DOT HS-801 413

A REVIEW OF THE LITERATURE ON THE INVOLEMENT OF ALCOHOL IN PEDESTRIAN COLLISIONS RESULTING IN DEATH AND INJURY

Contract No. DOT-HS-4-00946
February 1975
Interim Report

PREPARED FOR:

U.S. DEPARTMENT OF TRANSPORTATION

NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION

WASHINGTON, D.C. 20590

Document is available to the public through
the National Technical Information Service,
Springfield, Virginia 22151

TECHNICAL REPORT STANDARD TITLE PAGE

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
DOT-HS-801-413		

4. Title and Subtitle	5. Report Date
A Review of the Literature on the Involvement of Alcohol in Pedestrian Collisions Resulting in Death and Injury.	February 1975
	6. Performing Organization Code
7. Author(s) Richard Zylman, Richard D. Blomberg, David F. Preusser	8. Performing Organization Report No. ED 74-10
9. Performing Organization Name and Address Dunlap and Associates, Inc. One Parkland Drive Darien, Connecticut 06820	10. Work Unit No.
	11. Contract or Grant No. DOT-HS-4-00946
12. Sponsoring Agency Name and Address Department of Transportation National Highway Traffic Safety Administration 400 Seventh Street, S.W. Washington D.C. 20590	13. Type of Report and Period Covered Interim Report 6/74-9/74
	14. Sponsoring Agency Code

15. Supplementary Notes

16. Abstract

A review of the literature on the existing state of knowledge of the role of alcohol in pedestrian accidents indicates that little is currently known. It is concluded that more data are needed before the extent of any pedestrian safety problems involving alcohol can be quantified or countermeasures can be devised.

17. Key Words	18. Distribution Statement
Pedestrian, alcohol	Document is available to the public through the National Technical Information Service, Springfield Virginia 22151

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
UNCLASSIFIED	UNCLASSIFIED	58	

Form DOT F 1700.7 (8-69)

TABLE OF CONTENTS

FOREWORD

This report was prepared by Dunlap and Associates, Inc., for the U.S. Department of Transportation, National Highway Traffic Safety Administration under Contract No. DOT-HS-4-00946. The basic purpose of the report is to summarize the literature and existing state of knowledge regarding alcohol and pedestrian safety. More specifically, attention has been focused upon the frequency and possible overinvolvement of alcohol in pedestrian accidents and alcohol as a causative element in these accidents. The ultimate objectives of the entire study are:

- To ascertain whether alcohol is overinvolved in pedestrian fatalities and/or accidents, and, if so, to determine the magnitude of overinvolvement.

- To determine *if significant* differences in pedestrian behavior are associated with different levels of BAC.

The responsible Officer and Project Director for this project is Richard D. Blomberg. David F. Preusser, John F. Oates, Jr., and Allen Hale comprise the Senior Research Staff. Richard Zylman, the principal author of this report, is a consultant to the project and a Research Specialist at the Center of Alcohol Studies, Rutgers University. Alfred J. Farina, Jr. is the NHTSA Contract Technical Manager for the study.

LIST OF TABLES

SUMMARY

The major conclusion to be drawn from a careful and thorough analysis of the existing state of knowledge regarding alcohol and pedestrian safety is that virtually nothing is known about this potentially serious problem. However, the bits of information available and the similarity of the pedestrian-alcohol situation to the more extensively researched area of drinking-driving permits an estimate of what is not known and how this needed knowledge can be acquired.

There are three types of information currently available concerning the pedestrian-alcohol problem. The first, and relatively the most voluminous, is post-mortem blood alcohol concentration, or BAC, measurements on fatally injured pedestrians. In some cases these have been gathered as part of a specific investigation of the pedestrian-alcohol problem. In others, they are part of the routine reporting of coroners or medical examiners. Regardless of the reason for their publication, these data on fatally injured pedestrians provide a woefully incomplete picture of the nature and extent of the problem. First, they only shed light on the tip of the iceberg--the fatal crash. They provide no information on the pedestrian accident which results in a non-fatal injury. Second, the measurement problems inherent in these studies make it difficult or impossible to estimate accurately the causal role of alcohol. At least ten major studies of fatally injured pedestrians were examined during this review. The percentage of pedestrians on whom tests were made who exhibited a positive BAC, i.e., had been drinking, varied from a high of almost 74 percent in a study conducted by Haddon et al (8) in New York City to a low of just under 30 percent in a study by Tonge et al (5), a difference of well over 100 percent. Overall, these studies show the mean occurrence of alcohol in tests on fatally injured pedestrians to be approximately 45 percent. However, even this number must be viewed with care.

There are several problems with the existing data on alcohol involvement in fatal pedestrian accidents. First, it is apparent that, taken at face value as, unfortunately, has been done in some public relations campaigns, they over-emphasize the role of alcohol. This is not to say that they erroneously create a problem which does not, in reality, exist. On the contrary, the total of the little available evidence points to the possible existence of an alcohol problem in pedestrian crashes. However, the existing fatality data, if taken out of context, tend to overstate the proportion of alcohol-related fatal pedestrian accidents. In all of the studies of fatalities which have reported a percentage of alcohol involvement, there are numerous cases for which post-mortem

BAC measurements were not made. In general, BAC measurements will not be made on victims who are under 14 years of age or who survive the crash by more than a specified criterion time--generally 6, 12 or 24 hours. If it is assumed that the rate of alcohol involvement in this non-tested group is the same as for those actually tested, two serious biases will be introduced into the estimation. First, there is ample evidence that the rate of alcohol involvement in victims under 15 years of age is exceedingly low or non-existent. Thus, assuming their alcohol involvement to be the same as that for those tested will overstate the role of alcohol. Second, studies of fatally injured drivers by Baker and Spitz (4) and Robertson et al (41) indicate that victims who survive over 6 hours are distinctly different from those who die within the criterion time for a post-mortem BAC test. Most importantly, they tend to be over 60 years old, less likely to have been drinking, and they tend to die of injuries from which younger people would have recovered. Again, this will have the effect of overemphasizing the role of alcohol.

Nothwithstanding the problems of estimation, it is of interest to estimate alcohol's role in fatal pedestrian accidents. From all of the admittedly vague available information, it would appear that approximately 36 percent of fatally injured adult pedestrians had a BAC of 100 mg% or more, approximately 70 percent of which (i.e. 25 percent of all pedestrian fatalities) were responsible for their crash. However, this 36 percent estimate will only become meaningful when it can be compared with the percentage of pedestrians who have been drinking and who are using the streets at those times and places where accidents occur but who are not involved in crashes. Simply, a control group is needed. Then, if it were found that injured pedestrians had been drinking to a greater extent than the control population, a causal relationship could be inferred. Further, the greater the discrepancy between what is found in the crash population and what is found in the control, the stronger will be the inference that alcohol is causally related to accident involvement.

The second type of information currently available concerning pedestrian accidents and alcohol is the controlled study. Surprisingly, there appears to have been only one such study ever performed. It was conducted by Haddon et al (8) in New York City in 1959 and presents BAC data on only 19 fatally injured pedestrians who are compared with 76 site-matched controls. While this study identifies a strong discrepancy between the blood alcohol levels of victims and controls across all levels of BAC from low to high, it must be viewed with great caution. Among other factors, the extremely small sample size itself gives rise to a potentially large statistical sampling error which

makes interpretation difficult. This may explain why the alcohol involvement rate of 74 percent among crash victims in this study differs so markedly from that reported in all of the other post-mortem studies reviewed. In any case, this discrepancy is sufficient to dictate caution when attempting to generalize the Haddon results to the total pedestrian-alcohol situation. Certainly, the Haddon study is suggestive of the existence of a problem. However, it is not sufficiently powerful to quantify that problem as guidance for the development of countermeasures.

The third type of available information on the role of alcohol in pedestrian accidents is based upon qualitative assessments of the presence of alcohol in the crash victims. By definition, these data can only be indicative because they lack any precise measurement of BAC. Nevertheless, they are capable of providing information on the dynamics of the alcohol involved pedestrian crash, and they are virtually the only available information on the alcohol-related non-fatal pedestrian accident. The basis of this information is a study performed by Snyder and Knoblauch (25) which examined over 2,000 pedestrian accidents in 13 U.S. cities. Although alcohol involvement was not a major focus of this study, data on pedestrian alcohol usage were gathered through observations by police, researchers and witnesses. In order to examine the alcohol-related information from this study for the current effort, a data tape of the original case information was obtained and software was written to examine the salient variables. In general, the results do not currently appear in the existing literature, but they represent the state of knowledge on the likely characteristics of the alcohol-related pedestrian accident.

The major findings of these analyses of the Snyder and Knoblauch data are:

1) Drinking adult pedestrians appear overrepresented in the dart and dash accident types. These are the accidents in which the pedestrian suddenly leaves the curb or other place of safety and quickly moves into the path of a car.

2) A larger proportion of pedestrian behavioral errors were found in crashes in which alcohol usage was suspected than were driver errors (11 percent to 7 percent). This suggests that the pedestrian system is, in fact, experiencing a greater number of failures when under the influence of alcohol.

3) Alcohol appears to be a particularly serious problem for pedestrians in the 25 to 64 age range. Drinking appears to be negligible up to age 19, increases rapidly, then tapers off as a major factor during old age.

4) The alcohol problem seems to be more acute among adult male pedestrians than among adult females (12 percent to 3 percent).

5) It appears as though ethnic minorities are overrepresented among alcohol-involved pedestrian accident victims.

6) There is indication that drinking by a pedestrian victim tends to be associated with an increase in injury severity resulting from an accident.

