKS LAST A COUPLE OF MINUTES OR LESS
- 4) THE ATTACKS LAST AN HOUR
- 5) THE ATTACKS LAST A COUPLE OF HOURS OR MORE

- 6) YOU HAD SOMETIMES FALLEN DOWN OR TO THE SIDE BECAUSE OF THE DIZZINESS
- 7) THE DIZZY SPELLS ARE MADE WORSE BY MOVING YOUR HEAD
- 8) YOU HAD SOMETIMES EPISODES OF NUMBNESS OR UNUSUAL SENSATIONS (BURNING, TINGLING, ETC.) SOMEWHERE IN YOUR BODY

- 9) NONE OF THE ABOVE

HAVE YOU EVER HAD ANY TEETH EXTRACTIONS

- 0) NO
- 1) YES

INDICATE WHETHER YOU HAVE RECENTLY HAD AN OPERATION ON YOUR:

- 1) STOMACH
- 2) GALLBLADDER
- 3) APPENDIX
- 4) COLON (BOWEL)
- 5) ANUS/RECTUM
- 6) OTHER PARTS OF YOUR ABDOMEN
- 7) NONE OF THE ABOVE

INDICATE WHETHER YOU RECENTLY HAD AN OPERATION ON YOUR:

- 1) TONSILS/ADENOIDS
- 2) NECK, HEAD, OR FACE
- 3) ARMS OR LEGS
- 4) REPRODUCTIVE SYSTEM INCLUDING VASECTOMY
- 5) OTHER PARTS OF THE BODY NOT ALREADY MENTIONED
- 6) NONE OF THE ABOVE

SINCE YOUR LAST VISIT HAVE YOU BEEN HOSPITALIZED FOR ANY REASON?

- 0) NO
- 1) YES

II. C-1

BUMC-ATC HEALTH CHANGE STUDY
MONTHLY HEALTH REVIEW

NAME _____ OPEN ID # _____

SUMMARY OF INSTRUCTIONS
=====

- A. Check in ILLNESS EPISODES COLUMN
 - 1. All symptoms that occurred together as a single illness.
(see definitions over)
 - 2. If more than one illness episode, check symptoms in
2nd & 3rd columns provided.
- B. Check in ISOLATED EVENTS COLUMN if symptom occurred by itself
infrequently -- and was not just a part of an illness episode.
- C. Check in CONTINUING PROBLEMS COLUMN if symptom occurred at least
half the days this month -- and was not just part of an illness episode.
- D. Check in NOT THIS MONTH COLUMN if symptom didn't occur.

FOR DETAILED INSTRUCTIONS SEE OTHER SIDE OF THIS PAGE.

PLEASE DO NOT DETACH THIS SHEET. WE WILL DESTROY UPON RECEIPT.

II. C-2

This form of the Monthly Health Review has two parts - the first for illness episodes and other symptoms and the second for injuries.

What is an "ILLNESS EPISODE"?

Most "illnesses" that people have are made up of a number of complaints or symptoms that occur in a cluster. For example, a "cold" may start with a sore throat and progress to a fever, cough, and runny nose. The throat may feel better before the nose begins running, but nevertheless we consider all four of these symptoms as the same illness episode. The illness episode is considered over when all the symptoms have been gone for at least a day or two (except for certain types of chronic, recurring conditions). Doctors use the particular combinations of symptoms as well as the length of the illness episode to help diagnose and classify diseases. Our new Monthly Health Review includes vertical columns for you to check off as many as three illness episodes.

In addition, people sometimes have isolated problems or complaints that occur on scattered occasions but are not part of a larger picture of disease. Examples are occasional headache or heartburn. If you have had any of these, check them in the "ISOLATED EVENTS" column.

Finally, those symptoms which are a chronic problem for you, though not occurring as a separate illness, and which were present during at least half the days of the month, check in the "CONTINUING PROBLEMS" column. The typical "cigarette cough" is this kind of symptom.

How to Complete the Review Accurately and Quickly

Before checking off anything:

- 1) Note the month entered at the top of the Form.
- 2) Look over the whole Form to see the health problems listed.
- 3) Recall as accurately as possible what health events have occurred to you in the specified month.

Then enter information:

- 4) Working vertically by columns, check off symptoms which happened in each "Illness Episode", then those that were "Isolated Events", and finally, "Continuing Problems".
- 5) If you have had no such symptom, check the column marked "Not This Month".
- 6) Note that, for each symptom, there should be a check mark in some column. Also, it is possible for a symptom to be checked in more than one column, if the symptom is part of more than one illness, or if it is a continuing problem that flares up as part of an acute "Illness Episode".
- 7) Be sure to answer questions about getting medical help and to enter numbers for days of disability resulting from each illness or injury.

If you have any questions, ask the ATC Medical Technician when he comes to your facility, or telephone us collect at 617-262-4022.

Thanks for your continuing interest and cooperation.

II. C-3

BUMC - ATC HEALTH CHANGE STUDY

HEALTH REVIEW FOR MONTH OF _____

LABEL: _____

ITEM NO	Please check all symptoms that occurred for each episode	Illness Episodes			Isolated Events	Continuing Problems	MOI (this Month)
		1	2	3			
1	Temperature of 100° or more						
2	Headache lasting more than 1 hour						
3	Skin rash or hives						
4	Painful, irritated, or burning eyes						
5	Earache or ear infection						
6	Throatache						
7	Sore throat						
8	Sneezing, stuffy or runny nose						
9	Dry cough (more than occasional)						
10	Coughing up substances other than saliva or thin phlegm						
11	Wheezing (from chest)						
12	Unusual shortness of breath						
13	Unplanned loss of weight						
14	Nausea and/or vomiting						
15	Stomach pain or abdominal cramps						
16	Heartburn						
17	Chest pain other than heartburn						
18	Rapid or pounding heartbeat						
19	Diarrhea						
20	Bloody or black stools						
21	Discomfort from hemorrhoids						
22	Urinary problems (unusual frequency, pain or discharge)						
23	Difficulty with sexual function						
24	Trouble getting to sleep or staying asleep						
25	Excess fatigue						
26	Neck pain or stiff neck						
27	Lower back pain spreading to leg						
28	Other pain anywhere in back						
29	Stiffness or swelling or soreness of joints in the absence of injury						
30	Aches or pains in muscles or joints other than back						

EVERYONE INSERT APPROPRIATE NUMBERS (e.g. 0,1,2,3,....) IN CORRESPONDING COLUMNS

	1	2	3	All Combined	All Combined	
31	ALTOGETHER HOW MANY DAYS DID THIS KEEP YOU FEELING BELOW "PAR"? (ENTER NUMBER)					
32	FOR HOW MANY OF THESE DAYS DID THIS CAUSE YOU TO CUT DOWN ON YOUR USUAL ACTIVITIES, INCLUDING TIME LOST FROM WORK? (ENTER NUMBER)					
33	DID YOU GET MEDICAL HELP (DOCTOR OR CLINIC) FOR THIS PROBLEM? (CIRCLE ANSWER)					
	yes	yes	yes	yes	yes	
	no	no	no	no	no	

(CONTINUE ON OTHER SIDE)

II. C-4

INJURIES: Please check all that occurred for each event.

	Injury Events			Not this Month
	1	2	3	
34 Major cuts, scrapes, or bruises				
35 Injuries to joints, such as sprains, strains, or wrenchings				
36 Broken bones or dislocations				
37 Burns (heat or chemical)				
38 Other injuries to head and face, such as concussion, injured eye, loss of teeth, etc.				

	INSERT APPROPRIATE NUMBER		
39 Altogether how many days did this keep you feeling below "par"? (enter number)			
40 For how many of these days did this cause you to rick down on your usual activation, including time lost from work? (enter number)			
41 Did you get medical help (doctor or clinic) for this problem? (CIRCLE ANSWER)	YES	YES	YES
	NO	NO	NO
42 HAVE YOU BEEN HOSPITALIZED DURING THIS MONTH (Circle Answer)	YES	NO	

43 During this month, have you had any illness or health problem NOT covered in this review form? (CIRCLE ANSWER)

YES NO

IF YES, what is it?

October 1976

ATC HEADACHE STUDY

Headaches are among the most common health complaints that Air Traffic Controllers report on their Monthly Health Review. In order to get a better understanding of the nature of these headaches, we will be enclosing these added items in several selected months.

A complete description of headaches helps doctors to classify them and to derive ideas regarding their causes. So would you please consider each item below and CHECK whether it Usually, Occasionally, or Never was true for the headaches you had THIS PAST MONTH.

Frequency

How many headaches did you have this last month:

- 1.) Total number of headaches _____ 1.
- 2.) How many lasted for more than one hour? _____ 2.
- 3.) How many were so severe they made you stop what you were doing? _____ 3.

(IF YOU ANSWERED "0" FOR "2" OR "3", YOU ARE FINISHED. PLEASE RETURN THIS PAGE WITH YOUR MONTHLY HEALTH REVIEW. IF YOU ANSWERED A POSITIVE NUMBER FOR "2" OR "3", CONTINUE.)

Please answer the questions for only those headaches which EITHER were so severe as to make you stop what you were doing, OR lasted more than one hour (or both).

Check how often EACH item below was true for your headaches this month. Please make a check for each numbered statement:

Just before the headache:

- | | <u>Usually</u> | <u>Occasionally</u> | <u>Never</u> | |
|--|----------------|---------------------|--------------|----|
| 4. Muscles of head or neck are tight | _____ | _____ | _____ | 4. |
| 5. Eyes become overly sensitive to light | _____ | _____ | _____ | 5. |
| 6. Vision blurs or flickers | _____ | _____ | _____ | 6. |
| 7. Other: (write in): _____ | _____ | _____ | _____ | 7. |
| 8. No symptoms precede the actual headache | _____ | _____ | _____ | 8. |

Starting location:

- | | | | | |
|--|-------|-------|-------|-----|
| 9. Forehead | _____ | _____ | _____ | 9. |
| 10. Around or behind the eyes | _____ | _____ | _____ | 10. |
| 11. Back of head or neck | _____ | _____ | _____ | 11. |
| 12. All over the head | _____ | _____ | _____ | 12. |
| 13. Either side of head (not both sides) | _____ | _____ | _____ | 13. |

Usual time of occurrence:

- | | | | | |
|--|-------|-------|-------|-----|
| 14. During periods of intense concentration | _____ | _____ | _____ | 14. |
| 15. During or after worry or emotional tension | _____ | _____ | _____ | 15. |
| 16. During the "let down" after a period of work | _____ | _____ | _____ | 16. |
| 17. During rest or relaxation | _____ | _____ | _____ | 17. |
| 18. Starts during sleep and wakes me up | _____ | _____ | _____ | 18. |
| 19. Usually only after eating or drinking too much | _____ | _____ | _____ | 19. |
| 20. Other (write in): _____ | _____ | _____ | _____ | 20. |

ATC HEADACHE STUDY

II. D-2

Page 2

<u>Type of Pain</u>	<u>Usually</u>	<u>Occasionally</u>	<u>Never</u>
21. Steady pressure	_____	_____	_____ 21.
22. Dull steady ache or pain	_____	_____	_____ 22.
23. Tight band of "head in a vise"	_____	_____	_____ 23.
24. Throbbing or pounding	_____	_____	_____ 24.
25. Other (write in): _____	_____	_____	_____ 25.
<u>During the Headache</u>			
26. Nausea or vomiting	_____	_____	_____ 26.
27. "Buzzing" in the ears	_____	_____	_____ 27.
28. Feeling faint	_____	_____	_____ 28.
29. Redness or watering of one eye	_____	_____	_____ 29.
30. Bright light makes it worse	_____	_____	_____ 30.
<u>Duration of Headache</u>			
31. Less than 1 hour	_____	_____	_____ 31.
32. 1 to 3 hours	_____	_____	_____ 32.
33. 4 to 8 hours	_____	_____	_____ 33.
34. 9 to 24 hours	_____	_____	_____ 34.
35. More than 1 day	_____	_____	_____ 35.
<u>Severity</u>			
36. Aching. No real interference with activities	_____	_____	_____ 36.
37. Pain. Some interference with most activities	_____	_____	_____ 37.
38. Severe pain. Makes me stop whatever I'm doing	_____	_____	_____ 38.
<u>What do you use to relieve headaches?</u>			
	<u>Do not use this.</u>	<u>I use this. It helps much.</u>	<u>I use this. It helps little.</u>
39. Rest or relaxation (no drugs)	_____	_____	_____ 39.
40. Massages of neck or head (no drugs)	_____	_____	_____ 40.
41. Aspirin, Anacin	_____	_____	_____ 41.
42. Stronger pain reliever (unprescribed)	_____	_____	_____ 42.
43. Stronger medicine (prescription)	_____	_____	_____ 43.
44. Needs a medicine containing ergot	_____	_____	_____ 44.
<u>Medical history items</u>			
	<u>YES</u>	<u>NO</u>	
45. A parent or close relative has severe headaches of the same type as mine.	_____	_____	_____ 45.
46. I first experienced headaches of the type I had this month before age 25 years.	_____	_____	_____ 46.
47. As a child I was subject to "motion sickness"	_____	_____	_____ 47.

