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Flight Attendant Fatigue, Part I: National Duty, Rest, and Fatigue Survey

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16. Abstract

Today's aviation industry is a 24/7 operation that produces a variety of challenges for cabin crew members including extended duty periods, highly variable schedules, frequent time zone changes, and increased passenger loads. While these operational requirements may be necessary, they are far from ideal with respect to the human body's biological rhythms for managing sleep and alertness. In fact, acute sleep loss, sustained periods of wakefulness, and circadian factors resulting from this form of misalignment all contribute to fatigue and fatigue-related mishaps (Caldwell, 2005; Rosekind et al., 1996). This survey study was conducted to identify the specific operational factors that may contribute to fatigue in cabin crew operations. A retrospective survey was disseminated to flight attendants representing 30 operators (regional = 17, low-cost = 7, and network = 6). The survey addressed 7 main topics: work background, workload and duty time, sleep, health, fatigue, work environment, and general demographics. Participants were 9,180 cabin crewmembers who voluntarily and anonymously completed the survey and met the criteria to be included in the report (i.e., active flight attendant that had flown the previous bid period with their current airline). This report outlines the results of this survey and provides specific recommendations regarding fatigue issues in cabin crew operations.

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EXECUTIVE SUMMARY

Today's aviation industry is a 24/7 operation that produces a variety of challenges for cabin crew members including extended duty periods, highly variable schedules, frequent time zone changes, and increased passenger loads. While these operational requirements may be necessary, they are far from ideal with respect to the human body's biological rhythms for managing sleep and alertness. In fact, acute sleep loss, sustained periods of wakefulness, and circadian factors resulting from this form of misalignment all contribute to fatigue and fatigue-related mishaps (Caldwell, 2005; Rosekind et al., 1996). This survey study was conducted to identify the specific operational factors that may contribute to fatigue in cabin crew operations.

A retrospective survey was disseminated to flight attendants representing 30 operators (regional = 17, low-cost = 7, and network = 6). The survey addressed 7 main topics: work background, workload and duty time, sleep, health, fatigue, work environment, and general demographics. Participants were 9,180 cabin crewmembers who voluntarily and anonymously completed the survey and met the criteria to be included in the report (i.e., active flight attendant that had flown the previous bid period with their current airline).

The majority (84%) of cabin crewmembers indicated they had experienced fatigue while on duty in the previous bid period. When asked to indicate their level of agreement with a series of statements regarding fatigue, 93% agreed that they had experienced fatigue at work. The majority (93%) indicated that flight attendant fatigue represents a safety risk, and 91% agreed that fatigue was a common occurrence. Despite the frequency of occurrence and safety implications, only 35% of flight attendants received any type of training or information regarding fatigue from their airline. Of those who had received training, 79% reported that the training was helpful to a "limited extent" or "not at all."

Fatigue factors identified by respondents included length of duty days, consecutive duty days, rest periods, nutrition, and others. The most frequently identified fatigue factors regarded length of duty day, consecutive duty days, missed meals, and lack of breaks. Scheduling factors made up 9 of the 10 most common operational change recommendations that flight attendants proposed to reduce flight attendant fatigue. The most common recommendations included: eliminate reduced rest, do not mix continuous duty overnight with early-morning report times, maintain consistent scheduling, limit number of flight segments/legs, limit number of duty hours allowed, start scheduled rest period on arrival at hotel, lengthen rest periods, do not schedule several-hour breaks or "airport sits" between flight segments/legs, schedule enough time between flight segments/legs for meals, and provide flight attendants with food and beverage on flights.

The data from cabin crewmembers also recommended improved fatigue management education and examination of scheduling practices. Education plays a critical role in any effort to address fatigue in aviation operations and can provide benefits to both the individual and the organization (Avers, Hauck, Blackwell, & Nesthus, 2009). Analyzing scheduling practices, identifying potential improvements, and implementing changes may result in reduced fatigue, as well as other benefits to operations.

Flight Attendant Fatigue, Part I: National Duty, Rest, and Fatigue Survey

BACKGROUND

While substantial research has been conducted on human circadian processes as applied to scheduling and training of flight crews, relatively little research has been accomplished among cabin crews. Performance of cabin duties is critical to safety and security, and the literature suggests that all human performance is vulnerable to sleep loss and daily variations in physiological processes tied to underlying body-clock mechanisms. The extent of sleep loss and fatigue and its impact upon performance of duties among the cabin crew population and within the current duty regulations is unknown.

In 2005, a Congressional directive to the Civil Aerospace Medical Institute (CAMI) was given to address issues regarding flight attendant fatigue. CAMI contracted with the National Aeronautics and Space Administration Ames Research Center's Fatigue Countermeasures Group to conduct literature and incident report reviews and examine a range of typical flight attendant schedules to assess potential vulnerability to fatigue. Nesthus, Schroeder, Connors, Rentmeister-Bryant, and DeRoshia (2007) concluded that some degree of fatigue-related performance impacts were likely under the current regulations and suggested 6 areas of research that would facilitate understanding and government-industry decision making. The 6 recommendations included: 1) a survey of field operations; 2) field research on the effects of fatigue; 3) a validation of models for assessing flight attendant fatigue; 4) a focused study of incident reports; 5) a review of international policies and practices; and 6) the potential benefits of training.