7) There is an indication that the pedestrian-alcohol problem parallels the driver alcohol problem in terms of time of day and day of week. Alcohol-involved pedestrian accidents occur more frequently at night and on weekends.

In summary, an analysis of the Snyder and Knoblauch data seems to extend many of the findings of alcohol and driving research to the pedestrian situation.

Overall, it must be concluded that our knowledge of the role of alcohol in pedestrian accidents is exceedingly small. Thus, there is a clear need for a carefully controlled epidemiological study focused upon both fatal and non-fatal pedestrian crash events. Only upon completion of such a study will we have sufficient data on the extent and nature of any problem which might exist to begin devising countermeasures against it. Fortunately, the study of which this review was an initial step is intended to accomplish this purpose as its major research objective.

I. INTRODUCTION

In 1972 there were 10,700 pedestrian fatalities in the United States and another 120,000 were injured (1). The purpose of the present effort is to determine what is currently known about the role which alcohol played in those casualties. Of particular interest are the behavioral correlates of drinking on the part of the pedestrian.

The usual review of this sort would list a series of studies and then summarize their findings in order to arrive at some "ball park" estimate of alcohol involvement in pedestrian collisions. It has been found, however, that available data fall far short of that which would be required to adequately define the problem, must less formulate countermeasures (2). There is a particularly severe lack of data concerning the behavioral correlates of alcohol use among pedestrians.

There are serious questions as to the representativeness of data and assumptions about the causal role of alcohol in injury and death producing collisions. The implications are so grave and the evidence so widespread that the present review will be directed first toward the extent and validity of all data on alcohol and pedestrian safety after which an estimate of the causal role of alcohol in fatal pedestrian crashes will be attempted. Finally, some insights on the characteristics of pedestrian crashes involving alcohol are presented based upon a new analysis of data previously collected by Snyder and Knoblauch (25). While not definitive, these findings add materially to the existing circumstantial evidence on the problem.

II. THE NATURE OF EXISTING DATA ON ALCOHOL AND PEDESTRIAN SAFETY

Fatality Data

The largest body of information on the incidence of alcohol in pedestrian accidents are the data from coroners and medical examiners on pedestrian fatalities. These data have either been reported as part of specific pedestrian or driver safety studies or in routine activity reports of the testing agencies. Table 1 summarizes the findings of ten such studies or reports. From this table, it can be seen that the percent of those victims who were tested who were free of alcohol varies from slightly over 26 percent (Haddon et al, 8) to just over 70 percent (Tonge et al, 43). Stated differently, the percentage of victims in fatal pedestrian accidents in these studies who exhibited a positive blood alcohol concentration (BAC), i.e. had been drinking, ranges from about 30 percent to about 74 percent. This large range is indicative of the uncertain state of current knowledge on the incidence of alcohol in fatal pedestrian accidents.

Unfortunately, there are several problems with the existing data on alcohol involvement in fatal pedestrian accidents. First, it is apparent that, taken at face value as, unfortunately has been done in some public relations campaigns, they overemphasize the role of alcohol. This is not to say that they erroneously create a problem which does not, in reality, exist. On the contrary, the total of the little available evidence points to the possible existence of an alcohol problem in pedestrian crashes. However, the existing fatality data, if taken out of context, tend to overstate the proportion of alcohol-related fatal pedestrian accidents. In all of the studies of fatalities which have reported a percentage of alcohol involvement, there are numerous cases for which post-mortem BAC measurements were not made. In general, BAC measurements will not be made on victims who are under 14 years of age or who survive the crash by more than a specified criterion time--generally 6, 12, or 24 hours. If it is assumed that the rate of alcohol involvement in this non-tested group is the same as for those actually tested, two serious biases will be introduced into the estimation. First, there is ample evidence that the rate of alcohol involvement in victims under 15 years of age is exceedingly low or non-existent. Thus, assuming their alcohol involvement to be the same as that for those tested will overstate the role of alcohol. Second, studies of fatally injured drivers by Baker and Spitz (4) and Robertson et al (41) indicate that victims who survive over 6 hours are distinctly different from those who die within the criterion time for a post-mortem BAC test. Most importantly, they tend to be over 60 years old,

Table 1

Adult Pedestrian Deaths Showing Number Killed, Number Tested and Distribution by BAC in Percent

	No. Killed	No. Tested	00*	Mg% 10-40	Mg% 50-90	Mg% 100-140	150Mg% or more
Waller et al (5)		435	64.6	1.1	3.7	4.6	26.0
Filkins et al (3)		167	40.7	11.4	5.4	4.2	38.4
Perrine et al (9)		14	64.3	7.1	0.0	7.1	21.4
Neilson (24)	1744	1617	54.7	3.2	4.6	6.7	30.8
Davis and Fisk (42)	528	318	57.2	3.5	2.5	15.7	21.0
Gerber (12)	151	81	60.5	2.5	7.4	0.0	29.6
New Jersey (23)	608	409	57.0	5.6	5.1	8.8	23.5
Haddon et al (8)	50	19	26.3	26.3	5.3	10.5	31.6
Tonge et al (43)		278	70.1	2.9	1.4	5.0	20.5
Preusser (45)	268	177	62.7	10.2	6.2	4.5	16.4

* BAC Test Negative

less likely to have been drinking, and they tend to die of injuries from which younger people would have recovered. Again, this will have the effect of overemphasizing the role of alcohol. Thus, the percentage of alcohol involvement in studies such as those listed in Table 1 should only be viewed as indicative of victims who were tested and not all victims. Finally, these data should not be viewed as an indication of the involvement of alcohol in pedestrian crashes which result in non-fatal injuries. Although little is known about the role of alcohol in these crashes (some circumstantial evidence is presented in Section IV), inferences from the drinking driver situation would indicate that the non-fatal pedestrian crash is likely to be distinctly different from the fatal event.

Controlled Studies of Fatal Crashes

It should also be noted that the use of such numbers as 10 percent, 30 percent or 50 percent to describe the proportion of pedestrian fatal crashes "involving alcohol" implies a need to compare those numbers with other numbers. In this case, those numbers become meaningful only if they can be compared with the proportion of pedestrians who have been drinking and who are using the highways at those times and places where crashes occur but who are not involved in crashes.

Theoretically, if a control group of pedestrians were randomly selected from those walking at times and places where such fatal crashes occur, each pedestrian will have had an equal chance of being selected to represent that population-at-risk or control as he would have of being involved in a fatal crash--if involvement in fatal crashes were a matter of chance.

Following this theory a step further within the context of the present study--if crash involvement were a matter of chance, pedestrians involved in crashes should be very similar to pedestrians in the control regarding such characteristics as age, sex, presence of alcohol, etc. On the other hand, if collisions are not a matter of chance but related to such characteristics as age, one would expect to find a different distribution of age groups in the collision population from that in the control group. For example, if it were found that young and old pedestrians appeared in the crash population more often than in the control, one could assume some causal relationship. Similarly, if it were found that injured pedestrians had been drinking at about the same frequency and with similar concentration of alcohol in their system as those in the control, one would conclude that alcohol was not predictive of crash involvement. On the other hand, if it were found that pedestrians with any given BAC were found significantly more often in the crash population, one could infer a causal relationship--and the greater the discrepancy between what is found in the crash population and what is found in the control, the stronger the inference that alcohol was causally related to crash involvement. This theory was originated by Holcomb (15) and is the basis of the few controlled studies of alcohol and traffic safety which have been performed. However, it must be noted that this process of establishing a control group may be biased. The extent and nature of this bias is a function of:

1. The extent to which drinking does lead to an increased likelihood of pedestrian/vehicle crash.

2. The extent to which drinking pedestrians tend to cluster by time of day, day of week and location.

Concerning the first source of bias, the greater the increase in accident occurrence after drinking, the relatively more drinking accidents will enter the sample and thus accident site controls will more often be drawn from a drinking accident location. This becomes a problem if the second source of bias is also operating. Namely, that the probability that a pedestrian has been drinking varies as a function of time of day, location, etc. The literature on drinking driving suggests that both of the above sources of bias will be present among pedestrians. Notably, neither source of bias is necessarily related to actual highway risk as it pertains to traffic flow, road construction or any other physical variable in the highway system.

This is not to say that there is no need for an accident site control group. On the contrary, these controls are a very valuable source of data, especially if the effects of alcohol on pedestrian behavior are differential across individuals. However, the accident site controls will underestimate the true role of alcohol to the extent that the above two factors are operating. Therefore, it would be beneficial to examine a second control group representative of the pedestrian population at large.

Surprisingly, of all the work done in this field, there are only two controlled studies related to alcohol involvement among drivers in fatal crashes and one directed toward the problem of pedestrian casualties. The only controlled study of pedestrian deaths was conducted in Manhattan by Haddon et al (8). The methodology used was similar to that described above. Included in the study were 50 adult pedestrian fatalities occuring in Manhattan over a six-month period. Investigators gathered relevant information including autopsy reports on those killed, and within a few weeks of such occurrence went to the location of the crash at the same time and on the same day of the week to interview four pedestrians and to obtain a breath specimen from each. The individuals were selected on the basis of being (a) walking pedestrians, (b) 18 years or older, and (c) of the same sex as the pedestrian who died at that location. In this way they obtained a sample of 200 passers-by as "controls" to be compared with those who were killed.

Among the 50 pedestrians who died, 28 survived more than six hours after the crash and were not included in the study; two were omitted because of clerical error, and one test was not used for other reasons, leaving 19 cases for comparison with 76 site-matched controls.