THANK YOU FOR YOUR ASSISTANCE

II. E-1
TROUBLE SLEEPING?

One of the most common problems reported by Air Traffic Controllers in the summer is trouble sleeping. We want to find out more about this problem in a search for possible causes.

If you had no sleep problems this past month, please return this form blank.

If you did have sleep problems, please check the correct description below: Make one check per item.

HOW OFTEN this month DID YOU:

	(0) Not at all	(1) 1-3 days	(2) 4-7 days	(3) 8-14 days	(4) 15-21 days	(5) 22-31 days
1. Have trouble falling asleep?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Have trouble staying asleep? (i.e. If you wake up far too soon and can't get back to sleep.)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Wake up several times per night?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Wake up after your usual amount of sleep <u>feeling tired</u> and worn out.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

CAUSES?

Check as many of the following which you feel cause the problems above:

	Yes	No
Things I've eaten or drunk	<input type="checkbox"/>	<input type="checkbox"/>
Having to use the bathroom <u>more</u> than once per night	<input type="checkbox"/>	<input type="checkbox"/>
Too many ideas spinning through my mind	<input type="checkbox"/>	<input type="checkbox"/>
Worries or problems	<input type="checkbox"/>	<input type="checkbox"/>
Changes in sleeping schedule, such as changes in work shifts	<input type="checkbox"/>	<input type="checkbox"/>
Not allowing enough time for sleep	<input type="checkbox"/>	<input type="checkbox"/>
Cause not on this list	<input type="checkbox"/>	<input type="checkbox"/>
Write in:	<input type="checkbox"/>	<input type="checkbox"/>
I have trouble sleeping, but have no ideas about its causes	<input type="checkbox"/>	<input type="checkbox"/>

PREFERRED TIME OF DAY

Some people feel far better--more alert, competent, and happy at one time of day, noticeably below that level at other times. You hear someone saying: "I'm a morning person", and another: "I'm a night owl."

For each description, please check the one set of hours which best fits

	7AM-12 Noon	12 Noon-5PM	5PM-10PM
Best time of day for me I feel more energetic, alert, and capable.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Most difficult time of day I often feel tired, irritable or irritable.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Times of day are about the same for me in terms of energy and ability.	<input type="checkbox"/>		

Also check here if your "best time" is just as likely to occur any time depending on other things.

ATC BIOGRAPHICAL QUESTIONNAIRE

The following questions ask about aspects of yourself, your family, and your experiences that have not been covered elsewhere.

Consider each question carefully and select your answer from among those presented. In some cases the question may not fit your situation exactly. For instance, if a question asks about your parents, you may have to interpret it in terms of guardians or step-parents. Please choose the one answer which is most accurate for you, even if it does not fit perfectly, by circling the number in front of your answer choice. Some answers will need to be written.

1) While you were growing up, where did you live most of the time:

- (1) in a rural area?
- (2) in a small town?
- (3) in a suburb of a large city?
- (4) in a city of less than 500,000 inhabitants?
- (5) in a city of over 500,000 inhabitants?

2) From birth up until you were 13 years old, how many times did your family move? (Do not count moves known at the time to be temporary, e.g. for the summer)

- (1) 0
- (2) 1
- (3) 2 - 3
- (4) 4 - 6
- (5) 7 or more

3) After reaching the age of thirteen, but before moving out on your own, how many times did your family move?

- (1) 0
- (2) 1
- (3) 2 - 3
- (4) 4 - 6
- (5) 7 or more

- (4) While you were growing up, was the section of town in which your family lived longest:
- 1) one of the poorer ones
 - 2) about average
 - 3) good but not the best
 - 4) one of the best
 - 5) not applicable, lived in rural area
- (5) What was the economic situation of your family:
- 1) not able to make ends meet
 - 2) able to have the necessities only
 - 3) able to live comfortably
 - 4) well-to-do
- (6) How many brothers and sisters did (do) you have: (Write in the actual number)
- _____ older brothers
- _____ older sisters
- _____ self
- _____ younger brothers
- _____ younger sisters
- (7) How often did you seriously consider quitting high school:
- 1) never
 - 2) once or twice
 - 3) occasionally
 - 4) frequently
- (8) During your last year in high school, what was the average number of evenings a week that you went out socially with persons of the opposite sex:
- 1) less than 1
 - 2) 1
 - 3) 2
 - 4) 3
 - 5) 4 or more

- (9) In high school did you have:
- 1) fewer friends than most others
 - 2) about the same number of friends as others
 - 3) more friends than most
- (10) During your teen years was your rate of physical growth compared to other boys:
- 1) much slower
 - 2) a little slower
 - 3) about the same
 - 4) a little faster
 - 5) much faster
- (11) When did you have your first alcoholic beverage (include beer) outside your home:
- 1) under age 14
 - 2) 14-16
 - 3) 17-20
 - 4) 21 or older
 - 5) I never drank
- (12) During your teens, was your relationship with your parents:
- 1) much worse than that of others
 - 2) somewhat worse than that of others
 - 3) about average
 - 4) better than that of most
 - 5) much better than that of most
- (13) Whether or not you played organized sports, how athletic and fit were you compared to most of your classmates?
- 1) much less athletic and fit
 - 2) less athletic and fit
 - 3) about average
 - 4) more athletic and fit
 - 5) much more athletic and fit

(14) In which religious tradition did your parents raise you?

- 1) no religion at all
- 2) the Roman Catholic Church
- 3) a Protestant religion
- 4) the Jewish religion
- 5) some other religion not listed
- 6) an atheist or agnostic tradition

(15) Please check for each person listed the highest level of formal schooling he or she was able to obtain. (Place one check in each vertical column. If you have not lived with a wife during this past year, please cross out columns 18, 19, and 20.)

Amount of School	15	16	17	18	19	20
	Myself	My father	My mother	My wife	My wife's father	My wife's mother
Eighth grade or less (1)						
Some high school but did not graduate (2)						
High school graduate (3)						
Formal vocational training after high school (4)						
Some college (5)						
College graduate (6)						
Master's degree or higher (7)						
Not known (9)						

(21) While you were growing up, what was your father's primary occupation?

Write in the answer. List more than one, if appropriate. Please indicate the nature of the work, not the employer -- Write "Repaired machines in a cannery." Do not write "Worked for food processor." If a farmer, indicate size of farm and whether owner, renter, or

(21) hired hand. For proprietor, indicate nature of business and number of employees.

(22) While you were growing up, what was your mother's occupation? Write in the answer. List more than one if appropriate.

In some families parents are very similar to one another, but in other families the parents are "as different as night and day." Please check how similar your parents were to each other in each of the following respects:

	<u>Very similar</u>	<u>A little different</u>	<u>Sharply different</u>
23) Social background	_____	_____	_____
24) Education	_____	_____	_____
25) Religious emphasis	_____	_____	_____
26) Their goals for you	_____	_____	_____
27) Personality	_____	_____	_____

(28) Up until you were age 17, was either of your natural parents out of your home for more than a year?

- 0) No, I lived with both natural parents until 18
- 1) No, my parents were together but I lived elsewhere (e.g. boarding school or in another home).
- 2) Yes, a separation only occurred
- 3) Yes, a divorce occurred
- 4) Yes, father away in military or related service
- 5) Yes, a parent died
- 6) Yes, some other reason

(29) If you answered "yes" to question 28, how old were you the first time a parent left your home for a year or more? Enter your age then: _____

(30) If you answered yes to question 28, which parent left? _____

HOW WE ARE GOING TO ASK ABOUT YOUR CURRENT LIVING SITUATION:

(31) How many of the following kinds of persons are living in your present household? Write in the number residing with you in each category.

- _____ in-laws
- _____ relatives on your side
- _____ children (include adoptions etc.)
- _____ friends
- _____ other: (specify) _____

(32) At the present time I live in a section of town which is:

- 1) one of the poorer ones
- 2) about average
- 3) good but not the best
- 4) one of the best

(33) I currently consider myself a member of:

- 1) no religion at all
- 2) the Roman Catholic Church
- 3) a Protestant religion
- 4) the Jewish religion
- 5) some other religion not listed
- 6) an atheist or agnostic tradition

(34) On the average, I go to church service:

- 1) never
- 2) once or twice a year
- 3) around once a month
- 4) twice a month or so
- 5) once a week or more

(35) For how many years have you lived in the county of your present address?
Write in the number of years.

(36) For how many years did you serve in the armed forces? Write in the number of years ("99" if you served for less than 1/2 year). If you never served, please skip to question 39.

(37) If you did serve in the armed forces, what was the highest rank you attained:

- 1) never served
- 2) private, corporal, seaman, airman, etc.
- 3) in the ranks of sergeant, petty officer, and so on
- 4) lieutenant (Jg., first, second), captain (AF or Army), lt. commander (Navy)
- 5) major (AF, Army), commander (Navy) or above

(38) While in the service were you an:

- 1) ATC
- 2) pilot
- 3) navigator
- 4) other job related to aviation
- 5) none of these
- 6) never served

(39) How many times have you been married? Write in the number: _____

(40) At present I am:

- 1) married (Please continue, starting with Item 41)
- 2) separated less than one year (Please continue, starting with Item 41)
- 3) separated one year or more (Please skip to Item 69)

- (40) 4) divorced (Please skip to Item 69)
- 5) widowed (Please skip to Item 69)
- 6) engaged (Please skip to Item 69)
- 7) unattached and none of the above (Please skip to Item 69)

(41) While your wife was growing up, what was the primary occupation of HER FATHER? (Write in the answer. List more than one if appropriate. As for Item 21, indicate the nature of the activity, not just the general field.)

(42) While your wife was growing up, what was the primary occupation of HER MOTHER? (Write in the answer. List more than one if appropriate.)

(43) Has your wife in the past or presently pursued any of the following vocations or professions? Please check as many as apply.

- 1) Business person, such as proprietor or manager, supervisor, personnel director, or the like
- 2) Professional person such as lawyer, certified accountant, registered engineer, physician, chemist or the like
- 3) Professional person such as school teacher, social worker, artist, registered nurse, medical technologist (with college degree)
- 4) Clerical & sales position, such as secretary, bookkeeper, office worker, salesperson.
- 5) Skilled occupation such as medical technician (without college degree), craftsman, machine operator, factory worker, electrical or similar work
- 6) Service positions such as hairdresser, waitress, or similar work
- 7) Some other area: Please specify: _____
- 8) None of the above

(44) At the present time, does your wife do work other than as a housewife?