In 2008, Congress provided another directive for CAMI to conduct follow-on studies in each of the 6 recommendation areas noted in the 2007 report. To accomplish this directive, CAMI researchers developed a project plan for completing each recommendation. To facilitate support for these projects and ensure participation, CAMI researchers coordinated with representatives of vested organizations (e.g., Air Transport Association, Regional Airline Association, Coalition of Flight Attendants, and non-unionized carriers) and provided them with the opportunity to review and comment on aspects of the project plan prior to commencement.

The current report provides specific details regarding the national survey of flight attendant field operations (recommendation #1). This report will be incorporated into CAMI's consolidated report to Congress.

INTRODUCTION

In a recent Aviation Safety Reporting System (ASRS) report, a flight attendant reported "…We were supposed to get meals. No meals. During the flight, all 4 of us were dizzy and very fatigued. I sat down on my jump seat and started to fall asleep. My eyes were burning and I was extremely hungry. If an emergency had happened, I would not have been able to perform. I feel this was extremely unsafe due to the fact that all 4 of us could not rest before the flight" (ASRS report 785013). Fatigue-related incident reports, like this one, began to increase following the events of 9/11 and have continued to increase with the onset of an economic recession and subsequent reductions in the flight attendant workforce (Holcomb et al., 2009). Following the events of 9/11, Brown (2009) surveyed 291 flight attendants and pilots and asked them if fatigue had ever affected their ability to perform their duties safely; 97% said that fatigue may "somewhat" affect their ability to perform duties safely; and 68% responded that fatigue would "greatly" affect their ability to complete their duties safely. The preliminary evidence suggests that flight attendants are experiencing fatigue, and their safety performance is at risk.

Fatigue Definition

Fatigue is a multi-dimensional construct that has been defined and interpreted in a number of ways (Åkerstedt et al., 2004; Dodge, 1982). Most commonly, fatigue is described as sleepiness or a general tired feeling resulting from extended wakefulness, insufficient sleep, or circadian disruption (Åkerstedt, 1995a; Dinges, 1995). Although this definition sufficiently describes fatigue in a general way, it inadequately represents the performance decrements associated with fatigue. In the aviation industry, it may be better to consider fatigue in terms of its symptoms such as forgetfulness; poor decision-making; slowed reaction time; reduced vigilance; poor communication; impaired mood; nodding off; or becoming fixated, apathetic, or lethargic (Rosekind et al., 1996). It is important to recognize that fatigue is more than sleepiness or tiredness. Fatigue has psychological, physiological, and emotional implications that can impact the performance of safety-related duties, particularly during non-routine and emergency events.

Nature of Fatigue

Extended duty times, rotating shifts, night flights, and transmeridian travel can all contribute to fatigue and the subsequent performance, alertness, and well-being of personnel via 2 biologically-based mechanisms: 1) the body's *circadian rhythm* or internal body clock, and 2) the *homeostatic mechanism* or recent sleep history (including the amount of time since the last sleep period and the amount of prior sleep) (Caldwell, 2005).

Circadian Rhythm. The circadian rhythm is the body's 24-hr internal clock that regulates bodily functions such as body temperature, hormone secretion, digestion, performance capabilities, and mood (Rosekind et al., 1996). Most notably, the circadian rhythm controls sleep and wakefulness patterns based on naturally occurring light-dark cycles in the environment (Dinges, Graeber, Rosekind, Samel, & Wegmann, 1996). Humans are pre-programmed to respond to these cues. In other words, the body is programmed to be awake when it is light and asleep when it is dark (Caldwell, 2005). There are 2 periods of circadian low or physiological sleepiness: in the early-morning hours from 0200 – 0700 and, to a lesser degree, during mid-afternoon from 1400 – 1700 (Akerstedt, 1995b; Caldwell, 1997; Mitler et al., 1988; Rosekind et al., 1996). These rhythms coincide with shift worker performance models and indicate that shift workers have an increased number of errors and delayed reaction times during periods of circadian low (Shappell, Patterson, & Sawyer, 2007). The circadian rhythm cannot adjust immediately to changes in the work/rest schedule or time zone. When such changes occur, the circadian rhythm is desynchronized from the environment for a period of time, and individual rhythms are out of sync with one another. The evidence suggests that work schedules in conflict with the circadian rhythm can result in cognitive and psychomotor performance decrements (Caldwell, 2005).

Homeostatic Sleep Mechanism. The homeostatic sleep process represents the accumulated sleep debt that occurs with increasing time awake, which dissipates with sleep (Billiard & Kent, 2003). The homeostatic mechanism interacts with the circadian rhythm and can result in progressive deterioration in alertness and performance as homeostatic pressure increases. Homeostatic regulation involves 2 factors that influence one's most recent sleep history: 1) quality and quantity of sleep prior to a performance period and 2) the amount of continuous wakefulness prior to a performance period (Caldwell, 2005). Sufficient daily sleep is a critical component in the homeostatic regulation of alertness and is often one of the first casualties in aviation operations. The evidence suggests that aircrews suffer from work-related sleep disturbances in a manner comparable to industrial shift workers that complain about sleep patterns and lack of sleep (Costa, 1997). Sleep loss is measured by time awake (not time on duty) and is central to the homeostatically-based drowsiness and inattention that is known to be problematic in work that involves non-standard schedules (Rosekind et al., 1996). In fact, 2 hours of sleep loss can result in performance and alertness decrements and an increased likelihood of error or accident (Carskadon & Roth, 1991; Mitler et al., 1988). A significant sleep debt can accumulate with 5 hours of sleep per night for 7 consecutive nights and can result in increased stress, subjective fatigue, fatigue, mood disturbance, tension, and decreased psychomotor vigilance performance (Dinges et al., 1997). Alternatively, continuous wakefulness beyond 17 hr can result in performance decrements comparable to an individual considered legally drunk (BAC = 0.05–0.10) (Arnedt, Wilde, Munt, & MacLean, 2001; Lamond & Dawson, 1999; Maruff, Falleti, Collie, Darby, & McStephen, 2005).