It was found "that the presence of ethyl alcohol in the blood, particularly in high concentration, was highly associated with such accident involvement, that only a minority of those killed who died within six hours had not been drinking, and that the findings were similar whether the comparison was made with the total control group, with the controls from the same sites, or with

the age and sex-matched controls. These findings are similar to and consistent with those relative to drivers obtained by other workers using laboratory, field trial and epidemiological methods. "

Regarding the involvement of the lower BACs, the authors reported "The smallness of the series precludes the estimation of relative risk as a function of blood alcohol concentration, but it is seen that persons with blood alcohol concentrations in the low, 10-40 mg% range were found significantly more often among the cases than among the noninvolved controls obtained from the same accident sites."

Finding an overrepresentation of the low BACs among the fatal pedestrian cases is at variance with each of the controlled studies of alcohol in collision-involved drivers (15, 16, 17, 19, 9, 20). Each of those studies found that BACs below 50 mg% appeared in the control population more often than among collision-involved drivers. Borkenstein et al (19) reported that there was a numerical overrepresentation of positive BACs in the collision-involved population at 50 mg% and above, and that at 80 mg%, the difference became statistically significant. It should be noted, however, that the Borkenstein et al study pertained to collisions-in-general and that the level at which alcohol becomes a statistically significant factor in fatal driver crashes has not yet been determined.

This raises the question as to the strength of the findings by Haddon et al, i.e., that BACs as low as 10-40 mg% appeared in the fatal cases more often than in the control. Shown in Table 2 are the actual numbers involved (from Table XI B in Haddon et al, 8).

It is readily seen that the numbers are exceedingly small. These small numbers take on new meaning when it is considered that 56 percent of the pedestrians survived more than six hours and that, on the basis of evidence on driver fatalities reported by Baker and Spitz (4), it can reasonably be assumed that such survivors tended to be older and to have died from injuries from which younger persons may recover, and tended not to have been drinking. If this is also true of pedestrians (and there is no readily apparent reason why it should not be), it might be expected that had a number of those extended survivors died, instead, within the six-hour period, the proportion shown above would have changed considerably.

Table 1 presents further reason to question the applicability of the Haddon et al results. Haddon et al reported only 26 percent of the deceased pedestrians as being alcohol free; the other studies vary from 41 percent to 70 percent. Haddon et al report 26 percent of the deceased as having a BAC in the 10-40 mg% range; the other seven studies vary from one to 11 percent.

Table 2

BAC by Subject Class from Haddon et al (8)

BAC*	Surviving less than six hours	Site Matched Controls from Same Sites
00	5	55
10 -40	5	8
50 -90	1	7
100-140	2	1
150-190	5	-
200-240	1	3
250-290	-	1
Lab loss	1 (omitted)	1
Totals	19	76

* Mg percent

One must also question why Haddon et al report 56 percent of the deceased pedestrians as surviving more than six hours after the collision, whereas each of the other seven studies reviewed of drivers and pedestrians combined show 32 percent or less as surviving more than six hours (Table 3). Even though Robertson et al (41) showed a higher percent of pedestrians surviving over six hours (35 percent to 31 percent for combined drivers and pedestrians), his data still show a much lower percentage than Haddon's. This variation could be purely statistical, arising from the small sample size in the Haddon et al study. It may also have arisen from the likely anomalous nature of Haddon's study site (New York City). In any case, care must be exercised when attempting to generalize the Haddon et al results to the nation.

Further, in view of the consistent results found in the controlled studies of drivers involvement in collisions, each of which shows that the low BACs are not predictive of collision-involvement, and the discrepancy in findings by Haddon et al when compared with seven other studies, the results of the Haddon et al study showing a relationship between the low BACs and pedestrian fatal crash involvement must also be used with extreme caution. As the authors stated, "The smallness of the series precludes the estimation of risk as a function of blood alcohol concentration." To this the present writer must add: at this point in time, evidence that low BACs are predictive of pedestrian injury and death is not convincing.

Table 3

Variations in Survival Time

Report	Number of Cases ***	Percent who survived more than six hours
Filkins et al. (3)	616	4
Freimuth et al. (40)	500	9
Perrine et al. (9)	209	9
New Jersey (23)	2653	21
Waller et al. (5)	2069	32
Baker and Spitz (4)	328 ****	32
Haddon et al. (8)*	50	56
Robertson et al. (41)**	2081	31

* Adult pedestrians only
** Among 864 pedestrians, 35 percent survived more than 6 hours
*** Combined drivers and pedestrians
**** Drivers only

Behavioral Responsibility

A survey of the literature yielded very little information about the responsibility of drunken pedestrians for behavioral errors which precipitated the collisions that lead to their own demise. The fact that so few researchers have examined this question may reflect the widespread belief that if one had been drinking, he must have been at fault, and the concomitant position if one were sober, he must have been innocent.

It is worth noting Waller's comment about the difference between assigning responsibility for research purposes and the determination of fault or legal culpability as made by police (21). Whereas the police are constrained by legal limitations and may assign fault to both parties in a two-vehicle crash, Waller followed the method devised by McCarroll and Haddon (17). One of the differences is that, for research purposes, responsibility should be assigned to one vehicle whenever possible. If both vehicles played a significant role in causing the crash, responsibility is classed as "unknown"; also, for research purposes, responsibility should be assigned to the person who initiated the crash, which may or may not be the same as legal responsibility.

Although the above discussion pertained principally to responsibility in motor vehicle crashes, it is apparent that determination of responsibility based on committed behavioral errors must be a part of any study of pedestrian casualties.

Responsibility of Impaired Pedestrians

Waller (21) is among the few researchers to have given serious consideration to whether the drunken pedestrian was responsible for his own death. He found that among 23 pedestrians between 15 and 59 years old who had a BAC of 100 mg% or more, the pedestrian was responsible in 14 of the cases; in 6 cases the driver was responsible and in 3 cases the responsibility was unknown. Among 22 pedestrians 60 years and older with 100 mg% BAC or more, nine were responsible for their own death; the driver was responsible in seven cases, and in five cases responsibility was unknown.

In a more recent study, Marsden (22) found that among 50 pedestrians known to have been drinking (of which 11 were below 100 mg%), the pedestrian was responsible for his own demise in 33 cases, the driver was responsible in six cases, and there was either no violation or it was unknown who was responsible for 11 deaths.

Among 24 adult pedestrian fatalities with a BAC of 100 mg% or more, Baker* found 14 probably negligent, six probably not, and too little information on four to make a determination as to who was responsible.

Among 120 adult pedestrians in the New Jersey study (23) who had a BAC of 100 mg% or more, and for whom responsibility had been determined, 94 percent were classified as either responsible or partially responsible.

Two characteristics stand out in the data about responsibility of pedestrians for their own deaths: (a) the numbers, in most studies, are extremely small considering that they are the basis for evaluating a problem that costs nearly 11,000 lives and billions of dollars per year; and (b) the range of "responsible" pedestrians varied from 45 percent to 94 percent. This range of conclusions suggests, if nothing more, the very uncertain state of knowledge in this field.

Sober Victims at Fault?

It should not be overlooked that a substantial number of those who had nothing to drink were also responsible for their death. Waller (21) found that of 19 child pedestrians for whom responsibility was determined, the victim was at fault in 13 cases; and among 47 sober adult pedestrians, the victim was responsible in 14.

It is abundantly clear that substantial numbers of pedestrians who die while sober have also committed behavioral errors which lead to their own deaths. This factor has been totally ignored in the public information campaigns, official reports and most research studies in which it has been assumed that if a person had been drinking before he died, he must be responsible in one way or another. Whether or not sober drivers may be behaviorally responsible has been considered irrevelant if considered at all.

This raises the question as to whether those who die with measureable BACs and who were responsible for their own deaths because of behavioral errors in the accident avoidance sequence are distinctly different from the sober victims who were responsible; different in such demographic and behavioral characteristics as age, sex, marital status, religion, national origin, race, social status, physical-psychological make-up, awareness,

* Personal correspondence from S. P. Baker to R. Zylman.

attitudes, prior police and health records, drinking habits, purpose for walking, drinking experience, driving experience, etc., that their deaths, can, with certainty, be "related to alcohol". If not, if it is conceded that some, or even many, of the behavioral characteristics found among sober responsible pedestrians when they died are also found among those who had been drinking when they died, then what proportion of the "alcohol-involved" traffic deaths involve alcohol in any causal fashion? That is, if alcohol does not produce distinctly different unsafe behaviors, does it increase the occurrence of some dangerous behaviors already identified as leading to pedestrian crashes?

It seems plausible that a thorough investigation of the similarities and differences between sober victims who died and those who have been drinking may aid in identifying common characteristics which, either independently or in combination with alcohol, may lead to crash involvement. It may even be learned that alcohol is only one of several major variables common in pedestrian deaths on the highway.

Brave New Approach--or Heresy?

Special mention should be made of the study by Snyder and Knoblauch (25) because it represents a behaviorally-oriented approach which has a potential of leading to a better understanding of the alcohol-traffic problem. They reported on 2,000 pedestrian injury collisions and more than 250 pedestrian deaths in 13 of the nation's largest cities in 1969 and 1970 and found that alcohol was a predisposing factor, i.e., an influencing factor, in less than 7 percent of the deceased pedestrians and just 6 percent of the drivers involved in pedestrian deaths.