- 1) No
- 2) Yes, volunteer work outside the home.
- 3) Yes, part time job
- 4) Yes, full time job

IF YOU ARE NOT PRESENTLY LIVING WITH YOUR WIFE, PLEASE SKIP TO ITEM 69.
Family Decision Making

In every family somebody has to decide such things as where the family will live and so on. Many couples talk things over first, but the final decision may really be made by one person. For each of the following issues, please indicate whether the decision is made (1) by the husband always, (2) by husband more than wife, (3) by husband and wife exactly the same, (4) by wife more than husband, or (5) by wife always. Please make one check in each horizontal row.

Issue	Final decision is made by:				
	(1) Husb. always	(2) Husb. more than wife	(3) Husb. & wife the same	(4) Wife more than Husb.	(5) Wife always
(45) What job the husband should take	_____	_____	_____	_____	_____
(46) What car to get	_____	_____	_____	_____	_____
(47) Whether or not to buy life insurance	_____	_____	_____	_____	_____
(48) Where to go on vacation	_____	_____	_____	_____	_____
(49) What house or apartment to take	_____	_____	_____	_____	_____
(50) Whether or not wife should go to work or quit work	_____	_____	_____	_____	_____
(51) What doctor to have when someone is sick	_____	_____	_____	_____	_____
(52) How much money the family can afford to spend on food	_____	_____	_____	_____	_____
(53) About how the children are to be disciplined	_____	_____	_____	_____	_____

II. F-10-

The following is a list of some possible family goals. Please rank the goals from one to ten in terms of how important you feel each goal should be for a family. Then rank each goal as you think your wife would. The most important goal should be ranked number 1; the least important should be ranked number 10.

A family should provide:	(1-10) Your ranking	(1-10) How you think your wife would rank them
(54) A respected place in the community	_____	_____
(55) The means for healthy and happy children	_____	_____
(56) Companionship for all members so that everyone feels comfortable and gets along	_____	_____
(57) Personality development for children	_____	_____
(58) Satisfaction with the amount of affection shown one another	_____	_____
(59) Economic security	_____	_____
(60) Emotional security	_____	_____
(61) Moral and religious unity	_____	_____
(62) Interesting activities	_____	_____
(63) A house and home where everyone feels they belong and other people cannot interfere	_____	_____

Did you take your children (either with or without your wife) to an eating place, the movies, some entertainment, or recreation, or to visit friends --

- (64) In the past week? 0 No.
 _____ Yes. Enter the number of times before the "Yes".
- (65) In the past month? 0 No.
 _____ Yes. Enter the number of times before the "Yes".

II. F-11-

(65a) _____ Check here if this is not applicable because you have no children (under age 18) living with or near you.

Did you go out with your wife to an eating place, the movies, to some entertainment or recreation, or to visit friends (You may include events reported above if your wife was present.) --

(66) In the past week? 0 No.

_____ Yes. Enter the number of times before the "Yes."

(67) In the past month? 0 No.

_____ Yes. Enter number of times before the "Yes".

(68) All things considered, how happy and satisfied have you been this year in your relationship with your wife?

- 1) Very happy and satisfied
- 2) Fairly happy and satisfied
- 3) Neutral -- or very mixed feelings
- 4) Somewhat unhappy and dissatisfied
- 5) Very unhappy and dissatisfied

The last five items deal with general issues about which everyone has some opinion. Please indicate the degree to which you agree or disagree with each of these statements:

(69) These days a person doesn't really know whom he can count on.

- 1) Strongly Agree
- 2) Agree
- 3) Disagree
- 4) Strongly Disagree

(70) Nowadays a person has to live pretty much for today and let tomorrow take care of itself.

- 1) Strongly Agree
- 2) Agree
- 3) Disagree
- 4) Strongly Disagree

(71) Most public officials (people in government offices) are not really interested in the problems of the average man.

- 1) Strongly Agree
- 2) Agree

- (71) 3) Disagree
4) Strongly Disagree

(72) In spite of what some people say, the condition of the average man is getting worse, not better.

- 1) Strongly Agree
- 2) Agree
- 3) Disagree
- 4) Strongly Disagree

(73) It is hardly fair to bring children into the world with the way things look for the future.

- 1) Strongly Agree
- 2) Agree
- 3) Disagree
- 4) Strongly Disagree

THANK YOU FOR YOUR COOPERATION IN COMPLETING ALL THESE ITEMS.
PLEASE TURN IN THIS FORM, WITH YOUR "OPEN ID NUMBER" ON IT,
TO THE PSYCHOLOGIST.

II. G-1

FIFTH ROUND

PSY 102: ATC QUESTIONNAIRE

CAREER ATTITUDES AND BEHAVIOR

This questionnaire asks about your ATC work. If you have permanently left Air Traffic Controlling please answer the following questions in terms of your present occupation. Please consider each question carefully before answering. Multiple choice answers are provided immediately above each question.

1 Enjoy very much 2 Enjoy quite a bit 3 Enjoy somewhat 4 Don't care either way 5 Dislike somewhat 6 Dislike quite a bit 7 Dislike very much

1. How do you regard the variety provided by shift changes?
.....

- 1. Work quality becomes much worse
- 2. Work quality becomes moderately worse
- 3. Work quality becomes somewhat worse
- 4. Work quality is not affected
- 5. Work quality becomes somewhat better
- 6. Work quality becomes moderately better
- 7. Work quality becomes much better

2. How is the quality of your work affected immediately after changing onto your "least" preferred shift?
.....

- 1. No time at all; shift changes don't affect my work quality
- 2. An hour or two
- 3. Several hours
- 4. At least one full shift
- 5. Two or more shifts
- 6. Up to a week
- 7. Over a week

3. How long does it take to get back to your peak after changing shifts?
.....

1 A day or less 2 A couple of days 3 Up to a week 4 About a week 5 Up to two weeks 6 Up to three weeks 7 Never get fully relaxed

4. How long does it take you to really unwind or relax once you have started annual leave?

II. G -2-

- | | | | | | | |
|--------------------|-------------------------|--------------------|-----------------|-----------------|---------------------|------------------|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| A month
or more | Up to
three
weeks | Up to
two weeks | About a
week | Up to
a week | A couple
of days | A day
or less |

5. Once you come back from a week or more of annual leave, how long does it take you to get up to peak again?

1. Much less than most
2. Quite a bit less
3. Somewhat less than most things
4. About as much as anything I do
5. Somewhat more than most things
6. Quite a bit more
7. Much more than most things

6. Even though Air Traffic Control may be a very exciting and rewarding job, to what extent do you feel it has "cost" you personally to be an ATC?

ATC work may affect many other areas in your life. Use the scale below for indicating how each of the following areas have been affected for you.

1. ATC work has interfered tremendously in this area
 2. ATC work has interfered moderately in this area
 3. ATC work has interfered slightly in this area
 4. ATC work has not affected this area
 5. ATC work has helped slightly this area
 6. ATC work has helped moderately this area
 7. ATC work has helped tremendously this area
7. Friendships
 8. Social life
 9. Relationships with wife or girlfriend
 0. Family life and relations with children
 1. Opportunity for advancement
 2. Physical health
 3. Peace of mind

The next set of questions asks about your perceptions and feelings regarding various aspects of being an ATC. If a question is not exactly appropriate for you respond in terms of the most parallel situation. For instance, some smaller towers do not have sectors but they do have arrival/departure specialists. Use whatever your tower/center has for its controllers. Also, in some questions, safety considerations would influence your answer. Please interpret each question as if safety were assured.

II. G -3-

For these questions please use the scale given below for selecting your answer. First decide whether a statement is true or false for you. Then select the number on the scale indicating how true or false the statement is.

1	2	3	4	5	6	7
Completely false	Mostly false	Somewhat false	Neither true nor false	Somewhat true	Mostly true	Completely true

14. I greatly dislike having to restrict aircraft prior to their entering my sector
15. When working a combined sector well, I don't like to have anyone suggest decumbing it
16. My own standards of performance are higher than those in the FAA rules
17. I am constantly reviewing my performance throughout a shift against my own set of standards
18. Even when I'm under IFR pressure, I don't feel I'm doing a complete job unless I provide VFR advisories
19. It is extremely important to me to try and fill pilot requests even when their requests will cause me extra work
20. I try to do something extra in every shift so that I'll end each shift with a sense of accomplishment
21. I try to get assigned to technically challenging sectors so that I won't get bored
22. Compared to other controllers, I keep my cool better in very difficult situations
23. I couldn't be a supervisor of my friends
24. People can easily tell from my words and actions how I really feel about them
25. People who know me well would say I let a lot of things "get to me"
26. If it were not for the FAA required physical I would rarely, if ever, go to a doctor
27. I find I have to drink more to get the same relief
28. If I'm not able to drink, I find it extremely difficult to unwind
29. After I have left the boards I continue thinking about all the possible conflicts and work them through again in my mind
30. I stay in "high gear" and have trouble relaxing once I leave work
31. Over the past few months, I find it is becoming increasingly difficult to unwind at the end of a shift

II. G -4-

1
Completely
false

2
Mostly
false

3
Somewhat
false

4
Neither
true nor false

5
Somewhat
true

6
Mostly
true

7
Completely
true

32. I get so involved with my work that at the end of a shift I often forget things such as where I parked my car, things to shop for, and so on
33. When I get home after work, I am so preoccupied with what happened on the job that I can't talk with my wife or friends
34. Even when I'm away from Air Traffic Controlling I spend much of my time thinking about ATC work
35. In describing me, my friends would say that I eat, drink and think ATC
36. Compared to other controllers, I can easily return to peak performance after a bad time on the boards
37. In the past six months it has been becoming more difficult for me to bounce back to peak performance when I've been away from the boards
38. In the last six months, I've been finding it harder to shift between peak and slow periods
39. I am relaxed when giving on-the-job training
40. On-the-job training puts an unnecessary strain on me
41. I often take over from trainees too early
42. I really enjoy giving on-job-training
43. I get very irritable with trainees when giving on-the-job training _____
44. I am never bothered by thoughts that actions of a trainee of mine will jeopardize my rating.
45. Whenever I have a near-miss, my self confidence is greatly shaken.
46. The last non-collision "pair" I had still bothers me greatly.
47. One of the greatest stresses in ATC work stems from the close-calls I have had.
48. The effect of having an incident wears off me within a week or so.
49. In the last year, how many "incidents" (reportable or otherwise) have you been involved in? Write in the actual number.
50. How many of these incidents still bother you greatly? Write in the actual number

II. G-5-

This section of the questionnaire is concerned with your reactions to various situations that arise in Air Traffic Control.

Please indicate how often in the past six months you have felt or experienced any of the following before going to work when you knew the weather and/or traffic conditions were bad. Use the scale given below:

- | | | | | | | |
|--------|--------|--------------|--|--------------|------------|-------------------|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Never. | Rarely | Occasionally | More than occasionally but less than often | Fairly often | Very often | Nearly every time |

Before going to work when weather and/or traffic conditions were bad, how often did you have:

51. Difficulty getting to sleep and staying asleep?
52. Upright, fidgety, and tense feelings?
53. Loss of appetite?
54. Upset stomach?
55. Wishes that it was not your shift?
56. Thoughts about calling in sick but not actually doing it?

While working difficult traffic in the last six months how often have you felt or experienced:

57. A lot of perspiration?
58. Your muscles tensing up?
59. Feeling uncomfortably warm?
60. A dry mouth?
61. Feeling "put on the spot"?
62. Tense and worried feelings?
63. Getting more irritable with other controllers?