Flight Attendant Workload

Cabin crew fatigue is thought of primarily as a function of scheduling and workload (Nesthus et al., 2007; Samel, Wegmann, & Vejvoda, 1995). Technological advances in the last 20 years have enabled passenger planes to increase in size and capacity, fly longer distances, and fly longer non-stop flights. With these advances, duty times and flight attendant responsibilities have also increased. On average, a flight attendant arrives one to 2 hours before a flight to begin pre-flight duties, continues to work during flight, and finishes the flight with post-flight duties (Nesthus et al., 2007). At completion of the post-flight duties, a flight attendant will either prepare for the next flight or conclude the duty day and travel to rest accommodations. Examples of flight attendant activities performed while on-duty include:

Pre-flight duties: Check E-mail, attend a pre-flight briefing, stock the galley, check all emergency and other equipment, monitor passenger access and seating, assist with the stowage of luggage, arm doors, and fill out and provide the flight crew with relevant paperwork.

Routine flight duties: Attend to passenger safety and comfort. Flight attendants provide safety instructions; enforce safety rules; prepare and serve food and drinks; distribute pillows, blankets, and magazines; work audio and video equipment; collect trays, glasses, and newspapers; answer passenger questions; and communicate as needed with the flight crew.

Non-routine flight duties: Depending on the emergency, flight attendants must notify the flight crew of malfunctioning equipment or emergency situations, deal with ill or disruptive passengers, operate first-aid or other medical equipment, distribute medication, operate emergency

equipment, instruct passengers on emergency landings, direct the evacuation of passengers, and various other duties as needed.

Post-flight duties: Disarm doors, deplane passengers, check and tidy the cabin, report cabin discrepancies to the flight crew members, and report to operations for e-mail and other instructions.

As evidenced above, flight attendants engage in a number of physically demanding tasks and are always "on" as they interact continuously with passengers. The most challenging tasks, however, seem to be those related to ensuring safety and responding to non-routine situations. Unfortunately, previous research on flight attendant fatigue indicates that safety-related duties may be most susceptible to the effects of fatigue and circadian rhythm dysfunction (Nesthus et al., 2007).

Flight Attendant Duty Time Regulations

The Code of Federal Regulations (CFR) is the codification of the general and permanent rules published in the Federal Register by the executive departments and agencies of the Federal Government, one of which is the FAA. Two sections of Title 14 of the CFR regulate flight attendant duty time and rest requirements (CFR, 2003a; CFR, 2003b).

The current regulations (14 CFR §121.467 & §135.273) require that flight attendants receive a minimum rest period of 9 consecutive hours following a scheduled duty period of 14 hr or less (CFR, 2003a; CFR, 2003b). This rest period may be reduced to 8 hr if the subsequent rest period is at least 10 consecutive hours. Following a scheduled duty period of greater than 14 hr, but no more than 20 hr, a minimum rest period of 12 hr must be provided. This may be reduced to 10 hr if the subsequent rest period is at least 14 consecutive hours. If the rest period is reduced to 10 hr, the flight attendant may not be scheduled for a duty period of greater than 14 hr during the 24-hr period commencing after the beginning of the reduced rest period. Flight attendants may not be scheduled for duty if they have not had at least the minimum rest requirements. Furthermore, flight attendants must be relieved from duty for at least 24 hr during any 7 consecutive calendar days.

A 14-hr duty period may be extended up to 20 hr if the carrier schedules additional flight attendants above the minimum complement required. One additional flight attendant is required above the minimum complement to extend the scheduled duty hours to 16 hr. If 2 additional flight attendants are scheduled, the duty hours may be extended to 18 hr; and if 3 additional flight attendants are scheduled, the duty hours may be extended to no more than 20 hr. Table 1 summarizes the CFR as they relate to flight attendant schedules (Nesthus et al., 2007).

The CFRs, however, are limited in scope and do not take into account a number of operational issues that affect fatigue, such as time-zone transitions, layover and recovery, duty day start or end times, and the individual's actual sleep need. In fact, existing fatigue research indicates that circadian disruption or circadian desynchrony are more important to fatigue concerns than simply "time on task" (Nesthus et al., 2007).

Several studies have examined the question of the amount of time a flight attendant has to be on duty before fatigue sets in. In one study (Simonson, 1984), the majority of flight attendants set the fatigue range at 6-10 hr of duty. However, 21% were not fatigued until completing 11-15 hr of duty. In another study (Galipault, 1980), the duty lengths that flight attendants thought induced tiredness ranged from 4 hr (10%), 5–6 hr (51.1%), to 7–9 hr (27.6%). This study also found that short-duration flights with beverage or snack service produced large increases in end-of-duty fatigue.