At first glance this estimate of alcohol involvement in pedestrian deaths seems too low to warrant serious consideration. However, a closer examination reveals several reasons why the figure is low and why it is more reasonable than it would first appear: (a) 28 percent of the fatalities were children under 15 years old (considering only those 15 and older, pedestrian alcohol was a predisposing factor in almost 10 percent of the fatalities), (b) establishing the presence of alcohol was accomplished by observation, from police records and witness interviews rather than by chemical tests of body substances, (c) the study was biased toward daytime fatalities when drinking among pedestrians is less prevalent, (d) and most important, they considered more than 60 precipitating factors and 20 predisposing factors, of which alcohol was one. Precipitating factors included such circumstances as failure to see vehicle, distraction, inattention, running stop signs, blinding headlights, etc.; factors frequently called "causes". Predisposing

factors are those which increase the likelihood of a collision. They relate to heavy exposure and high risk, the environment, the vehicle and human element; alcohol was only one of 20 such predisposing factors and was judged to be a predisposing factor only when it contributed to the precipitating events. Thus, when alcohol is considered objectively as just one cause among many, it appears that its relationship to crash involvement on the part of the pedestrian was unknown in 37 percent of the cases in this study.

The Snyder and Knoblauch study should be regarded as the prototype of studies that would lead to a better and, above all, more objective understanding of the traffic problem. In addition, some special analyses of the data from this study (presented later in this report) provide virtually the only available glimpse at alcohol's role in pedestrian accident crash dynamics, and in the non-fatal crash.

It would appear that the notion that alcohol is always the unique causal factor if a pedestrian victim had been drinking prior to his crash cannot be substantiated. Thus, careful examination of victims and controls who are not accident involved must be made on the level of crash-inducing behaviors as was done by Snyder and Knoblauch (25). This analysis must also include driver behaviors as Snyder and Knoblauch did so that true "responsibility" or causality can be properly attributed for each type of crash. Only then will it be possible to delineate alcohol's role in terms of inducing accidents and inducing particular accident types related to specific pedestrian behavioral errors.

III. ESTIMATING THE ROLE OF ALCOHOL IN FATAL PEDESTRIAN ACCIDENTS

How Many Pedestrian Deaths Involve Alcohol?

It is apparent that the problem is nationwide but has only been studied in bits and pieces and mainly in urban areas, none of which are representative of all America. There is no right answer, no one statement about the number involved that will be viable at all times and in all places. About the best that can be hoped for is a range, e.g., 20 to 30 percent of adult pedestrian deaths may "involve alcohol".

The dearth of information about the behavioral errors of drunk vs sober pedestrians is an example of the fragmented research characteristic of this field; there are almost no data on this aspect of the problem. The present review quotes Waller (21) and Marsden (22) as using numbers that seem insignificant when compared with a death toll of about 10,700 pedestrians per year. They are anything but insignificant; they may very well be some of the most important figures in the literature, if only because of their paucity.

For example, Waller (21) reported on 22 sober pedestrian deaths between the ages of 15 and 59 years old, of which 5 were responsible, 11 were not responsible and 6 were undetermined. These few cases represent all that is known within the context of the alcohol-traffic problem about the behavioral responsibility of adult pedestrians for their own death. Thus, the data on what may be one of the most important aspects of the whole problem consists of just 22 cases, in 6 of which responsibility was not determined. Presumably, had there been sufficient evidence to assign responsibility to the other six, responsibility on the part of the sober adult pedestrian could be as high as 50 percent or as low as 23 percent. Projected to the national scene, that could mean that as many as 2600 adult sober pedestrians or as few as 1200 were responsible for their own death--and it all depends on the presence or absence of information on six cases in California in the early 1960's. (Note: This is not a criticism of Waller: he was one of the few researchers who even thought the responsibility status in behavioral terms of sober victims might be of value in evaluating the responsibility of drunken victims.)

Why is it so important to understand how sober pedestrians die, when alcohol is the problem? Because, if we can learn how sober adult pedestrians die, it may be helpful in understanding how inebriated pedestrians die; it may even be found that some of the factors prevalent in sober predestrian deaths, e.g., the accident types identified by Snyder and Knoblauch (25), are also found among inebriated pedestrian deaths and that alcohol is not always the precipitating factor it is reported to be. Furthermore, there are at least twice as many sober adult pedestrians killed as there are drunken pedestrians.

It should be noted that this is not an effort to mitigate the role of alcohol in the death of pedestrians, but rather, to place the role of alcohol in proper perspective. This is necessary for two reasons: (1) so that a more rational attack may be made on a more precisely defined problem, and (2) because such a more precise definition of the problem is needed if the effects of countermeasures are to be measured. Nothing is more difficult and frustrating than to attempt to measure progress against a problem which, at least in part, does not exist as assumed or has not been quantified. Information about the behaviors of sober adult pedestrians is just one example of information needed to properly appraise the "alcohol-involved" traffic death problem.

To arrive at a reasonable estimate of the number of pedestrian deaths that "involve alcohol", i.e., in which the pedestrian committed the precipitating behavioral error(s) and had been drinking "to excess" by an arbitrary definition of "excess" at 100 mg%, rough estimates and a number of empirical guesses have entered into the computation. It would be well to keep to keep in mind the indications of non-representative data mentioned in this report; the effect of such non-representative data, if improperly interpreted, is to overemphasize alcohol involvement in traffic deaths. For this reason the figures presented in Table 4 as "alcohol-involved" should be considered maximum estimates.

Child Pedestrians

There were 10,700 pedestrian deaths of which it is estimated that 2,800 were under the age of 15 (1). Research findings on the responsibility of children for their own death is scanty; Waller (21) and Marsden (26) found 75 percent of the child pedestrian casualties responsible for their own injury. Among 28 child pedestrians killed in Detroit in 1972, 27 (96 percent) were precipitated by the child (27). For the purpose of this report the figure will arbitrarily be set at

Table 4

Estimates of the Number of Pedestrian Deaths in the United States and the Proportion that May Involve Alcohol in Some Causal Fashion

	Sober Not Responsible	Driver Alcohol Involved	Sober Responsible	100 mg% Not Responsible	Driver Alcohol Involved	100 mg% Responsible	Pedestrian Alcohol Involved	Total
Adult Pedestrian	2525	(250)	2525	855	(430)	1995	(1995)	7900
Child Pedestrian	700	(70)	2100					2800
	3225	(320)*	4625	855	(430)*	1995	(1995)**	10,700

* Killed by surviving drivers who may have been impaired.

** Impaired pedestrians responsible for their own death.

75 percent. On this basis, it will be estimated that 2100 of the child pedestrian deaths were the fault of the child and 700 will be considered as having died because of driver negligence. (Table 4)

There is almost no information about the number of child pedestrians killed by drunken drivers. Most child deaths can be assumed to have occurred in the daytime when there are a few drunken drivers on the road; Zylman (28) reported as few as 3 in every thousand drivers on the streets of Grand Rapids in the daytime had a BAC of 50 mg% or more, compared with as many as 220 in every thousand from 3 a.m. to 6 a.m. Huelke (29, 30) reported that pedestrians under 11 years old were generally killed between 2 and 8 p.m., but the peaks for this group were between noon and 1 p.m. and 4 to 7 p.m.; and in Detroit (27) 74 percent of all child traffic deaths occurred between 7 a.m. and 8 p.m. Yakisch (7) reported that more than half of all school-age pedestrian deaths occurred on the way to or from school and that more than two-thirds of the deaths for that age group occurred between 3 and 5 p.m. In Houston (31), of the 86 fatal and non-fatal collisions involving pedestrians under 20 years old, 80 occurred between 6 a.m. and 9 p.m. Heise (32) reported that the very young and the very old were most likely struck by sober drivers. However, it is assumed that a few of these cases may have been caused by drunken drivers, so it will be estimated that perhaps as many as 10 percent, or about 70 of the non-responsible child pedestrian deaths involved drunken drivers.

Adult Pedestrians

Having accounted for 2800 of the 10,700 pedestrian fatalities as being under the age of 15, there are 7900 adult pedestrians remaining to be discussed. Table 1 shows that among more than 3300 adult pedestrians tested in 8 studies, from 25 to 42 percent were found to have a BAC of 100 mg% or more. This averages out to 36 percent (2). Utilizing this proportion for the 7900 cases, there would have been 2850 adult pedestrians with a BAC of 100 mg% or more, and 5050 who were sober or had BACs below the legally impairing limit. However, having a BAC of 100 mg% is not the same as being responsible for one's own death; nor is being sober evidence of not being responsible. Although there is very little information on this aspect of pedestrian deaths, the studies do indicate that not all "impaired" pedestrians are responsible for their own death and not all sober pedestrians are without fault. For example, a pedestrian with a BAC of 150 mg% struck on a sidewalk by a car which is out of control can hardly be considered to have contributed behaviorally (been "responsible" or "at fault") for the crash.

For the purpose of this analysis 70 percent of those pedestrians who died with 100 mg% or higher BAC are designated as being responsible for their own death. Regarding the sober pedestrians, there is less information--almost none, in fact. To place them in Table 4 they will be arbitrarily divided evenly between the responsible and non-responsible categories; about 2525 each.

It is reasonable to believe that the 855 adult pedestrians who died with BACs of 100 mg% or more but were not responsible for their own death, more than likely were walking in areas and at times when a substantial number of drunken drivers were also on the road. On this assumption, it will be decided arbitrarily that about half, or 430, of the "impaired" but not responsible adult pedestrian victims were killed by drunken drivers.

The sober adult pedestrians who were not responsible for their own death could be quite different from the "impaired" pedestrians who were not responsible. Filkins et al (3) reported that, of 71 adult pedestrians with BACs of 100 mg% or more, 9 (13 percent) died between 6 a.m. and 6 p.m. compared with 59 percent of those who had BACs below 50 mg%.