Now please indicate how often you have felt or experienced the following after you have been relieved from a long period of heavy traffic. How often have you felt or experienced:

64. The realization that your muscles were very tense?
65. A backache

II. G-6-

1 2 3 4 5 6 7
Never Rarely Occasionally More than occasionally but less than often Fairly often Very often Nearly every time

- 66. Your heart beating very hard or fast?
- 67. A headache?
- 68. A total lack of appetite?
- 69. Feeling exhausted and in need of rest?

Considering an average work day for you, indicate how accurately each of the following statements describe usual things you do to unwind at the end of the day. Use this scale:

- 1. Extremely inaccurate
 - 2. Moderately inaccurate
 - 3. Somewhat inaccurate
 - 4. Neither accurate nor inaccurate
 - 5. Somewhat accurate
 - 6. Moderately accurate
 - 7. Extremely accurate
- 70. I take a walk to relax
 - 71. I do strenuous exercise or some physical sport
 - 72. I prefer to be alone to recuperate
 - 73. I join a group for social conversation
 - 74. I go for a drive after getting home
 - 75. I start doing a hobby
 - 76. I go out with the guys for a drink
 - 77. I just do whatever's handy

Overall, considering only those things which you do to unwind, which you rated above, how helpful are they in assisting you to unwind at the end of a day?

USE THIS SCALE:

- 1. Extremely unhelpful
- 2. Moderately unhelpful
- 3. Somewhat unhelpful
- 4. Neither helpful nor unhelpful
- 5. Somewhat helpful
- 6. Moderately helpful
- 7. Extremely helpful

II. C-7-

- | | | | | | | |
|------------------|-----------------|--------------|---------------------|-------------|----------------|-------------------|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Absolutely
no | Probably
not | Maybe
not | Really
can't say | Maybe
so | Probably
so | Definitely
yes |

79. In your opinion, will all controllers eventually "burn out"?

- | | | | | | | |
|-------|--------|--------------|-------------------------------------|-----------------|---------------|------------|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Never | Rarely | Occasionally | About as
often as
Anyone else | Fairly
often | Very
often | Constantly |

80. How often do you find yourself worrying about your own burnout?

- | | | | | | | |
|--------------------|---------------|-------------------|---------------------------------|---------------------|-----------------|----------------------|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Extremely
close | Very
close | Somewhat
close | Neither
close nor
distant | Somewhat
distant | Very
distant | Extremely
distant |

81. At the present time, how close to "burnout" do you feel?

2. Rate yourself on the scale below

1. I am more likely to be level headed and factual about most of life's problems
- 2.
- 3.
4. As much one as the other
- 5.
- 6.
7. I am more likely to be emotional, fly off the handle, decide on the basis of feelings over facts

- | | | | | | | |
|-------------|-------------|-------------|--------------|---------------|---------------|---------------|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 0-2
days | 3-5
days | 6-8
days | 9-11
days | 12-14
days | 15-17
days | 18-20
days |

Most controllers have days when they feel on top of the world, like they could handle traffic of four sectors at once and master every situation that arises (well, almost). In an average working month of about 20 days how often do you feel really topnotch?

II. G-8-

1	2	3	4	5	6	7
0-2 days	3-5 days	6-8 days	9-11 days	12-14 days	15-17 days	18-20 days

84. There are other days when a person feels he just can't "get it all together", when he really feels below par. You may or may not be sick, you just feel that your controlling skills are really below your own average. Of the average 20 working days in a month, how many are like this for you on the average?

When you are having a poor day, such as described above, how often do you use each of the following ways to cope with it at work?
Use the following scale:

1	2	3	4	5	6	7
Never	Rarely	Occasionally	More than occasionally	Fairly often	Very often	Nearly always

85. Try to get assigned to a sector with a light load
86. Take longer breaks
87. Take more breaks
88. Find a work partner that understands and can help out
89. Drink more coffee or other stimulants
90. Find a friend or diversion to take your mind off the problem

Given the twenty working days in an average month, indicate how many days (out of twenty) you would usually do each of the following

Use this scale:

1	2	3	4	5	6	7
0-2 days	3-5 days	6-8 days	9-11 days	12-14 days	15-17 days	18-20 days

91. I drink alone at home.
92. I drink with a few friends
93. I don't drink

II. G-9-

- | | | | | | | |
|-----------------------|---------------------|---------------------|-----------------------|------------------|-----------------|-------------------|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Not helpful
at all | A little
helpful | Somewhat
helpful | Moderately
helpful | Quite
helpful | Very
helpful | The best
thing |

94. On the whole, how helpful is drinking in helping to unwind and relax at the end of a working day?

People often pursue other interests outside their jobs. We would like to know if you have pursued any of the following activities in the last six months. Use the scale below for indicating how much time, on the average, you give to the following activities.

- | | | | | | | |
|---------------------|---------------------|---------------------|----------------------|-----------------------|-----------------------|------------------------|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 0-2 hours
a week | 3-5 hours
a week | 6-8 hours
a week | 9-11 hours
a week | 12-14 hours
a week | 15-17 hours
a week | 18-20
Hrs a
week |

5. Another outside job
6. Dating, drinking, or partying
7. Hobbies, such as stamp collecting, carpentry, car repairs
8. Physical sports, such as baseball, basketball, bowling, hockey, fishing

1. Very ungratifying and quite overextended
2. Quite ungratifying and somewhat overextended
3. Somewhat ungratifying and overextended
4. Neither gratifying nor ungratifying
5. Somewhat gratifying and rewarding
6. Quite gratifying and rewarding
7. Very gratifying and rewarding

Given those activities which you pursue, how much overall gratification and reward to you get from these activities?

IF YOU ARE NOT MARRIED, SKIP TO QUESTION # 104

How much support do you feel your wife provides you in coping with the pressures of your job?

1. She criticizes me tremendously
2. She criticizes me quite a bit
3. She criticizes me somewhat
4. She neither supports me nor criticizes me
5. She supports me somewhat
6. She gives me moderate support
7. She supports me tremendously

II. G-10-

101. How often do you talk with you wife about your feelings that are a consequence of your work?

1. Never or extremely rarely
2. Once a month or less
3. A couple of times a month
4. Once a week at most
5. A couple of days a week
6. Once a day at most
7. More than once a day

102. How do you feel about your wife sharing her trials and tribulations of the day when you arrive home?

1. I hate it
2. I dislike it quite a bit
3. I dislike it somewhat
4. I don't feel either way about it
5. I somewhat like her to
6. I most often like her to
7. I really like her to share her problems with me

103. How understanding is your wife of your need to unwind at the end of a day's work?

1. Completely lacks such an understanding
2. Lacks such an understanding quite a bit
3. Somewhat lacks such an understanding
4. Neither understanding nor misunderstanding
5. Somewhat understanding
6. Quite understanding
7. Extremely understanding

1	2	3	4	5	6	7
None	1-2	3-4	5-6	7-8	9-10	10 or more

If you or your family were struck by a crisis or tragedy, how many persons of the following categories could you really count on to help you? For these purposes, count a married couple or a family unit as "1".

104. Among relatives

105. Among friends

106. Among people at work

107. How many people do you consider close friends who live within an hour's drive of your home? (use the scale above)

THIS IS THE END OF THIS QUESTIONNAIRE. THANK YOU FOR YOUR COOPERATION

FIFTH ROUND

II. H-1

PSY103-Sociometric Questionnaire

This particular questionnaire has only three questions. For each question you will give three answers. The questions ask about your choice or preference among your co-workers when various conditions exist. We are having you write in code numbers rather than names to make it easier to answer. These numbers do not correspond in any way to your confidential code.

Please do not list a person more than once in each question. However, you may list a person in more than one question. Also, do not use yourself as an answer. Use your choice of three other controllers. You should have been given a list of names and codes with this questionnaire. If you have not, please obtain a list from the receptionist-coordinator. The receptionist-coordinator will indicate which list of names you will use.

The list you will use will include all members of your team and sister teams in your facility. If you are not from Islip or Nashua, your list will include members of your team and sister teams in your facility.

You will find a number to the left of each controller's name. This is the code you are to use on the answer sheet.

THE THREE QUESTIONS AND THE ANSWER SPACES ARE TOGETHER ON THE NEXT PAGE.

FIFTH ROUND

II. H-2

ANSWER SHEET

for

PSY103- Sociometric Questionnaire

QUESTIONS

-
- I. If all assignments were changed to correspond with your preferences, which three ATCS's would you most like to work with? List in order of preference on the answer sheet as indicated.
-
- II. Without considering technical ability, with which three ATCS's do you find it easiest to work? List in order as indicated on the answer sheet.
-
- III. Without considering how easy it is to work with someone, whom do you believe are the three best controllers from a technical standpoint? List in order as indicated on the answer sheet.
-

ANSWER SPACES

- I. A. Top choice: Name code: _____ Is he presently on your team?(1=yes,0=no) _____
- B. Second choice: Name code: _____ Is he presently on your team?(1=yes,0=no) _____
- C. Third choice: Name code: _____ Is he presently on your team?(1=yes,0=no) _____
- II.A. Easiest to work with: Name code: _____
Is he presently on your team?(1=yes,0=no) _____
- B. Second easiest to work with: Name code: _____
Is he presently on your team?(1=yes,0=no) _____
- C. Third easiest to work with: Name code: _____
Is he presently on your team?(1=yes,0=no) _____
- III.A. Best: Name code: _____ Is he presently on your team?(1=yes,0=no) _____
- B. Second best: Name code: _____ Is he presently on your team?(1=yes,0=no) _____
- C. Third best: Name code: _____ Is he presently on your team?(1=yes,0=no) _____

II. I-1

PSY 131
FIFTH ROUND

This questionnaire inquires about things which sometimes happen to people. Their recent occurrence is thought to be related to an increased chance of becoming ill.

This particular inventory is concerned with the actual occurrence of various events and the distress which they caused you. The exact details of what happened are of no importance. We are simply concerned with gathering information about the actual number of events which happened to you and the amount of distress which you experienced.

As you may recall, during your previous visits here, this life change questionnaire was quite long and some times tedious if many things had happened to you. We have revised this procedure considerably to eliminate fatigue.

This time, if an event did not occur to you since your last regular exam here, or in the last 8 months if you skipped visit 4 for any reason, please circle "NO" on the answer sheet.

If an event did occur since your last exam here, or in the last 8 months if you skipped visit 4 for any reason, simply report its occurrence by writing a Distress Rating next to the YES on the answer sheet. You can use any number from 01 to 99, depending on how seriously the event troubled you.

Your distress ratings should reflect how much discomfort, upset, or distress each event caused you. The scale below will reappear at the top of each page. It shows that in another study most people gave numerical ratings between 10 and 20, 40 and 55, and 95 and 99 to the events in the following example. Remember, this example is only a rough guide for you. Your own ratings may take any value from 01 to 99 according to the degree of distress which the event caused for you.