Other Aviation Factors Contributing to Fatigue

Flight attendants are exposed to many other factors believed to contribute to or compound the risk of fatigue. Nesthus et al. (2007) conducted a literature review to identify the factors that influence fatigue in

Table 1. Summarized Flight Attendant (FA) Rest Periods According to CFRs.

Scheduled Duty Period *(Hours)*	Normal Minimum Rest Period *(Hours)*	Reduced Rest Period *(Hours)*	Subsequent Rest Period *(Hours)*	Number of FAs Required
14 or less	9	8	10	Minimum
14-16	12	10	14	Minimum + 1
16-18	12	10	14	Minimum + 2
18-20*	12	10	14	Minimum + 3

*Applies only to duty periods with one or more flights that land or take off outside the 48 contiguous states and the District of Columbia.

Note: Generally, rest periods begin no less than 15 min after the aircraft pulls into the gate and continues until 1 hr prior to a flight attendant's next departure.

cabin crew operations. They collected and examined 99 articles, websites, and other sources. The factors identified were: time pressure, high task demands, prolonged mental or physical exertion, extreme temperatures, time zone changes, personal demographics, nutrition and hydration, physical or medical problems, commuting, additional jobs, sleep environment, flight duration and type, and work environment. For a detailed discussion of these specific issues see: Enck, Muller-Sacks, Holtmann, and Wegmann, 1995; Ewing, 1999; Haugli, Skogstad, and Hellesoy, 1994; Hunt and Space, 1994; Nagda and Koontz, 2003; Rayman, 1997; Smolensky, Lee, Mott, and Colligan, 1982; Tashkin, Coulson, Simmons, and Spivey, 1983.

Scope of the Report

The present report will examine the frequency with which fatigue is occurring in cabin crew operations, the context in which it occurs (e.g., personal demographics, work environment, duty time), and the implications fatigue may have for cabin safety.

METHOD

Survey

A retrospective survey was disseminated to flight attendants representing 30 operators (regional = 17, low-cost = 7, and network = 6); see Table 2. The survey addressed each of the fatigue-related factors identified in a NASA 2007 literature review (Nesthus et al., 2007) and were broadly grouped into 7 main topics: work background, workload and duty time (including reserve status and rest periods), sleep demographics (including sleep at home and away from home), health, fatigue (including perceptions of fatigue, fatigue factors, fatigue effects, and coping strategies), work environment (including training and corporate attitudes), and demographic information. The survey is available upon request.

Participants

Respondents to the survey were active flight attendants certificated by the FAA and listed in its Civil Aviation Registry. Using the Registry's certification records, a random and representative sample was selected from each of the 30 operators included in this study. A total of 20,826 surveys were distributed. Flight attendants voluntarily and anonymously returned 10,550 completed surveys (online = 4,571; paper = 5,979), resulting in a 51% overall response rate. Of those who responded, 9,180 (online = 4,039; paper = 5,141) met the criteria for inclusion (i.e., were employed as an active flight attendant with their current airline for at least a month and had flown within the previous bid period), resulting in a 44% adjusted response rate.

Administration

Flight attendants were mailed a survey package to the permanent address on file with the Civil Aviation Registry. Each survey packet included a paper survey, a postage-prepaid envelope addressed to the investigators, instructions for accessing the online survey (if desired), and a cover letter signed by the FAA's Federal Air Surgeon. To encourage accurate and forthright responses, the cover letter emphasized that participation was voluntary and anonymous. Flight attendants were instructed to either complete the survey and return it in the enclosed envelope or to access and submit the survey online. A unique identification number was provided to access the online survey, which enabled the researchers to verify that only one survey mode was submitted by each flight attendant.

The surveys were disseminated in 6 separate distributions over a one-month period beginning in November

Table 2. Airline Classifications by Type of Operation.

Low-Cost (N=7)	Regional (N=17)		Network (N=6)
Air Tran	Air Wisconsin	Horizon	Alaska
Frontier	American Eagle	Mesa	American
JetBlue	Atlantic Southeast	Mesaba	Continental
Southwest	Chautauqua	Pinnacle	Delta
Spirit	Comair	PSA	Northwest
US Airways*	Compass	Republic	United
Virgin America	Executive	Shuttle America	
	ExpressJet	Trans States	
	Go Jet		

* Classifications were obtained from the Bureau of Transportation Statistics. At the time of development, US Airways was classified as a low-cost operator.

2008. To improve the response rate, reminder postcards were mailed 2 weeks and 4 weeks following each survey distribution. The postcards encouraged participation and provided the participants with their original identification number to access the online survey. Following the postcards, a letter was sent to all non-responders to encourage participation. Eight weeks after the initial distribution of the surveys, a second survey package was sent to all non-responders. In total, survey packages were sent to 22,594 flight attendants representing each type of operation (regional, low-cost, network). Of those, 1,768 surveys were deemed undeliverable for various reasons (e.g., deceased, undeliverable by the U.S. Postal Service, or no longer a flight attendant).

Data and Analysis

Data from the completed surveys were scanned using Snap Survey© software. Online responses were secured on a private Snap server and downloaded periodically. Data were exported to Microsoft Access© tables for data processing. Subsequently, data were imported by SPSS© for final analysis. Open-text numerical items were examined for outliers and classified as missing if the response was more than 2 standard deviations above or below the mean. Comments were transcribed and cleaned to remove any personal identification information.