Baker and Spitz (4) reported that older victims of traffic crashes were less likely to have been drinking, more likely to die from injuries incurred in the daytime and more likely to succumb to injuries from which younger victims might recover--all conditions that do not suggest having been run down by a drunk. However, it is also reasonable to assume that a few of the deaths among sober non-responsible adult pedestrians "involved" alcohol on the part of the offending driver, therefore, it will be estimated that as many as 10 percent, or about 250 of the sober not-at-fault adult pedestrians may have been killed by drunken drivers. In summary, it is estimated on the basis of available information that:

(A) Approximately 7900 adult pedestrians died, of whom about 2850, or 36 percent, had BACs of 100 mg% or more.

(B) Of the 2850 adult pedestrians who had a BAC of 100 mg% or more, an estimated 70 percent were responsible for their own death; this constitutes 25 percent of all pedestrians 16 and older. (Table 4)

Considering the fact that each research study from which these figures are derived is, to some extent, incomplete these figures, must, in general, be regarded as extremely uncertain estimates. Thus, the most that can currently be said is that the proportion of adult pedestrian fatalities that causally involves alcohol use by the pedestrian may be on the order of 20 to 30 percent. However, this says nothing about the mechanisms of these crashes and therefore provides no insight for countermeasure development.

Inferences From Non-Alcohol-Related Data

Discussion so far has centered on the validity and representativeness of data in studies of the relationship between alcohol and pedestrian accidents, and how these qualities may affect what is known or believed about alcohol-involvement in such crashes.

There are other types of data, however, that may suggest avenues of exploration for clues as to the involvement of alcohol in serious and fatal traffic crashes. In the interest of brevity only a few numbers on age and sex will be presented.

Table 5 shows a comparison of the age distribution of 10,700 pedestrians killed as reported in Accident Facts (1), with those reported from a number of individual states. (The reports from which those figures were taken do not necessarily represent all 50 states; they happen to be the first several reports which presented the data in appropriate grouping and which were conveniently available to the present writer.) One might suspect that the differences in age distribution reflect the instability of smaller numbers, i.e., that as the numbers become larger, they would become more similar to those reported in Accident Facts. On the other hand, the possibility of differences in reporting practices or actual differences in the nature of the problem should not be overlooked. Is there significance, for example, in the fact that Wisconsin (33) recorded more than half of its pedestrian deaths as being under the age of 25, whereas Virginia (34) reported 38 percent in that age range?

Table 5

Age Distribution of Pedestrian Deaths
in Assorted Geographic Areas

	0-4	5-14	15-24	25-44	45-64	65+	Total
N.S.C. - '73 (1)	7.5	18.7	13.1	15.0	21.5	24.3	10,700
Wisconsin - '70-'72 (33)	10.9	21.2	18.9	9.3	12.8	26.9	439
California - '71-'72 (35)	9.2	14.9	14.6	14.1	21.3	25.9	1,590
Minnesota - '72 (13)	--	44.7	--	15.2	7.6	32.6	132
Virginia - '67-'69 (34)	7.3	17.7	13.2	18.3	23.4	20.3	689
Texas - '71-'72 (44)	7.6	15.4	16.3	17.8	22.1	20.7	999
North Carolina - '71-'72 (37)	5.4	21.6	15.8	20.0	21.3	15.6	647

There are also significant differences between states in the male-female distribution of pedestrians killed:

States	Years	Total Pedestrians Killed	Percent Male
Wisconsin (33)	'70-'72	435	61.6
California (35. 36)	'71-'72	1590	67.5
North Carolina (37)	'71-'72	653	73.5
Virginia (34)	'67-'69	417	78.9

These figures represent a cursory examination of data from only four states. It is possible that further investigation would reveal even wider differences. Such variations should be explored to determine whether they are real and, if so, whether different patterns of alcohol usage may be a factor. In this case, North Carolina and Virginia report the larger proportion of pedestrian deaths as being male. Whether by coincidence or whether there is a relationship is not certain, but those two states also report a higher number of pedestrian deaths in the "heavy drinking" age groups, i.e. 25-44. Add to these bits of information the fact that males generally drink more and are more likely to drink to excess, and the inference of a causal relationship between different patterns of alcohol usage and variations in age and sex distributions becomes more viable.

Ratio of Pedestrian Deaths to Pedestrian Injuries

One way to determine whether pedestrian collisions are more severe in one area than in another would be to determine the ratio of fatal pedestrian crashes to non-fatal crashes. For example, a higher proportion of fatalities among all pedestrian collisions in one area than in another could mean that the collisions are more severe or that emergency care is poorer--or both. On the other hand, a discrepancy in the ratio of deaths to injuries could simply indicate a difference in definition and/or reporting. (38)

Huelke and Davis (30) pointed out an important factor in counting pedestrian injuries. By NSC definition pedestrians, to be "officially" injured, should suffer injury of sufficient severity to restrict activity for at least one day beyond the accident. Many injuries which require

hospital attention but do not restrict activity are not included. This may account for some of the discrepancy in the ratio of pedestrian injuries to pedestrian deaths found among various reports.

NSC Accident Facts (1) shows 11 injuries for each pedestrian death. These figures from page 61 in that report do not agree with the figures presented on page 47 of the same report. Page 47 shows 10,500 fatal crashes among a total of 400,000 pedestrian accidents. By subtracting the 10,500 fatal collisions from the 400,000 pedestrian accidents and then dividing the remainder by 10,500 a ratio of one fatal pedestrian crash for each 37 non-fatal pedestrian collision is obtained. While some difference could be expected in the ratio of fatal to non-fatal injuries and fatal to non-fatal collisions, the difference of 1/11 vs 1/37 seems too great to be explained other than that different criteria for measurement must have been used.

The 1972 report from California (35, 36) shows 15.7 injuries for each pedestrian death; Michigan Accident Facts (34) shows 353 pedestrians killed and 5,970 injured for a ratio of 1/16.9; Wisconsin Accident Facts (33) shows the number of killed and the number of injured and then breaks them down further into major and minor injuries. There were 140 pedestrians killed, 2437 injured, of which 696 were major injuries and 1741 were minor injuries. Overall the ratio of pedestrian deaths to serious injuries is 1/5.0, and the ratio of pedestrian deaths to minor pedestrian injuries is 1/12.4.

On the basis of this scant information it appears that either definitions and criteria for reporting pedestrian collisions vary from state to state, or the problem, is in fact, different. In this case, considering that California, Michigan and Wisconsin are similar and NSC Accident Facts so different, it would appear that the difference is in the criteria for reporting. Among the first needs, then, is a uniform criterion for reporting.

IV. CRASH DYNAMICS, FATAL AND NON-FATAL

While several studies have attempted to estimate alcohol involvement in pedestrian accidents, few studies provide information concerning the dynamics of these crashes, other than to determine crash responsibility. One study that does provide some information, particularly on non-fatal pedestrian accidents is that of Snyder and Knoblauch (1971) mentioned earlier. This study examined over 2,000 urban pedestrian accidents in 13 U.S. cities. On-site interviews with drivers, pedestrians and witnesses were taken as well as the data from police accident reports. Alcohol involvement in accidents was not a major focus of this effort; however, data on pedestrian alcohol usage were gathered. In order to examine the alcohol-related information from this study, a data tape of the Snyder and Knoblauch cases was obtained and software written to examine the relationships among the salient variables. The following paragraphs outline the results of these special analyses of the alcohol variables and present information heretofore unavailable in the general literature. The details of the methods, sampling plan, etc., used to obtain these data may be found in the original Snyder and Knoblauch report (25).

Overview

The Snyder and Knoblauch data base contains four variables of specific interest to the investigation. The first, referred to as "Indication of Pedestrian Alcohol", represents the on-site investigator's best estimate as to whether or not the pedestrian had been drinking. This variable was coded for 2,026 accidents in the study. The results showed that for 1,735 crashes, there was no evidence that the pedestrian had been drinking, for 89 there was evidence and for 202 it was either unknown or only possible that the pedestrian was drinking.

The second variable of interest is "Pedestrian Human Factor--Alcohol". This was one of many "predisposing factors," using Snyder and Knoblauch's terminology, that contributed to crash occurrence. The data show that the on-site investigators felt that 81 of the accidents investigated involved this predisposing factor. The third variable is the BAC of the pedestrian and the fourth variable is the test used to determine this BAC. Unfortunately,

the gathering of BACs at the accident site was not part of the Snyder and Knoblauch study, and thus only 11 data points were recorded, nine of which were post-mortem blood tests. Therefore, the BAC data were not sufficient to permit any detailed analysis.

The "Indication of Pedestrian Alcohol" variable and the "Pedestrian Human Factor--Alcohol" variable track very closely in the data base. Therefore, the data presented in this section will deal primarily with "Indication of Pedestrian Alcohol". Also, the data presented will exclude all crashes in which the pedestrian was 14 years old or younger. Only four pedestrians 14 years or younger were judged to have been drinking and inclusion of data for all young pedestrians could mask any difference due to alcohol. It is important to note that the data presented below are not based on on-site BAC measurements. Therefore, the absolute number of alcohol involvement recorded reflects only those cases in which the field investigator obtained other indications of pedestrian drinking.

Accident Type

The first breakdown conducted on these data was by accident type. The results of this analysis are shown in Table 6. Of particular interest is the number of pedestrians under "yes" for the dart and dash accident types (Dart-outs, Pedestrian Strikes Vehicle and Intersection Dash). These results are summarized below:

	Pedestrian Drinking	
	No	Yes
Darts and dashes*	138	27
All others	590	58

$\chi^2 = 7.72$ $p < .01$

It can be seen that even with this relatively small amount of data that the drinking adult pedestrians appear over-represented in the dart and dash events.

* Excludes data for pedestrians 14 or younger.