DISTRESS SCALE

DISTRESS	MODERATE DISTRESS	EXTREME DISTRESS
.....10 ... 20.....30.....40..... 50.....60.....70...80....90.....99		
OLD MARRIED	ADDITIONAL PERSON MOVES INTO HOUSE	CHILD DIED

DISTRESS SCALE

LOW DISTRESS MODERATE DISTRESS EXTREME DISTRESS
01.....10.....20.....30.....40.....50.....60.....70.....80.....90.....99

- NO YES: ___ 01.) HAVE YOU CHANGED TO A DIFFERENT LINE OF WORK?
 NO YES: ___ 02.) HAVE YOU CHANGED YOUR PLACE OF WORK (DIFFERENT ADDRESS)?
 NO YES: ___ 03.) HAS THERE BEEN A CHANGE IN YOUR RESPONSIBILITIES AT WORK (SUCH AS A LATERAL TRANSFER OR SHIFT TO A NEW WORK AREA OR NEW COLLEAGUES, OR A PROMOTION OR DEMOTION)?
 NO YES: ___ 04.) HAVE YOU HAD TO START LEARNING ANY MAJOR NEW EQUIPMENT?
 NO YES: ___ 05.) HAVE YOU INCREASED THE AVERAGE NUMBER OF HOURS THAT YOU WORK PER DAY?
 NO YES: ___ 06.) HAVE YOU DECREASED THE AVERAGE NUMBER OF HOURS THAT YOU WORK PER DAY?
 NO YES: ___ 07.) HAVE YOU HAD ANY TROUBLE WITH ANY OF YOUR SUPERVISORS?
 NO YES: ___ 08.) HAVE YOU HAD ANY TROUBLES WITH CO-WORKERS, OR PERSONNEL UNDER YOUR SUPERVISION?
 NO YES: ___ 09.) HAVE YOU RECEIVED ANY DISCIPLINARY ACTION OF RECORD?
 NO YES: ___ 10.) HAVE YOU BEEN PUT ON MEDICAL WAIVERS?
 NO YES: ___ 11.) HAVE YOU TAKEN ON A SECOND JOB?
 NO YES: ___ 12.) HAVE YOU GIVEN UP A SECOND JOB?
 NO YES: ___ 13.) IF YOU HAVE A SECOND JOB, HAVE YOU HAD PROBLEMS THAT DISCOURAGED YOU?
 NO YES: ___ 14.) HAVE YOU TAKEN A VACATION?
 15.) IN SUMMARY, HOW WELL WOULD YOU SAY YOUR LIFE AT WORK HAS GONE FOR YOU RECENTLY? (CIRCLE ANSWER BELOW)
 1.) THE BEST EVER
 2.) ESPECIALLY WELL
 3.) GOOD
 4.) AVERAGE
 5.) POOR
 6.) REALLY BAD
 7.) THE WORST EVER
 YES: ___ 16.) HAVE YOU STARTED TAKING ANY COURSES TO HELP YOU IN YOUR WORK OR TO PREPARE YOU FOR ANOTHER JOB?
 YES: ___ 17.) HAVE YOU BEGUN AN ON-THE-JOB TRAINING COURSES?
 YES: ___ 18.) DID YOU PASS THE EXAMINATION QUALIFYING YOU FOR JOURNEYMAN ATC STATUS?
 YES: ___ 19.) HAVE YOU MOVED TO A NEW PLACE OF RESIDENCE WITHIN THE SAME CITY OR AREA OF THE STATE?
 YES: ___ 20.) HAVE YOU MOVED TO A NEW PLACE OF RESIDENCE FROM A DIFFERENT AREA IN THE SAME STATE?
 YES: ___ 21.) HAVE YOU MOVED TO A NEW PLACE OF RESIDENCE FROM ANOTHER STATE?
 YES: ___ 22.) HAVE YOU HAD ANY MINOR TROUBLES WITH THE LAW, NOT LEADING TO A COURT APPEARANCE? (FOR EXAMPLE, LESSER TRAFFIC VIOLATIONS, TAX RETURNS, ETC.)
 YES: ___ 23.) HAVE YOU HAD A VIOLATION LEADING TO A COURT APPEARANCE (INCLUDING LOSING DRIVER'S LICENSE)?
 YES: ___ 24.) HAVE YOU BEEN INVOLVED IN A LAW SUIT?

DISTRESS SCALE

LOW DISTRESS

MODERATE DISTRESS

EXTREME DISTRESS

01.....10.....20.....30.....40.....50.....60.....70.....80.....90.....99

- NO YES: 25.) HAVE YOU HAD ANY TROUBLE WITH THE LAW WHICH LED TO YOUR BEING HELD IN JAIL FOR AWHILE? (FOR EXAMPLE, DRINKING TOO MUCH, DISTURBING THE PEACE, AWAITING BAIL)
- NO YES: 26.) HAVE YOU BEEN THE VICTIM OF A CRIME? (E.G., ROBBERY, ASSAULT, ETC.)
- NO YES: 27.) HAVE YOU HAD MODERATE FINANCIAL DIFFICULTIES, SUCH AS EXCESSIVE EXPENSES OR TROUBLE FROM BILL COLLECTORS?
- NO YES: 28.) HAVE YOU BEEN THREATENED WITH LEGAL ACTION (SUCH AS REPOSSESSION) OVER NOT PAYING YOUR MORTGAGE OR INSTALLMENT PAYMENTS?
- NO YES: 29.) HAVE YOU BEEN IN AN AUTO ACCIDENT (OR OTHER ACCIDENT) INVOLVING INJURY TO A PERSON OR PROPERTY DAMAGE OF OVER \$200?
- NO YES: 30.) HAVE YOU HAD MAJOR LOSSES IN THE STOCK MARKET OR OTHER SECURITIES TRADING?
- NO YES: 31.) HAVE YOU HAD MAJOR FINANCIAL DIFFICULTIES RESULTING IN EXTREMELY HEAVY DEBTS OR BANKRUPTCY?
- NO YES: 32.) HAVE YOU HAD A BUSINESS FAILURE?
- NO YES: 33.) HAVE YOU BUILT A HOME OR MADE MAJOR IMPROVEMENTS ON YOUR HOME?
- NO YES: 34.) HAVE YOU TAKEN ON ANY SUBSTANTIAL LOANS OR MADE MAJOR PURCHASES (FOR LESS THAN \$10,000? (FOR EXAMPLE, A COLOR TV, CAR, FREEZER, ETC.))
- YES: 35.) HAVE YOU TAKEN ON A PURCHASE FOR MORE THAN \$10,000, SUCH AS A HOME OR REAL ESTATE?
- YES: 36.) HAVE YOU HAD A SUBSTANTIAL IMPROVEMENT IN FINANCES, SUCH AS A MAJOR RAISE IN PAY, NEW SOURCES OF INCOME, OR AN INHERITANCE?
- 37.) ALL IN ALL, HOW WELL WOULD YOU SAY YOUR HOUSING, FINANCIAL AND LEGAL MATTERS HAVE GONE FOR YOU RECENTLY? (CIRCLE ANSWER BELOW)
- 1.) THE BEST EVER
 - 2.) ESPECIALLY WELL
 - 3.) GOOD
 - 4.) AVERAGE
 - 5.) POOR
 - 6.) REALLY BAD
 - 7.) THE WORST EVER
- YES: 38.) HAVE YOU HAD AN ILLNESS OR INJURY THAT REQUIRED MEDICAL ATTENTION OR THAT KEPT YOU FROM WORKING OR FUNCTIONING NORMALLY? (IF YOU ANSWER NO, SKIP TO QUESTION 41.)

DISTRESS SCALE

LOW DISTRESS MODERATE DISTRESS EXTREME DISTRESS
 01.....10.....20.....30.....40.....50.....60.....70.....80.....90.....99

- 55.) HAVE YOU BECOME MARRIED OR REMARRIED?
 56.) HAVE YOU HAD AN INCREASE IN ARGUMENTS WITH YOUR WIFE?
 57.) HAVE ANY OF YOUR ARGUMENTS WITH HER BEEN SERIOUS OR VIOLENT?
 58.) HAVE YOU HAD TO BE SEPARATED FROM YOUR WIFE BECAUSE OF MARITAL PROBLEMS?
 59.) HAVE YOU HAD TO BE SEPARATED FROM YOUR WIFE FOR REASONS OTHER THAN MARITAL PROBLEMS?
 60.) ARE YOU SERIOUSLY CONSIDERING DIVORCE?
 61.) HAVE YOU FILED FOR DIVORCE OR HAD A DECREE GRANTED?
 62.) HAVE YOU FOUND OUT THAT YOUR WIFE IS PREGNANT:
 63.) AND THIS IS A WANTED PREGNANCY?
 64.) AND THIS IS AN UNWANTED PREGNANCY?
 65.) HAS YOUR WIFE HAD A MISCARRIAGE, STILLBIRTH, OR ABORTION?
 66.) HAVE YOU BEEN HAVING SEXUAL DIFFICULTIES?
 67.) HAVE YOU BEGUN AN EXTRAMARITAL AFFAIR?
 68.) HAS YOUR WIFE BEGUN AN EXTRAMARITAL AFFAIR (OR HAVE YOU DISCOVERED REASON TO SUSPECT ONE)?
 69.) HAVE YOU HAD A MARKED IMPROVEMENT IN YOUR RELATIONSHIP WITH YOUR WIFE?
 70.) HAVE YOU HAD LESS THAN YOUR USUAL NUMBER OF ARGUMENTS WITH YOUR WIFE?
 71.) HAVE YOU HAD A MARITAL RECONCILIATION?
 72.) HAS YOUR WIFE BEGUN WORK OUTSIDE THE HOME?
 73.) HAS YOUR WIFE STOPPED WORK OUTSIDE THE HOME?
 74.) HAVE YOU EVER HAD ANY CHILDREN (BY BIRTH OR ADOPTION)?
 (CIRCLE ANSWER BELOW)

0 = NO
 1 = YES

(IF NO, PLEASE SKIP TO QUESTION 81.)

- 74.) HAVE YOU GAINED A NEW CHILD BY BIRTH OR ADOPTION?
 75.) HAVE YOU HAD A CHILD ENLIST OR BE DRAFTED INTO THE ARMED FORCES?
 76.) HAVE YOU HAD A CHILD LEAVE HOME FOR OTHER REASONS? (E.G., COLLEGE, OR OTHER INSTITUTION)
 77.) HAS ONE OF YOUR CHILDREN HAD A SEVERE PERSONAL PROBLEM (E.G., UNWANTED PREGNANCY, MAJOR ARGUMENT WITH PARENT OR TROUBLE WITH THE LAW)?
 78.) HAS A SON OR DAUGHTER BECOME ENGAGED TO BE MARRIED?
 79.) HAS A SON OR DAUGHTER MARRIED WITH YOUR APPROVAL?
 80.) HAS A SON OR DAUGHTER MARRIED AGAINST YOUR WISHES?