RESULTS

The results for this report combined all flight attendant responses and represent an analysis of the data overall. Subsequent reports will provide analysis of the data based on other factors such as seniority level and type of operation.

Demographics

Seventy-nine percent of the respondents were female, and respondents averaged 45.9 years of age, 5 ft 5 in of height, and 150 lbs. Most (83%) were satisfied with their job, overall. Over half (53%) reported an assigned domicile in the Eastern time zone, 24% in the Central, and 15% in the Pacific. Likewise, a majority (48%) reported living in the Eastern time zone, 26% in the Central, and 16% in the Pacific. Flight attendants reported using multiple modes of transportation to travel to their assigned domicile. The most frequently reported were personal vehicles (83%) and airplanes (28%). Commute times varied, with 38% reporting more than 1½ hr and 62% reporting less than 1½ hr. The 15% that reported holding other jobs described spending an average of 39 hr per bid period working at them.

Health

Flight attendants were asked to rate their overall physical and mental health. Eighty-four percent indicated they were in "good" or "very good" physical health; 88% reported they were in "good" or "very good" mental health. Fifty-three percent had been diagnosed by a physician with a medical condition that could contribute to fatigue. Of those diagnosed with a medical condition, 45% reported it had prevented them from flying a trip within the past year. The majority of flight attendants (82%) indicated they exercised at least once per week, 34% reported "1-2" times, 36% reported "3-4," 10% "5-6" times, and 2% reported exercising 7 or more times in a week. Of flight attendants who reported routinely exercising, 68% exercised for 31 min or longer. Most flight attendants (75%) described their diet/eating pattern as "healthy" or "very healthy." Half of flight attendants (51%) ate 2 meals in a 24-hr period, when on duty and only 33% drank 7 or more 8-ounce glasses of water. Thirteen percent of flight attendants reported using tobacco, with 11% indicating use of cigarettes. Of those who indicated tobacco use, 69% used it 4 times or more in a 24-hr period. Forty-eight percent indicated that in a 24-hr period, they typically drank at least 1 serving of alcohol, while 90% drank at least 1 serving of a caffeinated beverage (e.g., coffee, tea, cola).

Work Background

The respondents reported working as flight attendants for a period of time ranging from 1 month to more than 36 years in their careers: 32% reported "1 month to 5 yrs," 32% "6 to 15 yrs," 21% "16 to 25 yrs," and 16% "26 yrs or more." The majority (73%) had worked for one airline throughout their career. Respondents represented the top one-third (41%), middle one-third (34%), and bottom one-third (26%) of the flight attendant seniority listing within their organization. Respondents were employed by airlines classified as "low-cost" (29%), "regional" (32%), "network carrier" (39%), and "other" (1%). Eighty-two percent of the respondents were represented by a union at their current airline.

The majority (64%) of flight attendants typically provided service on aircraft with a seating capacity of 50 to 150 seats, and 24% provided service on flights with a seating capacity of 151 to 250. Flight attendants were personally responsible for a median of 50 passengers on a typical flight segment. The average flight attendant-to-passenger ratio was somewhat skewed because when asked how many passengers they were personally responsible for on a typical flight, many flight attendants commented that service responsibilities were shared, while others reported personal responsibility for the safety of all passengers. Some examples of such comments include: "*No*

one is finished with their service unless everyone is finished" and "You are always responsible for all the pax [passengers], you may be the only one left."

Flight attendants were asked a series of questions regarding their schedule. The average reported bid period was 28 days (including on duty, off duty, and training). Respondents were asked to report the extent to which the previous bid period was their preferred schedule (or first choice bid request): 30% indicated "not at all" or "limited extent," 25% "moderate extent," 45% reported "considerable" or "great extent." Flight attendants frequently trade trips to create a more preferred schedule, 42% indicated they were successful to a "considerable" or "great extent" in creating their preferred schedule. Thirty-eight percent voluntarily exchanged flight segments or trips with colleagues "1 to 2" times in the previous bid period; 14% exchanged "3-4" times. When asked how many times they were *required* to change their work schedule on short notice in the previous bid period, 51% reported "never," while 35% were required to change "1 to 2" times. Fifty-five percent of flight attendants picked up extra (in addition to scheduled duty time) flying time at least once. Of those, 31% picked up "1 to 8 hr" of flying time, 34% picked up "9 to 16 hr," 19% "17 to 24 hr," 9% "25 to 32 hr," and 7% picked up "33 hr or more."

For the survey, a duty day was defined as a scheduled period of work including flight time, duty time, time spent "deadheading" (traveling to or from a flight assignment), and training. The number of flight segments/legs flown in a duty day ranged from 0 to 7, with an average of 2.8 per day. Reported flight hours per segment/leg ranged from less than 1 hr to 7 hr or more: 2% reported flights "less than 1 hr," 50% "1 to 2 hr," 25% "3 to 4 hr," 8% "5 to 6 hr," and 16% "7 hr or more." Nearly half of respondents (47%) reported that none of their flights went to countries outside of the United States, while about one-third (30%) indicated that up to 20% of their flights were outside the country, and 15% had flights outside the country more than 80% of the time. Respondents worked in each type of cabin service: on average 64% of the time in economy, 8% in business, 13% in first class, and 1% of the time in premium service.