Table 6

Indication of Pedestrian Drinking by Accident Type*

Accident Type	No	Yes	Unknown or Possible	%Yes
Dart-out - 1st half	40	10	13	16
Dart-out - 2nd half	36	5	3	11
Pedestrian Strikes Vehicle	18	7	4	24
Intersection Dash	44	5	11	8
Multiple Threat	33	2	5	5
Vehicle Turn/Merge	110	8	7	6
Vendor	1	-	2	-
Bus Stop	30	2	4	6
Non-Pedestrian Activity in Roadway	27	2	3	6
Other	389	44	116	8
Total	728	85	168	

---

* Excludes data for pedestrians 14 or younger.

Primary Precipitating Factors

It was also possible in the Snyder and Knoblauch data to look at indication of pedestrian drinking by the primary precipitating factors leading to the crash. These factors can be thought of as major system failure in the pedestrian/vehicle accident avoidance sequence. The specific failures noted by Snyder and Knoblauch were grouped into five major areas for both pedestrian and driver. Up to three major failures could have been cited for each crash. These factor areas and the number drinking in each factor area are shown in Table 7. It can be seen from this table that when the pedestrian was said to have been drinking, pedestrian factors predominate over driver factors. Fully 11 percent of all pedestrian factors occurred under "pedestrian drinking-yes", while only 7 percent of driver factors occurred under "pedestrian drinking-yes". This suggests that the pedestrian system is, in fact, experiencing a greater number of failures when under the influence of alcohol. Of course, none of this is tied to BAC data and thus an accurate scaling of the extent of system breakdown due to alcohol is impossible. A major focus of future efforts should be the scaling of both the extent and type of pedestrian system failures against pedestrian BAC. The central problem, at least in these preliminary data, appears to be occurring under the categories of pedestrian search and pedestrian course (selection and negotiation). Specific delineation of these factors as a function of BAC should be carefully investigated in the future.

Pedestrian Age

The next area examined in this set of analyses was pedestrian age. Table 8 shows pedestrian age by indication of pedestrian drinking. It is clear from this table that alcohol is a particularly serious problem for pedestrians in the 25-64 age range. Drinking appears to be negligible up until age 19, increases rapidly, then tapers off as a major factor during old age. Preusser (45) found very similar results in Nassau County, N.Y. He analyzed BAC data for fatally injured pedestrians who died in the five year period 1968-1972. These data are shown in Table 9. It can be seen from this table that when all pedestrians aged 15 or over were considered, the estimated percent alcohol involved was only 37 percent. However, when only the middle age range of 30-59 years is considered, the

Table 7

Indication of Pedestrian Drinking
by Primary Precipitating Factors*

	Pedestrian Drinking			
	No	Yes	Unknown/ Possible	% Yes
Pedestrian Course	272	43	72	11
Pedestrian Search	304	56	68	13
Pedestrian Detection	62	3	17	4
Pedestrian Evaluation	80	4	12	4
Pedestrian Action	13	2	2	12
Driver Course	79	9	17	9
Driver Search	294	22	49	6
Driver Detection	77	9	19	9
Driver Evaluation	42	5	6	9
Driver Action	42	1	13	2
Other	80	8	25	7
TOTAL	1345	162	300	

*Excludes pedestrians 14 years of age and younger

Table 8

Indication of Pedestrian Drinking
by Pedestrian Age

Age	Pedestrian Drinking			
	No	Yes	Unknown/ Possible	% Yes
1 - 4	194	0	5	0
5 - 9	588	1	9	<1
10 - 14	209	1	9	<1
15 - 19	118	2	9	2
20 - 24	91	10	11	9
25 - 44	206	34	47	12
45 - 64	150	28	49	12
65 - Over	163	11	52	5

Table 9

Distribution of BACs for Fatally Injured Pedestrians in Nassau County, New York for the Period 1968-1972*

BAC	All cases	Ages 30-59 only
No test **	91	9
.00	111	16
.01-.04	18	6
.05-.09	11	6
.10-.14	8	3
.15-.19	12	7
.20-.24	6	5
.25 +	11	10
% had been drinking for all tested cases	37%	70%

* Adapted from Preusser (45)

** No test is made for pedestrians who are 14 years old or younger (or who survive 24 hours)

estimated percentage of alcohol involved cases jumps to 70 percent. Clearly both Snyder and Knoblauch and the Preusser data indicate that age is a critical variable in the study of alcohol involvement in pedestrian crashes.

Pedestrian Sex

Throughout the literature on highway safety and alcohol involvement, there is the almost universal finding that males are more often found to have been drinking than females. The Snyder and Knoblauch data are no exception. Table 10 shows the distribution of pedestrian sex by indication of pedestrian drinking. Fully 12 percent of the male pedestrians had been drinking, while 3 percent of the female pedestrians had been drinking.

Pedestrian Race

These data from Snyder and Knoblauch were also analyzed with respect to the race of the pedestrian. The results, shown in Table 11, suggest that alcohol involvement is proportionately more of a problem for racial and ethnic minorities than for the "white" population. Overall, 7 percent of the "white" pedestrians were coded as "yes" under indication of pedestrian drinking and an additional 14 percent were coded under unknown/possible. For all non-whites, the respective percentages were 12 percent "yes" and 16 percent unknown/possible. This result is probably a reflection of the drinking patterns of the white and non-white socioeconomic groups. Regardless of interpretation, however, these preliminary results clearly indicate that ethnic, racial and/or socioeconomic variables must be considered in the study of pedestrians and alcohol.

Injury Severity

Another variable considered in the current analysis of the Snyder and Knoblauch data was injury severity. These data, injury severity by "indication of pedestrian drinking", are shown in Table 12. They tend to support the notion that drinking increases the severity of the injury incurred. While this finding has been reported for drivers, it has never been shown for pedestrians. The Snyder and Knoblauch data are not conclusive on this point, but there is sufficient indication here to warrant further investigation.

Table 10

Indication of Pedestrian Drinking
by Pedestrian Sex*

	Pedestrian Drinking			
	No	Yes	Unknown/ Possible	% Yes
Male	398	71	114	12
Female	327	13	52	3

* Excludes pedestrians 14 years of age and younger.

Table 11

Indication of Pedestrian Drinking
by Pedestrian Race*

	Pedestrian Drinking			
	No	Yes	Unknown/ Possible	% Yes
White	434	37	78	7
Negro	182	33	48	12
Mexican/American	23	1	2	4
Oriental/American	16	1	0	6
American Indian	1	2	0	67
Puerto Rican	7	1	2	10
Res. Alien	0	0	1	0
Other	4	0	0	0

* Excludes pedestrians 14 years of age and younger

Table 12

Indication of Pedestrian Drinking
by Pedestrian Severity of Injury *

	Pedestrian Drinking			
	No	Yes	Unknown/ Possible	% Yes
Fatal	71	17	71	11
Serious	110	15	28	10
Moderate	196	15	24	6
Slight	281	28	31	8
None	32	5	3	12
Unknown	37	5	11	9

* Excludes pedestrians 14 years of age and younger

Time of Day, Day of Week

The literature on alcohol and driving shows that drinking is a particularly serious problem in the late night hours and on weekends. The Snyder and Knoblauch data apparently extends these findings to drinking on the part of pedestrians. The data show that for crashes occurring between midnight and 3:59 a.m., 18 pedestrians were scored "no" on "indication of pedestrian drinking"; 15 "yes"; and 8 "unknown/possible". In other words, 37 percent fell in the "yes" column for this time period (excludes 14 years or younger). For the remaining hours of the day, only 7 percent were scored "yes" (excludes 14 years or younger).

Concerning day of week, the Snyder and Knoblauch data indicate that Saturday and Sunday are particularly bad in terms of alcohol involvement. The data show that 14 percent of the pedestrians, 15 years or older, were scored as "yes" under "indication of pedestrian drinking" for Saturday and Sunday crashes. For the remaining days of the week, only 7 percent were scored "yes".

In summary, the Snyder and Knoblauch data provide some useful insights into the pedestrian problem with alcohol. They appear to extend much of the alcohol and driving research to the vehicle/pedestrian situation. More importantly, they provide a starting point for the measurement and classification of pedestrian crash avoidance behavior.

V. IMPLICATIONS OF THE FINDINGS

It is clear from the foregoing discussion that there is a scarcity of data on the involvement of alcohol in pedestrian accidents. The only controlled study was performed by Haddon et al (8) in 1959 and provided only 19 cases of fatally injured pedestrians to compare with a control group. Even less is known about the causative or behavioral role of alcohol in non-fatal crashes. Apparently, no study has focused on the problem. Thus, the data contained in Section IV of this report apparently represent the extent of our knowledge on the injured pedestrian's use of alcohol and the majority of these data have heretofore been unpublished. Moreover, they are not based on a quantitative measurement of BAC.

The absence of data from controlled studies makes it difficult to estimate the overrepresentation of alcohol in pedestrian accidents. To be sure, there are data on the BACs of fatally injured pedestrians. These together with considerations of responsibility in fatal crashes permits us to conclude that approximately 25 percent (20 percent to 30 percent) of fatal pedestrian accidents are causally related to alcohol. Nevertheless, it is impossible to conclude that this is overrepresentation in the absence of control comparisons. It is strongly suggestive of an epidemiological problem and indicative of the need for further research, but it is not conclusive. Moreover, it sheds no light on the pedestrian accident which does not result in a fatality.

There are studies and routine tabulations of non-fatal pedestrian accidents. Unfortunately, these do not include quantitative measures of BAC. In fact, there is apparently little acknowlegement on the part of researchers of the need to obtain this information. Perhaps they have been unwilling to attack the problems inherent in obtaining BAC measurements from injured pedestrians. More likely, they have been diverted by the recent interest in the alcohol impaired driver. In any case, the subject area has been totally neglected and should be pursued with vigor prior to the formulation of countermeasures against alcohol related pedestrian accidents.