DISTRESS SCALE

LOW DISTRESS
01.....10.....20.....30.....40.....50.....60.....70.....80.....90.....99

MODERATE DISTRESS

EXTREME DISTRESS

81.) AT ANY TIME IN THE LAST 2 YEARS HAVE YOU BEEN INVOLVED IN A "DATING RELATIONSHIP" (CIRCLE ANSWER BELOW)

0 = NO
1 = YES

(IF NO, PLEASE SKIP TO QUESTION 87)

- NO YES: 82.) HAVE YOU STOPPED STEADY DATING (OF THREE MONTHS OR MORE) OR ENDED AN ESTABLISHED RELATIONSHIP?
- NO YES: 83.) HAVE YOU BEGUN A SERIOUS DATING RELATIONSHIP OR BECOME ENGAGED?
- NO YES: 84.) HAVE YOU HAD AN INCREASE IN ARGUMENTS OR DIFFICULTIES WITH A LONG TERM STEADY DATE, WITH YOUR FIANCE, OR A VERY CLOSE FRIEND?
- NO YES: 85.) HAVE YOU BROKE AN ENGAGEMENT?
- NO YES: 86.) IF YOU HAVE A GIRLFRIEND, HAS SHE RECENTLY BECOME PREGNANT?
- NO YES: 87.) HAS A NEW PERSON OTHER THAN AN INFANT MOVED INTO YOUR HOUSEHOLD (E.G., AN OLDESTER, RELATIVE, LODGER, OR CHILDREN RETURNING FROM LIVING ELSEWHERE)?
- NO YES: 88.) HAS A MEMBER OF YOUR HOUSEHOLD (OTHER THAN YOUR SPOUSE OR CHILD) MOVED OUT OF THE HOME?
- NO YES: 89.) HAVE YOU HAD ANY PROBLEMS WITH YOUR IN-LAWS (WIFE'S PARENTS OR YOUR CHILDREN-IN-LAWS), FRIENDS, OR CLOSE RELATIVES WHO LIVE IN THE HOME?
- NO YES: 90.) HAVE YOU HAD ANY PROBLEMS WITH SUCH PEOPLE WHO LIVE OUTSIDE YOUR HOME?
- NO YES: 91.) HAVE YOU BEEN CONCERNED ABOUT THE PHYSICAL OR MENTAL HEALTH OF A MEMBER OF YOUR IMMEDIATE FAMILY (SPOUSE, CHILD, PARENT, SIBLING), A RELATIVE OUTSIDE OF THE IMMEDIATE FAMILY, OR AN INTIMATE FRIEND? (IF YOUR ANSWER IS "NO", PLEASE SKIP TO QUESTION 95)

- 92.) WHAT WAS THE INTENSITY OF THE PHYSICAL OR MENTAL HEALTH DIFFICULTY OF: A MEMBER OF YOUR IMMEDIATE FAMILY (SPOUSE, CHILD, PARENT, SIBLING)?
- 93.) A RELATIVE OUTSIDE OF THE IMMEDIATE FAMILY?
- 94.) AN INTIMATE FRIEND?

- 0.) NO PROBLEM
- 1.) RELATIVELY MILD
- 2.) QUITE SERIOUS
- 3.) LIFE THREATNING

USE THIS ANSWER SCALE FOR QUESTIONS 92, 93, & 94

- YES: 95.) HAS THERE BEEN A MARKED INCREASE IN HOW FREQUENTLY YOU "GET TOGETHER" WITH RELATIVES OR FRIENDS?
- YES: 96.) HAS THERE BEEN A MARKED DECREASE IN HOW FREQUENTLY YOU "GET TOGETHER" WITH RELATIVES OR FRIENDS?
- YES: 97.) HAS THERE BEEN A BREAK UP OF A LOVE RELATIONSHIP OTHER THAN ONE YOU HAVE ALREADY REPORTED IN THIS QUESTIONNAIRE?

DISTRESS SCALE

LOW DISTRESS	MODERATE DISTRESS	EXTREME DISTRESS
01.....10.....20.....30.....40.....50.....60.....70.....80.....90.....99		

- YES: 98.) HAS THERE BEEN A MARKED IMPROVEMENT IN YOUR RELATIONSHIP WITH SOME-ONE CLOSE TO YOU (EXCLUDING YOUR WIFE)?
- YES: 99.) HAS THERE BEEN A MAJOR CHANGE IN YOUR PERSONAL HABITS? (E.G., YOUR CHOICE OF FRIENDS, STYLE OF DRESS, INTERESTS, ETC.)
- YES: 100.) HAVE YOU MADE ANY RECENT MAJOR DECISION REGARDING YOUR FUTURE (FOR EXAMPLE, WHEN YOU WILL RETIRE FROM YOUR PRESENT WORK, PLANS TO BUY A NEW HOUSE, MOVE TO ANOTHER PART OF THE COUNTRY, ETC.)?
- YES: 101.) HAS THERE BEEN A MAJOR CHANGE IN YOUR RELIGIOUS OR POLITICAL CONVICTIONS?
- YES: 102.) HAVE YOU EXPERIENCED ANY OUTSTANDING PERSONAL ACHIEVEMENT?
- 103.) ALL IN ALL, HOW WELL WOULD YOU SAY YOUR MARRIAGE, FAMILY, AND/OR PERSONAL LIFE HAS GONE FOR YOU RECENTLY? (CIRCLE ANSWER BELOW)

- 1.) THE BEST EVER
- 2.) ESPECIALLY WELL
- 3.) GOOD
- 4.) AVERAGE
- 5.) POOR
- 6.) REALLY BAD
- 7.) THE WORST EVER

WE HAVE ASKED YOU MANY QUESTIONS ABOUT THINGS THAT HAVE HAPPENED TO YOU, AND NOW WE HAVE TWO QUESTIONS OF A DIFFERENT SORT.

- YES: 104.) FIRST, HAS ANYTHING THREATENED TO HAPPEN WHICH COULD HAVE CAUSED SOME CHANGE IN YOUR LIFE BUT WHICH PASSED WITHOUT HAPPENING?
- YES: 105.) SECOND, HAS ANYTHING FAILED TO HAPPEN WHICH YOU HAD HOPED FOR AND EXPECTED (FOR EXAMPLE, ANTICIPATED PLEASURE, RECOGNITION, OR SUCCESS)?

THIS INTERVIEW IS COMPLETED

THANK YOU FOR YOUR COOPERATION AND CANDID ANSWERS.

II. J-1

Satisfaction With FAA Policy
Questionnaire

1. The FAA is more concerned with improving hardware than with helping people do their job.
2. The greatest problems I face in doing my job well are due to FAA policies and not the work itself.
3. The facility's reluctance to use overtime often seriously disrupts my personal life.
4. The facility's reluctance to use overtime often results in dangerous understaffing.
5. The FAA does not reward consistently good performance.
6. Job performance counts very little for promotion.
7. One of the problems of being promoted to supervisor is that you become a "yes-man" for management.
8. You lose the respect of your peers when you are promoted to supervisor.
9. About the only reward for controlling well is the recognition other controllers give you.
10. The only time management responds to the quality of my work is when something goes wrong.
11. Our facility chief would do a lot more for us if it were not for FAA policies handed down from Washington.
12. My facility chief puts the controllers' welfare too low on his list of priorities.
13. The quality of candidates accepted into the training program is too low.
14. In the last couple of years, it has become too easy to become a fully rated journeyman.
15. I don't feel that training developmental controllers with live traffic should be a part of my job.
16. The FAA is more concerned with helping people do their job than improving hardware.

II. J -2-

17. The greatest difficulty I have in doing my job well is due to the nature of the work itself rather than FAA policies.
18. The facility's use of overtime does not often disrupt my personal life.
19. The facility's reluctant use of overtime does not often result in dangerous understaffing.
20. Consistently good performance is properly rewarded by the FAA.
21. Our facility chief does more for us because of policies set by the national FAA administration.
22. The welfare of controllers is high on the priorities of my facility chief.
23. I feel that training developmental controllers with live traffic should be a required part of my job.
24. The quality of accepted training candidates is appropriately high.
25. I believe it is just as difficult as ever to become a fully-rated journeyman controller.
26. I believe excellent performance as a controller is an important consideration when promotions are made.
27. An ATC does not lose the respect of fellow controllers when he is promoted.
28. An ATC's attitude toward controllers becomes much worse when he is promoted to supervisor.
29. Exceptional controller performance results in recognition from supervisors that helps in getting promoted.
30. Management give appropriate recognition when things are going well.

II. K-1

FAA Awards Questionnaire

We understand that the FAA has an awards and recognition program. The official names for these awards are:

- Outstanding Performance Award
- Quality step increase
- Point with Pride
- Award for Valor
- Yearly In-grade
- Suggestion Award
- Special Act Award (group)
- Special Achievement award

Please indicate the number of each of these awards you have received during the three years you have been in this study.

1. Outstanding Performance Award
2. Quality step-increase
3. Point with Pride
4. Award for Valor
5. Yearly In-grade
6. Suggestion Award
7. Special Act Award (group)
8. Special Achievement Award

ATCS SUBJECTIVE DIFFICULTY QUESTIONNAIRE

This short questionnaire inquires about several aspects of your work today. Please respond solely in terms of only your own experience. Select the answer to each question that most accurately reflects your response. Put an "X" in the appropriate box on the answer sheet.

If anything unusual or stressing occurred that is not included on this questionnaire, write it in the space provided at the end of the answer sheet.

1. Overall, how difficult do you feel your assignments have been today?
 - 1 Very easy
 - 2 Moderately easy
 - 3 A little easy
 - 4 Neither easy nor difficult
 - 5 A little difficult
 - 6 Moderately difficult
 - 7 Very difficult

2. Considering all of the tasks that composed your various assignments, how good a job do you feel you have done today?
 - 1 Best I've ever done
 - 2 Quite a bit better
 - 3 A little better than my average
 - 4 About my average
 - 5 A little less good a job
 - 6 Quite below my average
 - 7 Worst I've ever done

3. How heavy has been today's traffic in terms of number of aircraft handled?
 - 1 The highest I can recall
 - 2 Quite high
 - 3 Somewhat above average
 - 4 Average
 - 5 Somewhat below average
 - 6 Quite a bit below average
 - 7 The lightest I've ever had

II. L-2

4. What kind of aircraft mix have you had?
- 1 Totally commercial
 - 2 Much more than usual proportion of commercial
 - 3 More than usual proportion of commercial
 - 4 About an average mix of commercial and military and general aviation
 - 5 More than usual proportion of military and general aviation
 - 6 Much more than usual proportion of military and general aviation
 - 7 Totally military and general aviation
5. How much did weather affect the ease of working traffic today?
- 1 Made extremely easier
 - 2 Made quite easier
 - 3 Made somewhat easier
 - 4 Neither made easier nor difficult
 - 5 Made somewhat difficult
 - 6 Made quite difficult
 - 7 Made extremely difficult
6. Compared to other times, what was the quality of help provided by your strip man and handoff man?
- 1 Terrific
 - 2 Much better than usual
 - 3 Better than usual
 - 4 Average
 - 5 Not quite as good as normal
 - 6 Quite a bit below par
 - 7 The worst they've ever done
7. How many breakdowns or serious impairments of function (quality of return, fruiting, degradation, etc.) did your radar and communications equipment have today?
- 1 The greatest number of faults ever
 - 2 Many more faults than normal
 - 3 More faults than normal
 - 4 Average number of faults
 - 5 Fewer than average defects
 - 6 Many fewer faults than normal
 - 7 The fewest I've ever experienced

II. L-3

8. How many failures and impairments of function did the communications equipment on the aircraft have today?
- 1 The greatest number of faults ever
 - 2 Many more faults than normal
 - 3 More faults than normal
 - 4 Average number of faults
 - 5 Fewer than average defects
 - 6 Much fewer than average defects
 - 7 The fewest faults I've ever experienced
9. How did your supervisor contribute to your performance today?
- 1 Helped tremendously
 - 2 Helped quite a bit
 - 3 Helped somewhat
 - 4 Didn't help or hinder
 - 5 Hindered somewhat
 - 6 Hindered quite a bit
 - 7 Hindered me completely
10. How many interpersonal conflicts occurred for you today?
(Such as those arising from FAM flights, administrative policy, and other non-ATC action)
- 1 The most I've ever had
 - 2 Quite a bit more than usual number
 - 3 More than usual amount
 - 4 About usual amount
 - 5 Fewer than usual number
 - 6 Quite a bit fewer than usual number
 - 7 Fewest I've ever had
11. How many potential traffic conflicts occurred today compared to "normal" times?
- 1 The most I've ever had
 - 2 Quite a bit more than usual number
 - 3 More than usual number
 - 4 About usual number
 - 5 Fewer than usual number
 - 6 Quite a bit fewer than usual number
 - 7 Fewest I've ever had

II. L-4

12. How many changes from peak to slow controlling conditions occurred today compared to "normal" times?
- 1 The most I've ever had
 - 2 Quite a bit more than usual number
 - 3 Somewhat more than usual number
 - 4 About usual amount
 - 5 Fewer than usual number
 - 6 Quite a bit fewer than usual number
 - 7 Fewest I've ever had
13. How many times did you feel you were about to "go down the pipe"?
- 1 The most I've ever had
 - 2 Quite a bit more than usual number
 - 3 More than usual amount
 - 4 About usual amount
 - 5 Fewer than usual number
 - 6 Quite a bit fewer than usual number
 - 7 Fewest I've ever had
14. How much did your general mood prior to coming to work affect the difficulty of your job today?
- 1 My mood was terrible; made job much more difficult
 - 2 My mood was poor; made job moderately more difficult
 - 3 My mood was not as good as usual; made job a little more difficult
 - 4 Average mood and very little effect on the job
 - 5 Better than average mood; made job a little easier
 - 6 Much better than average mood; made job moderately easier
 - 7 I was in the best mood ever; made job much easier
15. If you gave training (formal or informal) today, how much of a burden was it? Circle box no. 4 if you did not give training today
- 1 Lightened the job extremely
 - 2 Lightened the job quite a bit
 - 3 Lightened the job somewhat
 - 4 Was neither burdensome nor did it lighten the job
 - 5 Somewhat burdensome
 - 6 Quite burdensome
 - 7 Extremely burdensome

II. L-5

16. How much did the requirements of this study contribute to the difficulty of your job today?

- 1 Made my job very much easier
- 2 Made my job quite easy
- 3 Made my job somewhat easier
- 4 Neither made easier or difficult
- 5 Made my job somewhat difficult
- 6 Made my job quite difficult
- 7 Made my job very difficult

17. Overall, in your experience as an ATC at this facility, how difficult were your assignments compared to most other assignments that you might have had?