Workload and Duty Time

Duty Time. Flight attendants reported flying an average of 3.9 duty days, on average, in a typical 7-day week with the average minimum number of duty days reported as 3.1 days per week and an average maximum of 4.9 days per week. Cabin crewmembers were asked how many consecutive duty days they worked in a 7-day week; they reported an average of 3.9 days in a row and an average maximum of 4.7 days in a row. They reported working an average of 9.6 hr in a duty day, with an average range from 6.4 to 12.9 hr. In the bid period preceding the survey, flight attendants most commonly reported for duty in the early morning between 0400 and 0759 (M = 6.0 times). Fewer respondents indicated reporting for duty between 0800 and 1159 (M = 3.6 times), and between 1200 and 1559 (M = 3.4 times). In contrast, duty end times were most commonly late at night, between 2000 and 2359 (M = 5.1). Fewer duty days ended between 1600 and 1959 (M = 4.3), and from 1200 to 1559 (M = 3.7). Flight attendants actually flew an average of 6.8 flight hours in a duty day, typically ranging from an average of 4.5 to 8.9 hr. A typical duty day included an average of 2.8 flight segments/legs, with an average minimum of 1.6 segments/legs and an average maximum of 4 segments/legs. These values are expected to vary by type of operation in future reports. Twenty-seven percent of flight attendants did not have the opportunity to leave the aircraft between flight segments/legs, 46% had the opportunity on "1-20%" of flight segments/legs, and 14% had the opportunity on "21-40%" of flight segments/legs. For the 73% that had an opportunity to leave the aircraft between flight segments/legs, their average time away from the aircraft was 27 min (median = 20). Twenty-four percent of flight attendants were *scheduled* for regular breaks in their duty day. For respondents who were able to take their scheduled breaks, the average time on break was 82 min. The majority that took scheduled breaks (59%) were provided with crew rest facilities (e.g., chair, bed) "81-100%" of the time.

Ninety-three percent of flight attendants experienced some type of flight delay within their previous bid period: 62% experienced delays "1-20%" of the time, 20% experienced delays "21-40%" of the time, 7% reported "41-60%," 3% "61-80%," and 1% experienced delays on "81-100%" of their flights. When flights were delayed, the typical delay was 54 min (median = 45). At the end of the duty day (when the cabin door was opened), it took flight attendants an average 49 min to arrive at their rest accommodations. The average wait for transportation to accommodations was 16 min. Flight attendants, on average per bid period, stayed at "home" 11 times per bid period, a "hotel" 9 times, a "trailer" less than 1 time, an "airport lounge" 1 time, and "other" accommodations 2 times. At the end of the duty day, during the required rest period, 18% of flight attendants were typically in their home time zone, 30% were "1" time zone away from home, 21% were "2" time zones away, 15% were "3" away, 5% were "4 or 5" time zones away, and 12% were "6 or more" time zones away.

Continuous Duty Overnight. In a typical bid period, 30% of flight attendants flew at least one Continuous Duty Overnight (CDO). A CDO is a duty day that begins in the evening and runs all night or ends the following

morning. Although a break may be provided, it is less than the reduced rest period, and the flight attendant remains on duty between flight segments/legs. On average, flight attendants served on 3.2 CDOs that were "all night" and 3.6 CDOs that were "night-into-day" in the previous bid period. The majority (87%) reported a CDO with "1 to 2" flight segments/legs. During a CDO, 26% of flight attendants reported having no scheduled ground time, 15% reported "less than 1 hr," 16% reported "1 to 2 hr," 4% indicated "3 to 4 hr," and 40% received "5 hr or more" scheduled ground time. Of the 74% of flight attendants that reported having scheduled ground time, 31% indicated having no available ground time for sleep. Of the 69% with available ground time for sleep, only 7% reported not actually sleeping, while 16% indicated they slept "less than 1 to 2 hr," 53% slept "3-6 hr," and 24% slept "7 hr or more" during that time. When on a CDO, 35% reported their airline provided "on board" crew rest periods. Of those who received "on board" rest periods, 95% reported that their airline provided specific facilities "on board" for crew rest.

On average while on CDO, flight attendants stayed in the following accommodations: at "home" (12%), a "hotel" (70%), a "trailer" (<1%), an "airport lounge" (4%), and "other" accommodations (13%). Overall, 16% of flight attendants reported "good" or "very good" quality rest, 32% reported "fair" quality, and more than half (52%) reported "poor" or "very poor" quality of rest when on CDO.

Reserve Status. Twenty-two percent of flight attendants reported flying "on reserve" (on call) in the previous bid period. The majority of "on reserve" flight attendants (87%) were without a flying assignment for some percentage of their bid period. Thirty percent identified their reserve assignment as "NOT at the airport" and 5% identified their reserve as "at airport." Most (65%), however, indicated they were assigned "both on reserve NOT at the airport and on reserve at airport." When on reserve at the airport, 51% were required to perform additional duties. Forty-three percent of flight attendants were notified an average of "1 to 2 hr" prior to report time while 27% were notified of "3 to 4 hr" prior to report time, 9% were notified "5 to 6 hr" prior to report time, and 20% were notified "7 hr or more" prior to report time. Many reserve flight attendants (44%) were able to get an average of "7 hr or more" of sleep prior to reporting for duty; 45% reported "5 to 6 hr" sleep; and 11% had 4 hr or less of sleep prior to reporting for duty.