The overwhelming conclusion of this report must, therefore, be that there is a void in our knowledge of the role of alcohol in pedestrian accidents. The little that is known is merely a glimpse of the situation that actually exists. We know something about the BAC of fatally injured pedestrians and little or nothing about all other aspects of the problem. The non-fatal pedestrian accident is a particularly obscure area. The inferences drawn from analogies with drivers and the bits of information available are indicative of a potential problem. However, it must be concluded that a major epidemiological study, such as the one of which this review is a part, is vitally needed to fill the gaps in our knowledge on this subject. In particular, major efforts must be directed at the establishment of controls for comparison with accident victims and on the entire problem of the non-fatally injured pedestrian.

BIBLIOGRAPHY

Attached herewith is a bibliography of research studies, tabulations of collisions and other reports that may shed light on the problem of pedestrian collisions and, in particular, those collisions related to alcohol.

Some of the reports do not pertain directly to pedestrian casualties but are considered important because of possible implications to the present study. Other studies and tabulations are listed even though not directed toward the question of alcohol involvement because it is felt by the present writer that knowledge about pedestrian casualties, whether alcohol involved or not, will aid in placing the role of alcohol in its proper perspective.

Not all of the items listed in the bibliography are cited in the text. This is due largely to time limitations; not all reports have been examined as closely as would be necessary for detailed comments.

1. National Safey Council, Accident Facts, 1973, 425 N. Michigan Avenue, Chicago, 111.

2. Zylman, R. "A critical evaluation of the literature on 'alcohol-involvment' in highway deaths". Accident Analysis and Prevention. Vol 6 (in press).

3. Filkins, L.D., Clark, C.D., Rosenblatt, C.A., Carlson, W.L., Kerian, M.W., and Manson, H. Alcohol abuse and traffic safety: A study of fatalities. DWI offenders and alcoholics and court-related treatment approaches. D.O.T. N.H.T.S.A. contract FH-11-665 and FH-11-7129. Ann Arbor, Michigan: Highway Safety Research Institute, University of Michigan, 1970.

4. Baker, S.P. and Spitz, W.U., "Age effects and autopsy evidence of disease in fatally injured drivers". J.A.M.A. Vol. 214, No. 6, Nov. 1970.

5. Waller, J.A., King, E.M., Nieson, G., Turkel, H.W. "Alcohol and other factors in California highway fatalities." J. of Forensic Sciences, Vol. 14, No. 4, October, 1969.

6. Gross, E.M. Pedestrian Accidents in New York City. Proc. Third triennial congress on medical and related aspects of motor vehicle accidents, International Association of Accident and Traffic Medicine, New York, May 29 - June 4, 1969. The University of Michigan, Highway Research Institute, Ann Arbor, Michigan.

7. Yaksich, S.A. A study of pedestrian fatalities in Washington. (mimeo) Traffic Engineering and Safety Department, American Autombile Association, Washington. D.C.

8. Haddon, W. Jr, Valien, P., McCarroll, J.R. and Umberger, C.J. "A controlled investigation of the characteristics of adult pedestrians fatally injured by motor vehicles in Manhattan," J. Chron. D. 14: 655-678, 1961.

9. Perrine, M.W., Waller, J.A. and Harris, L.S. Alcohol and highway safety: behavioral and medical aspects. Project ABETS, D.O.T. N.H.T.S.A. Contracts No. FH-11-6609 and FH-11-6899. Final Report Project 14, Burlington, Vt.: University of Vermont, 1971.

10. Davis, J.H. Alcohol, violence and the automobile. Medical Examiner's Digest, 1963, Dade County (Florida) Board of Commissioners and the Dade County Manager.

11. Gerber, S.R. Coroner's statistical report, Cuyahoga County, Ohio, 1972. 2121 Adelbert Road, Cleveland, Ohio.

12. Gerber, S.R. Cuyahoga county coroner's statistical report, 1971, 2121 Adelbert Rd., Cleveland, Oh.

13. Minnesota Department of Public Safety, Highway Safety and Research Section, Minnesota alcohol programs for highway safety 1972. Highway building. St. Paul. Minn.

14. Laessig, R.H. Nashold, R.D. and Wadsack, H. Blood Alcohol testing for motor vehicle deaths. Wisconsin Department of Health and Social Services, Division of Health. Bureau of Health Statistics, Section of Statistical Services, Madison, Wisc. Annually, 1969-73.

15. Holcomb, R.L. "Alcohol in relation to traffic accidents". J. Amer. Med. Ass. 111: 1067-1085, 1938

16. Lucas, G.H., Kalow, W., McColl, J.D., Griffith, B.A. Smith, H.W. Quantitative studies of the relationship between alcohol levels and motor vehicle accidents.

17. McCarroll, J.R. and Haddon, W., Jr. "A Controlled study of fatal automobile accidents in New York City". J. Chron. Dis. 15: 811-826, 1961

18. Vamosi, M. Determination of the amount of alcohol in the blood of motorists. Traf. Saf. Res. Rev. 4; 8-11, 1960

19. Borkenstein, R.F., Crowther, R.F., Shumate, R.P., Ziel, W.B. and Zylman, R. The role of the drinking driver in traffic accidents. (The Grand Rapids Study) Department of Police Administration, Indiana University, Bloomington, 1964

20. Zylman, R., "The variability of collision involvement at low blood alcohol concentrations: the Grand Rapids curve explained". Blutalkohol, Vol. 9, No. 1, January, 1972

21. Waller, J.A. "Factors associated with alcohol and responsibility for fatal highway crashes." Quarterly Journal of Studies on Alcohol. 33: 160-170, 1972.

22. Marsden, W.E. Jr. Alcohol and pedestrian fatalities: A study of fatal pedestrian collisions in San Diego County. (Monograph) Department of County Engineer, County of San Diego, Calif. 1972.

23. New Jersey Department of Law and Public Safety, New Jersey alcohol determination program in fatal accident cases, 1961-63. Division of Motor Vehicles. Traffic Safety Service, Trenton, 1964.

24. Neilson, R.A. Alcohol involvement in fatal motor accidents. 1962 - 1968. California Traffic Safety Foundation, San Francisco, Cal. 1969.

25. Snyder, M.S. and Knoblauch, R.L. Pedestrian safety: The identification of precipitating factors and possible countermeasures. Vol. 1 and Vol. 11 -appendices. U.S.D.O.T. contract No. Fh-11-7312 with Operations Research, Inc. Silver Spring. Md. 1971.

26. Marsden, W.E. School pedestrian collisions: Are public beliefs justified? (Monograph) Department of County Engineer, County of San Diego, Calif. 1973.

27. Detroit Police Traffic Safety Section, The Child in Detroit traffic. (1972 1973 Annual Reports) Detroit police department, Traffic Safety Section.

28. Zylman, R. "Time of day as a factor in collision-involvement of drunken drivers." Q.J.S.A. Vol. 34, No. 2, 527-529, June 1973.

29. Huelke, D.F. Pedestrian fatalities in Wayne County (Detroit) Michigan. Third trienniel congress on medical and related aspects of motor vehicle accidents, International Association of Accident and Traffic Medicine, New York, May 29-June 4, 1969. The University of Michigan, Highway Research Institute, Ann Arbor, Michigan.

30. Huelke, D.F. and Davis, R.A. A study of pedestrian fatalities in Wayne County, Michigan. HSRI Report No. Bio-9, Highway Safety Research Institute, The University of Michigan, Ann Arbor, 1969.

31. Tharp, K.J. Multidisciplinary accident investigation: Pedestrian involvement. NHTSA contract No. DOT HS 087-1-117, University of Houston, Civil Engineering Department, Houston, Texas, March 1974.

32. Heise, H.A. "Alcohol and automobile accidents." J.A.M.A. Vo;. 103, No. 10. September 1934 739-741.

33. Division of Motor Vehicles, Wisconsin Department of Transportation, Wisconsin accident facts, 1971, '72 and '73 editions. Madison, Wisconsin.

34. Virginia Department of State Police, Virginia traffic crash facts. Richmond, Va. 1967, 1968, 1969.

35. Department of California Highway Patrol, 1971 report of fatal and injury motor vehicle traffic accidents. Sacramento, California, 1972.

36. Department of California Highway Patrol, 1972 report of fatal and injury motor vehicle traffic accidents. Sacramento, California, 1973.

37. Driver Education and Accident Records Division, North Carolina Department of Motor Vehicles. Pedestrians (special summaries) 1970, 1971.

38. Zylman, R. "Drivers records are they a valid measure of driver behavior?" Accident Analysis and Prevention, Vol. 4: 333-349, 1972.

39. Department of State Police, Michigan traffic accident facts, (annual reports) Michigan State Police, East Lansing, Michigan. 1966-1973.

40. Freimuth, H.C. Watts, S.R. and Fisher, R.S. "Alcohol and highway fatalities!' J. Forensic Sci. 3: 65-71, 1958.

41. Robertson, J.S. Phil, D. and Tonge, J.!. 'Duration of survival in traffic accident fatalities!' The Medical Journal of Australia. 1968, 2: 571-579.

42. Davis, J.H. and Fisk, A.J. The Dade County, Florida, study on carbon monoxide, alcohol and drugs in fatal single vehicle automobile accidents. Proceedings National Association of Coroners Symposium, 1964-1966, pp 197-204.

43. Tonge, J.1., "Traffic crash fatalities: injury patterns and other factors." The Medical Journal of Australia, 2:5, 1972 (July).