- 1 Very easy
- 2 Moderately easy
- 3 A little easy
- 4 Average-- neither easy nor difficult
- 5 A little difficult
- 6 Moderately difficult
- 7 Very difficult

DIAGNOSTIC SUMMARIES SCORING ALGORITHMS

TEXT	LEVEL	ICDA	NDME	1-2	3-6	7-14	15-30	31+	STILL	UNDET
SPERMATOCELE	1	607.6	0	1	1	*	*	*	*	0
	2		0	1	1	*	*	*	*	0
	3		*	*	*	*	*	*	*	*
BOIL OF FACE	1	680.0	1	1	1	*	*	*	*	1
	2		1	1	1	*	*	*	*	1
	3		*	*	*	*	*	*	*	*
BOIL OF NECK	1	680.1	1	1	1	*	*	*	*	1
	2		1	1	1	*	*	*	*	1
	3		*	*	*	*	*	*	*	*
BOIL OF TRUNK	1	680.2	1	1	1	*	*	*	*	1
	2		1	1	1	*	*	*	*	1
	3		*	*	*	*	*	*	*	*
BOIL OF BUTTOCK	1	680.5	1	1	1	*	*	*	*	1
	2		1	1	1	*	*	*	*	1
	3		*	*	*	*	*	*	*	*
INFECTION-LOWER EXTREMITY	1	680.6	1	1	1	*	*	*	*	1
	2		1	1	1	*	*	*	*	1
	3		*	*	*	*	*	*	*	*
SKIN INFECTION	1	680.8	1	1	1	1	2	2	4	1
	2		1	1	1	1	2	2	4	1
	3		*	2	2	2	3	3	4	*
BOIL	1	680.9	1	1	1	*	*	*	*	1
	2		1	1	1	*	*	*	*	1
	3		*	*	*	*	*	*	*	*
CELLULITIS OF DIGIT	1	681.0	1	1	1	1	2	2	*	1
	2		1	1	1	1	2	2	*	1
	3		*	2	2	2	3	3	*	*
CELLULITIS	1	682.1	1	1	1	1	2	2	*	1
	2		1	1	1	1	2	2	*	1
	3		*	2	2	2	3	3	*	*
CELLULITIS OF ARM	1	682.2	1	1	1	1	2	2	*	1
	2		1	1	1	1	2	2	*	1
	3		*	2	2	2	3	3	*	*

DIAGNOSTIC SUMMARIES SCORING ALGORITHMS

TEXT	LEVEL	ICDA	NONE	1-2	3-6	7-14	15-30	31+	STILL	UNDET
PRURITIS ANI	1	698.0	0	1	1	1	1	1	1	0
	2		0	1	1	1	1	1	1	0
	3		0	1	1	1	1	1	1	0
NEURODERMATITIS	1	698.3	0	1	1	1	1	1	1	0
	2		0	1	1	1	1	1	1	0
	3		0	1	1	1	1	1	1	0
INGROWN NAIL	1	703.0	0	1	1	1	1	1	1	0
	2		0	1	1	1	1	1	1	0
	3		0	1	1	1	1	1	1	0
HAIR DISEASE	1	704.0	0	1	1	1	1	1	1	0
	2		0	1	1	1	1	1	1	0
	3		0	1	1	1	1	1	1	0
DYSIDROSIS	1	705.9	0	1	1	1	1	1	1	0
	2		0	1	1	1	1	1	1	0
	3		0	1	1	1	1	1	1	0
ACNE	1	706.1	0	1	1	1	1	1	1	0
	2		0	1	1	1	1	1	1	0
	3		0	1	1	1	1	1	1	0
SEBACEOUS CYST	1	706.2	0	1	1	1	1	1	1	0
	2		0	1	1	1	1	1	1	0
	3		0	1	1	1	1	1	1	0
SEBORRHEA	1	706.3	0	1	1	1	1	1	1	0
	2		0	1	1	1	1	1	1	0
	3		0	1	1	1	1	1	1	0
HIVES	1	708.9	0	1	1	1	1	1	1	0
	2		0	1	1	1	1	1	1	0
	3		0	1	1	1	1	1	1	0
OTHER SKIN DISEASE	1	709.9	0	1	1	1	1	1	1	0
	2		0	1	1	1	1	1	1	0
	3		0	1	1	1	1	1	1	0
OSTEOARTHRITIS	1	713.0	0	1	1	1	1	1	1	0
	2		0	1	1	1	1	1	1	0
	3		0	1	1	1	1	1	1	0

DIAGNOSTIC SUMMARIES SCORING ALGORITHMS

TEXT	LEVEL	ICDA	NONE	1-2	3-6	7-14	15-30	31+	STILL	UNDET
NECK PAIN	1	728.0	0	1	1	2	2	2	2	0
	2		0	1	1	2	2	2	2	0
	3		2	1	2	2	2	2	2	2
CERVICAL MYELOPATHY	1	728.4	0	1	1	2	2	2	2	0
	2		0	1	1	2	2	2	2	0
	3		2	1	2	2	2	2	2	2
THORACIC RHOICULITIS	1	728.5	0	1	1	2	2	2	2	0
	2		0	1	1	2	2	2	2	0
	3		2	1	2	2	2	2	2	2
LOW BACK PAIN	1	728.7	0	1	1	2	2	2	2	0
	2		0	1	1	2	2	2	2	0
	3		2	1	2	2	2	2	2	2
BACK PAIN	1	728.9	0	1	1	2	2	2	2	0
	2		0	1	1	2	2	2	2	0
	3		2	1	2	2	2	2	2	2
JOINT PAIN	1	729.9	0	1	1	2	2	2	2	0
	2		0	1	1	2	2	2	2	0
	3		2	1	2	2	2	2	2	2
SHOULDER BURSIITIS,ETC.	1	731.1	0	1	1	2	2	2	2	0
	2		0	1	1	2	2	2	2	0
	3		2	1	2	2	2	2	2	2
ELBOW BURSIITIS	1	731.2	0	1	1	2	2	2	2	0
	2		0	1	1	2	2	2	2	0
	3		2	1	2	2	2	2	2	2
OSTEOARTHRITIS,KNEE	1	731.6	0	1	1	2	2	2	2	0
	2		0	1	1	2	2	2	2	0
	3		2	1	2	2	2	2	2	2
BURSIITIS,ETC.	1	731.9	0	1	1	2	2	2	2	0
	2		0	1	1	2	2	2	2	0
	3		2	1	2	2	2	2	2	2
MYOSITIS	1	732.0	0	1	1	2	2	2	2	0
	2		0	1	1	2	2	2	2	0
	3		2	1	2	2	2	2	2	2

DIAGNOSTIC SUMMARIES SCORING ALGORITHMS

TEXT	LEVEL	ICDA	MONHE	1-2	3-6	7-14	15-30	31+	STILL	UNDET
CLOSED FRACTURE-CLAVICLE	1	810.0	2	2	2	2	2	2	2	2
	2		1	1	1	2	2	3	2	1
	3		2	1	2	2	2	3	2	2
CARPAL FRACTURE	1	814.0	2	2	2	2	2	2	2	2
	2		1	1	2	2	2	3	2	1
	3		2	1	2	2	2	3	2	2
CLOSED METACARPAL FRACTURE	1	815.0	2	2	2	2	2	2	2	2
	2		1	1	2	2	2	3	2	1
	3		2	1	2	2	2	3	2	2
FINGER FRACTURE	1	816.0	2	2	2	2	2	2	2	2
	2		1	1	2	2	2	3	2	1
	3		2	1	2	2	2	3	2	2
OPEN FRACTURE-FINGER	1	816.1	2	2	2	2	2	2	2	2
	2		1	1	2	2	2	3	2	1
	3		2	1	2	2	2	3	2	2
PATELLA FRACTURE	1	822.0	2	2	2	2	2	2	2	2
	2		1	1	2	2	2	3	2	1
	3		2	1	2	2	2	3	2	2
ANKLE FRACTURE	1	824.0	2	2	2	2	2	2	2	2
	2		1	1	2	2	2	3	2	1
	3		2	1	2	2	2	3	2	2
TARSAL/METATARSAL FRACTURE	1	825.0	2	2	2	2	2	2	2	2
	2		1	1	2	2	2	3	2	1
	3		2	1	2	2	2	3	2	2
TOE FRACTURE	1	826.0	2	2	2	2	2	2	2	2
	2		1	1	2	2	2	3	2	1
	3		2	1	2	2	2	3	2	2
FRACTURE	1	829.0	2	2	2	2	2	2	2	2
	2		1	1	2	2	2	3	2	1
	3		2	1	2	2	2	3	2	2
SHOULDER DISLOCATION	1	831.0	1	1	2	2	2	2	2	1
	2		1	1	2	2	2	3	2	1
	3		2	1	2	2	2	3	2	2

DIAGNOSTIC SUMMARIES SCORING ALGORITHMS

TEXT	LEVEL	JCDA	NONE	1-2	3-4	7-14	15-30	31+	STILL	UNDET
FINGER DISLOCATION	1	834.0	1	1	1	2	2	3	3	1
	2		1	1	1	2	2	3	3	1
	3		1	1	2	2	2	3	3	3
KNEE DISLOCATION	1	836.0	1	1	1	2	2	3	3	1
	2		1	1	1	2	2	3	3	1
	3		1	1	2	2	2	3	3	3
DISLOCATION-FOOT	1	838.0	1	1	1	2	2	3	3	1
	2		1	1	1	2	2	3	3	1
	3		1	1	2	2	2	3	3	3
SPRAIN-SHOULDER/ARM	1	840.0	0	1	1	2	2	3	3	0
	2		0	1	1	2	2	3	3	0
	3		1	1	2	2	2	3	3	3
SPRAIN-ELBOW/FOREARM	1	841.0	0	1	1	2	2	3	3	0
	2		0	1	1	2	2	3	3	0
	3		1	1	2	2	2	3	3	3
SPRAIN-WRIST	1	842.0	0	1	1	2	2	3	3	0
	2		0	1	1	2	2	3	3	0
	3		1	1	2	2	2	3	3	3
SPRAIN-HAND	1	842.1	0	1	1	2	2	3	3	0
	2		0	1	1	2	2	3	3	0
	3		1	1	2	2	2	3	3	3
HIP STRAIN	1	843.0	0	1	1	2	2	3	3	0
	2		0	1	1	2	2	3	3	0
	3		1	1	2	2	2	3	3	3
SPRAIN-KNEE/LEG	1	844.0	0	1	1	2	2	3	3	0
	2		0	1	1	2	2	3	3	0
	3		1	1	2	2	2	3	3	3
SPRAIN-ANKLE	1	845.0	0	1	1	2	2	3	3	0
	2		0	1	1	2	2	3	3	0
	3		1	1	2	2	2	3	3	3
SPRAIN-FOOT	1	845.1	0	1	1	2	2	3	3	0
	2		0	1	1	2	2	3	3	0
	3		1	1	2	2	2	3	3	3