Rest Periods. Flight attendants most frequently (79%) reported the *normal* minimum rest period was "9hr or more." The airline designated *reduced* rest period was most often (54%) reported as "8 hr"; 30% reported "9 hr or more." On average, flight attendants were scheduled for normal minimum rest 6.8 times during the bid period and reduced rest 1.2 times in the previous bid period. Flight attendants were required to take unscheduled reduced rest approximately 1 time in the previous bid period. When asked how frequently their 24-hr period free from duty was retroactively assigned as a required rest period, 84% percent reported none, 7% indicated that it occurred 1 time, and 9% indicated "2 or more" times in the previous bid period. Although regulations specify that flight attendants are required to have 24 hr of rest in 7 consecutive duty days, 6% of flight attendants indicated they had worked 7 consecutive duty days without 24 hr of rest at least once in the previous bid period.

Sleep

Overall, the majority (87%) of flight attendants reported being "moderate," "light," or "very light" sleepers. Most (66%) believed they needed "7 to 8" hr of sleep in a 24-hr period, and 26% felt they needed "9 to 10" hr.

At Home. The flight attendants presented a normal sleep profile, on average, sleeping 7.7 hr per night. They reported a median bedtime of 2200 hr, and a get out of bed time of 0730 hr on their days off. The frequency and range of go to bed times and get out of bed times can be seen in Figure 1. The majority reported an average sleep latency of 30 min or less (69%) and reported 1 to 3 awakenings per night (75%). After awakening, 63% of respondents took 15 min or less to return to sleep. They reported getting 15.6 nights of sleep at home, on average, within a bid period.

Respondents were asked the frequency with which they nap when at home: 31% reported taking "none," 49% reported napping "1-5 times," 12% "6-10 times," 5% "11-15," and 3% indicated "16 times or more." Reporting the number of nights they experienced problems falling to sleep at home, 80% indicated they had problems falling asleep, while 20% indicated they did not have a problem falling asleep and did not use sleep aids. When at home, 20% of respondents used 2 or more sleep aids to help fall asleep. Twenty percent of respondents said they used prescription medication, 27% reported using over-the-counter medications, 20% indicated they used alcohol, and 9% used melatonin to help them sleep.

Flight attendants were asked to rate 22 factors and an "other" option on the extent to which each interfered with typical home sleep, using a 5-point scale from "1=not at all" to "5=great extent." The responses for each factor were averaged (Figure 2). The top-5 factors interfering with sleep at home based on these averages were: stress (M = 2.42, SD = 1.24), personal worries (M=2.37, SD=1.18), trips to the bathroom (M=2.15, SD=0.98), time zone changes or jet lag (M=2.11, SD=1.33), and readiness for sleep (M=2.08, SD=1.20). When asked to rate their

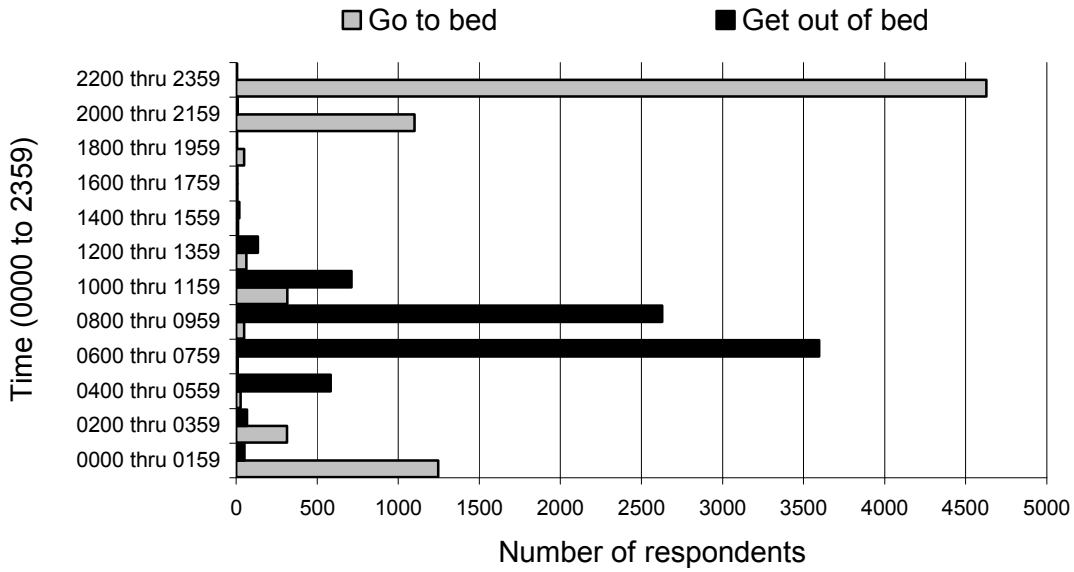
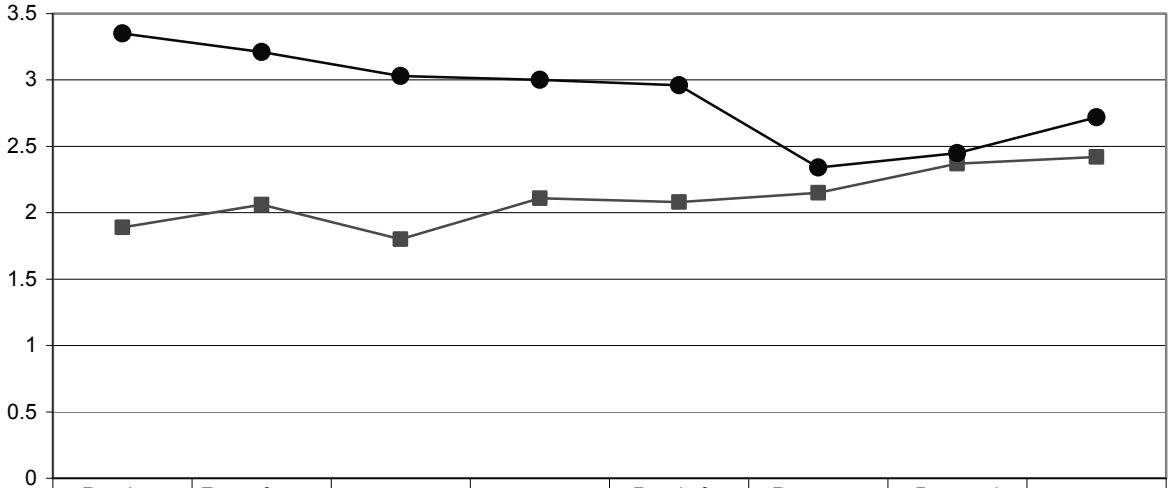