44. Texas Department of Public Safety, Motor vehicle traffic accidents, 1971, 1972, Austin, Texas.

45. Preusser, D.F., Analysis of Blood Alcohol Levels in Fatally Injured Drivers and Pedestrians in Nassau County, New York during 1972. Dunlap and Associates, Inc. Technical Report prepared for the U.S. Department of Transportation (NHTSA) under prime contract No. FH-11-7547, 1973.

46. Adams, A.1. "Death and injury on country roads; a study of 816 persons involved in rural traffic accidents." Med. J. Aust. 2: 799-807, 1967.

47. American Autombile Association. Pedestrian safety report: AAA special study of school child pedestrian accidents.

48. American Automobile Association, Pedestrian safety report: AAA special survey on alcohol testing and pedestrian accidents. Vol. 1, No. 2. November 1970.

49. Baker, S.P. "Fatal pedestrian collisions: driver negligence." Amer. J. Public Health. Vol. 64, No. 4, 1974.

50. Baker, S.P., Pedestrian deaths in Rio de Janeiro and Baltimore. Presented at the 101st Annual Meeting of the American Public Health Association, San Francisco, November 6, 1973.

51. Baker, S.P., Robertson, L.S. and O'Neill, B. Drivers involved in fatal pedestrian collisions. In Proc: 16th Conference of the American Association for Automotive Medicine, Chapel Hill, N.C. October 19-21, 1972. Society of Automotive Engineers, Inc. New York, 1973.

52. Baker, S.P., Robertson, L.S. and Spitz, W.U., "Tattoos, alcohol and violent death." J. Forensic Sciences, Vol. 16, No. 2, 1971.

53. Birrell, J.H. "Alcohol as a factor in Victorian road collisions." Med. J. Aust. 47: 713-722, 1960.

54. Birrell, J.H.W. "Blood alcohol levels in drunk drivers, drunk and disorderly subjects and moderate social drinkers." Med. J. Aust. 2: 949-953, 1965.

55. Bowden, K.M. Wilson, D.W. and Turner, L.K. "A survey of blood alcohol testing in Victoria (1951 to 1956)." Med. J. Aust. 452: 13-15, 1958.

56. Cassie, A.B. and Allan, W.R., "Alcohol and road traffic accidents," Brit. Med. J. 2: 1668-1671, 1961.

57. (Copenhagen Correspondent) "Alcohol and traffic accidents." J. Amer. Med. Ass. 114: 815, 1940.

58. Department of California Highway Patrol, State of California report of fatal and injury motor vehicle traffic accidents for 1966. Sacramento, Calif.

59. Ewing, M.R. and Fox, A.R. "Blood alcohol levels in adult patients admitted to hospital after road traffic accidents." Med. J. Aust. 28: 976, 1961. Source of English language abstract: Excerpta Criminol. 2, No. 1008, 1962.

60. Fisher, R.S. "Alcohol, accidents and crime." Current Med. Dig. 19 (No. 6): 37-41, 1952.

61. Gerber, S.R. Vehicular fatalities in Cuyahoga County, Ohio, U.S.A.: twenty years' experience (1941-1960) Proc. 3rd International Conference on Alcohol and Road Traffic, London, 1962, British Medical Association, BMA House, Tavistock Square, W.C.1.

62. Gonzales, T.A. and Gettler, A.O. "Alcohol and the pedestrian in traffic accidents." J. Amer. Med. Ass. 117: 1523-1525, 1941.

63. Haddon, W. Jr., and Bradess, V.A., "Alcohol in the single vehicle fatal accident; experience of Westchester County, N.Y." JAMA 169, 1587-1593, 1959.

64. Harris, S. "Factors in automobile accidents; fatigue, disease and alcoholic beverages." J. Med. Ass. Ala. 6: 257-265, 1937.

65. Highway Safety Research Institute, Alcohol Safety. Final Report, N.H.S.B. Contract No. FH-11-6555, Vol. 1 of 11, University of Michigan, Ann Arbor, February 1969.

66. Hopkinson, B.R. And Widdowson, G.M. "Relation of alcohol to road accidents." Brit. Med. J. 2:1569-1570. 1964.

67. Hossack, D.W. "Investigation of 400 people killed in road accidents with special reference to blood alcohol levels." The Medical Journal of Australia. 1972. 2: 255-258.

68. (JAMA London Correspondent) "Increase of road accidents due to the black out." J. Amer, Med. Assoc. Vol. 114, No. 9, pp 114, 1940.

69. Jeffcoate, G.O. "Alcohol and Road Accidents in 1951. Brit. J. Addict." 50: 67-83, 1953.

70. Jeffcoate, G.O. "An examination of reports of fatal road accidents in three police districts from the point of view of effect of alcohol." Brit. J. Addict. 54: 81-103, 1958/

71. Jeffcoate, G.O. "The importance of alcohol in road accidents." Brit. J. Addict. 55: 37-39, 1959.

72. Joss, G. "Contribution of alcohol to accident fatalities in Hennepin County during a one-year period." Quart. J. Stud. Alc. 7: 588--595, 1947.

73. Kielholz, P., Battegay, R. and Muhlemann, R. "Alcohol and traffic," Schweiz. Med. Wscher. 103: 21-26, 1973.

74. Kowalski, J.M., Rose, N.J. and Fiorese, F.F., "Blood alcohol levels in vehicular and pedestrian fatalities in Illinois." 111. Med. J. Vol. 131, No. 5, pp. 659-661, 1967.

75. LeRoux, L.C. and Smith, L.S. "Violent deaths and alcohol intoxication." J. Forens. Med. 11: 131-147, 1964.

76. McBay, A.J."Alcohol and highway fatalities: a study of 961 fatalities in North Carolina during the last six months of 1970." N.C. Med. J. 33: 769-773, 1972.

77. Medina-L, E., Papel del alcohol en los accidentes y violencias: Arch. Biol. Med. Exp., Child, Supple. No. 3, pp. 305-308, 1969. Also as: The role of alcohol in accidents and violence. pp. 350-355. In: Popham. R.E. ed. Alcohol and alcoholism. Totonto, University of Toronto Press; 1970.

78. Neilson, GlL. Annual reports, Sacramento County Coroner, 1971-1973.

79. Neilson, R.A. Alcohol involvement in fatal motor vehicle crashes. California Traffice Safety Foundation, San Francisco, April, 1967.

80. Neilson, R.A. A survey of post-mortem blood alcohols from 41 counties in 1966, California Traffic Safety Foundation, San Francisco, April 1967.

81. Solheim, K. "Pedestrian deaths in Oslo traffic accidents." Brit. Med. J. 1: 81-83, 1964.

82. Spain, D.M. Bradess. V.A. And Eggston, A.A. "Alcohol and violent death: a one year study of consecutive cases in a representative community." J. Amer. Med. Ass. 146" 334-355, 1951.

83. Spriggs, N. 1. Road accidents and alcohol. The Medical Press, 240: 933-937, 965-970, 1957.

84. State of Idaho, Department of Highways, Pedestrian and bicycle accidents, Boise, 1973.

85. Sterling-Smith, R. S. A psychosocial analysis of operators involved in fatal motor vehicle accidents: intermediate report. N. G. T. S. A. contract No. DOT-HS-310-3-595, Traffic Accident Research Project, Boston University, Boston, May 1974.

86. Tonge, J. E. "Blood alcohol levels in patients attending hospital." Journal of Forensic Medicine, Vol. 15, No. 4, pp. 152-156, 1968.

87. Tonge, J. 1. Post-mortem blood alcohol levels in road accident victims. In proc: National Road Safety Symposium, March 14-16, 1972, Canberra.

88. Tonge, J. E., Czechowicz, A. S. and Robertson. J. S. "Survival after fatal traffic accidents." (Letter to the editor) The Lancet, September, 1967.

89. Tonge, J. 1., O'Reilly, J. J., Division, A. and Derrick, E. H. 'Fatal Traffic accidents in Brisbane from 1935-1964," The Medical Journal of Australia, 2: 811, 1964.

90. U. S. Congress, House Committee on Public Works, Subcommittee on Road, 1972 Highway Legislation, Ninety Second Congress, Second session, February 17,]2, 23, 24; March 1, 2, 9, 14, 15, 16, 21, 22, 23, 28, 29; April 12, 1972. (Toms, pp 24-29).

91. Viel, B, Salcedo, D., Donoso, S., and Varela, A, Alcoholism, accidents, atherosclerosis, and hepatic damage, pp. 319-337, in: Popham, R. E. ed. Alcohol and alcoholism. Toronto, University of Toronto Press, 1970.

92. Waller, J. A. and Turkel, H. W., "Alcoholism and traffic deaths." The New England Journal of Medicine, 275, 532-536, 1966.

93. Watson, J. P. "Alcohol and the accident department." Brit. J. Addict. 64: 223-230, 1969.

94. Wilentz, W.C. Resume of Annual reports of the Chief Medical Examiner of the County of Middlesex, State of New Jersey. 13 pp. Middlesex County, N.J. 1961.

95. Wilentz, W.C. and Brady, J.P. "The alcohol factor in violent deaths." Amer. Practit. Dig. Treatm. 12: 829-835, 196 1961.

96. Zylman, R. "Overemphasis on alcohol may be costing lives." The Police Chief, Vol XL1. No. 1, January 1974.

97. Zylman, R. Semantic gymnastics in alcohol-highway crash research and public information programs. Proceedings of the 16th Annual Conference of the American Association for Automotive Medicine, Chapel Hill, NC October 11, 1973.

98. Zylman. R. "Drinking and driving after it's legal to drink at 18; is the problem real?" The Police Chief, Vol. XL1 (in press).