DIAGNOSTIC SUMMARIES SCORING ALGORITHMS

TEXT	LEVEL	ICDA	NONE	1-2	3-6	7-14	15-30	31+	STILL	UNDET
SPRAIN-SACROILIAC	1	846.0	0	1	1	2	2	2	2	0
	2		0	1	1	2	2	3	2	0
	3		2	1	2	2	2	3	2	2
SPRAIN-NECK	1	847.0	0	1	1	2	2	2	2	0
	2		0	1	1	2	2	3	2	0
	3		2	1	2	2	2	3	2	2
SPRAIN-LOW BACK	1	847.8	0	1	1	2	2	2	2	0
	2		0	1	1	2	2	3	2	0
	3		2	1	2	2	2	3	2	2
SPRAIN-BACK	1	847.9	0	1	1	2	2	2	2	0
	2		0	1	1	2	2	3	2	0
	3		2	1	2	2	2	3	2	2
SPRAIN-JOINT	1	848.0	0	1	1	2	2	2	2	0
	2		0	1	1	2	2	3	2	0
	3		2	1	2	2	2	3	2	2
CEREBRAL CONCUSSION	1	850.0	1	1	1	2	2	2	2	1
	2		1	1	1	2	2	3	2	1
	3		2	1	2	2	2	3	2	2
OPEN WOUND-EYE COMPLICATED	1	870.1	2	2	2	2	2	2	2	2
	2		1	1	1	2	2	3	2	1
	3		2	1	2	2	2	3	2	2
SCALP LACERATION	1	873.0	1	1	1	2	2	2	2	1
	2		1	1	1	2	2	3	2	1
	3		2	1	2	2	2	3	2	2
LACERATION OF FACE	1	873.7	1	1	1	2	2	2	2	1
	2		1	1	1	2	2	3	2	1
	3		2	1	2	2	2	3	2	2
OPEN WOUND-HAND	1	882.0	1	1	1	2	2	2	2	1
	2		1	1	1	2	2	3	2	1
	3		2	1	2	2	2	3	2	2
LACERATION OF FINGER	1	883.0	1	1	1	2	2	2	2	1
	2		1	1	1	2	2	3	2	1
	3		2	1	2	2	2	3	2	2

DIAGNOSTIC SUMMARIES SCORING ALGORITHMS

TEXT	LEVEL	ICDA	NONE	1-2	3-6	7-14	15-30	31+	STILL	UNDET
UPPER LIMB WOUNDS	1	884.0	1	1	1	2	2	2	2	1
	2		1	1	1	2	2	3	2	1
	3		2	1	2	2	2	3	2	2
OPEN WOUND-HIP	1	890.0	1	1	1	2	2	2	2	1
	2		1	1	1	2	2	3	2	1
	3		2	1	2	2	2	3	2	2
OPEN WOUND-LEG	1	891.0	1	1	1	2	2	2	2	1
	2		1	1	1	2	2	3	2	1
	3		2	1	2	2	2	3	2	2
OPEN WOUND-FOOT	1	892.0	1	1	1	2	2	2	2	1
	2		1	1	1	2	2	3	2	1
	3		2	1	2	2	2	3	2	2
MULTIPLE OPEN WOUNDS	1	907.0	1	1	1	2	2	2	2	1
	2		1	1	1	2	2	3	2	1
	3		2	1	2	2	2	3	2	2
SUPERFICIAL INJURY-HEAD	1	910.0	0	1	1	2	2	2	2	0
	2		1	1	1	2	2	3	2	1
	3		2	1	2	2	2	3	2	2
SUPERFICIAL INJURY-TRUNK	1	911.0	0	1	1	2	2	2	2	0
	2		1	1	1	2	2	3	2	1
	3		2	1	2	2	2	3	2	2
SUPERFICIAL INJURY-HAND	1	914.0	0	1	1	2	2	2	2	0
	2		1	1	1	2	2	3	2	1
	3		2	1	2	2	2	3	2	2
FINGER INJURY	1	915.0	0	1	1	2	2	2	2	0
	2		1	1	1	2	2	3	2	1
	3		2	1	2	2	2	3	2	2
SUPERFICIAL INJURY-LEG	1	916.0	0	1	1	2	2	2	2	0
	2		1	1	1	2	2	3	2	1
	3		2	1	2	2	2	3	2	2
SUPERFICIAL INJURY-LEG	1	918.0	0	1	1	2	2	2	2	0
	2		1	1	1	2	2	3	2	1
	3		2	1	2	2	2	3	2	2

DIAGNOSTIC SUMMARIES SCORING ALGORITHMS

TEXT	LEVEL	ICDA	NONE	1-2	3-6	7-14	15-30	31+	STILL	UNDET
CONTUSION-HEAD	1	920.0	0	1	1	2	2	3	3	0
	2		1	1	1	2	2	3	3	1
	3		1	1	2	2	2	3	3	3
CONTUSION-TRUNK	1	921.0	0	1	1	2	2	3	3	0
	2		1	1	1	2	2	3	3	1
	3		1	1	2	2	2	3	3	3
CONTUSION-EYE	1	922.0	0	1	1	2	2	3	3	0
	2		1	1	1	2	2	3	3	1
	3		1	1	2	2	2	3	3	3
CONTUSION-ARM	1	924.0	0	1	1	2	2	3	3	0
	2		1	1	1	2	2	3	3	1
	3		1	1	2	2	2	3	3	3
CONTUSION-HAND	1	925.0	0	1	1	2	2	3	3	0
	2		1	1	1	2	2	3	3	1
	3		1	1	2	2	2	3	3	3
CONTUSION-FINGER	1	926.0	0	1	1	2	2	3	3	0
	2		1	1	1	2	2	3	3	1
	3		1	1	2	2	2	3	3	3
CONTUSION-LEG	1	927.0	0	1	1	2	2	3	3	0
	2		1	1	1	2	2	3	3	1
	3		1	1	2	2	2	3	3	3
CONTUSION-FOOT	1	928.0	0	1	1	2	2	3	3	0
	2		1	1	1	2	2	3	3	1
	3		1	1	2	2	2	3	3	3
CONTUSION-FOOT	1	929.0	0	1	1	2	2	3	3	0
	2		1	1	1	2	2	3	3	1
	3		1	1	2	2	2	3	3	3
FOREIGN BODY	1	930.0	0	1	1	2	2	3	3	0
	2		1	1	1	2	2	3	3	1
	3		1	1	2	2	2	3	3	3
BURN-HEAD	1	941.0	0	1	1	2	2	3	3	0
	2		1	1	1	2	2	3	3	1
	3		1	1	2	2	2	3	3	3

DIAGNOSTIC SUMMARIES SCORING ALGORITHMS

TEXT	LEVEL	ICDA	NONE	1-2	3-6	7-14	15-30	31+	STILL	UNDET
BURN-HAND	1	944.0	0	1	1	2	2	2	2	0
	2		1	1	1	2	2	3	2	1
	3		2	1	2	2	2	3	2	2
THIRD DEGREE BURN-LEG	1	945.3	1	1	1	2	2	2	2	1
	2		1	1	2	2	2	3	2	1
	3		2	1	2	2	2	3	2	2
BURN	1	949.0	0	1	1	2	2	2	2	0
	2		1	1	1	2	2	3	2	1
	3		2	1	2	2	2	3	2	2
ADVERSE EFFECT-PENICILLIN	1	960.0	0	1	1	2	2	2	2	0
	2		0	1	1	2	2	3	2	0
	3		2	1	2	2	2	3	2	2
ADVERSE EFFECT-ERYTHROCYCIN	1	960.3	0	1	1	2	2	2	2	0
	2		0	1	1	2	2	3	2	0
	3		2	1	2	2	2	3	2	2
ADVERSE EFFECT-OTHER ANTIBIOTICS	1	960.9	0	1	1	2	2	2	2	0
	2		0	1	1	2	2	3	2	0
	3		2	1	2	2	2	3	2	2
ADVERSE EFFECT-COAL TAR DERIV.	1	965.5	0	1	1	2	2	2	2	0
	2		0	1	1	2	2	3	2	0
	3		2	1	2	2	2	3	2	2
ADVERSE EFFECT-SALURITICS	1	975.3	0	1	1	2	2	2	2	0
	2		0	1	1	2	2	3	2	0
	3		2	1	2	2	2	3	2	2
ADVERSE EFFECT-OTHER	1	977.8	0	1	1	2	2	2	2	0
	2		0	1	1	2	2	3	2	0
	3		2	1	2	2	2	3	2	2
ADVERSE EFFECT-GASOLINE	1	981.1	0	1	1	2	2	2	2	0
	2		0	1	1	2	2	3	2	0
	3		2	1	2	2	2	3	2	2
TOXIC EFFECT-GAS FUMES	1	987.1	0	1	1	2	2	2	2	0
	2		0	1	1	2	2	3	2	0
	3		2	1	2	2	2	3	2	2

DIAGNOSTIC SUMMARIES SCORING ALGORITHMS

TEXT	LEVEL	ICDA	NGHC	1-2	3-6	7-14	15-30	31+	STILL	UNDET
TOXIC EFFECT-PESTICIDE	1	989.3	0	1	1	2	2	3	3	0
	2		0	1	1	2	2	3	3	0
	3		3	1	2	2	2	3	3	3
TOXIC EFFECT-VENOM	1	989.4	0	1	1	2	2	3	3	0
	2		0	1	1	2	2	3	3	0
	3		3	1	2	2	2	3	3	3
MOTION SICKNESS	1	994.6	0	1	1	2	2	3	3	0
	2		0	1	1	2	2	3	3	0
	3		3	1	2	2	2	3	3	3
INJURY-TRUNK	1	996.1	0	1	1	2	2	3	3	0
	2		1	1	1	2	2	3	3	1
	3		3	1	2	2	2	3	3	3
INJURY-FINGER	1	996.5	0	1	1	2	2	3	3	0
	2		1	1	1	2	2	3	3	1
	3		3	1	2	2	2	3	3	3
INJURY KNEE,LEG ETC.	1	996.7	0	1	1	2	2	3	3	0
	2		1	1	1	2	2	3	3	1
	3		3	1	2	2	2	3	3	3
INJURY-OTHER	1	996.8	0	1	1	2	2	3	3	0
	2		1	1	1	2	2	3	3	1
	3		3	1	2	2	2	3	3	3
POST-OP HEMORRHAGE	1	998.1	0	1	1	2	2	3	3	0
	2		0	1	1	2	2	3	3	0
	3		3	1	2	2	2	3	3	3
SERUM REACTION-OTHER	1	999.5	0	1	1	2	2	3	3	0
	2		0	1	1	2	2	3	3	0
	3		3	1	2	2	2	3	3	3