Figure 1. Average "go to bed" and "get out of bed" times on days off.



	Random noise	Fear of over-sleeping	Temp	Jet lag	Ready for sleep	Restroom use	Personal worries	Stress
Home	1.89	2.06	1.8	2.11	2.08	2.15	2.37	2.42
Away	3.35	3.21	3.03	3	2.96	2.34	2.45	2.72

Figure 2. Factors that most interfere with sleep.

overall quality of sleep at home on a 5-point scale from "very poor" to "very good," 56% reported "good" or "very good," 35% reported "fair," and 10% reported "poor" or "very poor."

Away from home. The flight attendants presented a somewhat different sleep profile when sleeping away from home. On average, flight attendants reported sleeping 6.5 hr per night away from home. Sixty-one percent reported an average sleep latency of 30 min or less, and 68% reported 1 to 3 awakenings per night. After awakening, 51% of respondents took 15 min or less to return to sleep. They reported getting an average of 11.2 nights of sleep away from home within a bid period.

Respondents were asked the frequency with which they nap when away from home: 48% reported "none," 42% reported napping "1-5 times," 7% "6-10 times," 2% "11-15," and 1% indicated "16 times or more." Reporting the number of nights they experienced problems falling to sleep away from home, 90% reported problems falling asleep, while 10% indicated they did not have a problem falling asleep and they did not use any type of sleep aids. When away from home, flight attendants had problems falling asleep an average of 6 nights in a bid period. Thirty-nine percent of flight attendants reported using some type of sleep aid when away from home, with 13% using 2 or more methods.

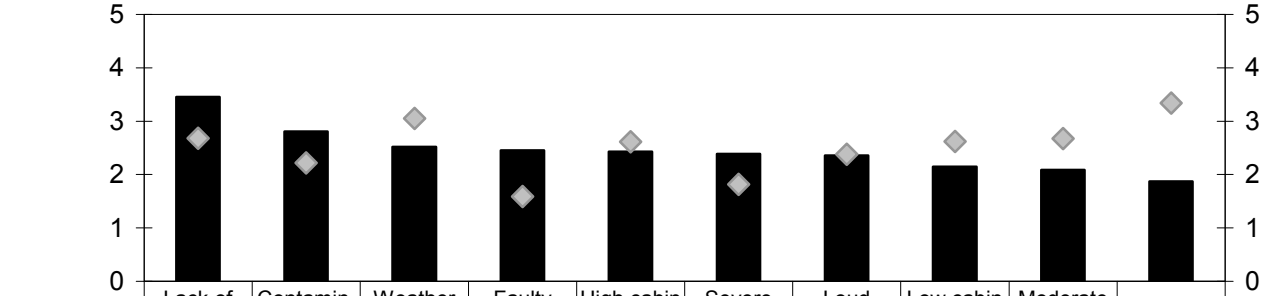
Eighteen percent reported using a prescription medication to help them sleep while 24% reported using over-the-counter medications, 17% indicated they used alcohol, and 8% used melatonin.

Flight attendants were asked to rate 22 factors and an "other" option on the extent to which each interfered with typical sleep when away from home, using a 5-point scale from "1=not at all" to "5=great extent." The responses for each factor were averaged. The top-5 factors interfering with sleep away from home, based on these averages, were: random noises (*M*=3.35, *SD*=1.26), fear of oversleeping (*M*=3.21, *SD*=1.45), temperature (*M*=3.03, *SD*=1.23), time zone changes or jet lag (*M*=3.00, *SD*=1.37), and readiness for sleep (*M*=2.96, *SD*=1.32). When asked to rate their overall quality of sleep away from home on a 5-point scale from "very poor" to "very good," 18% reported "good" or "very good," 48% reported "fair" and 34% reported "poor" or "very poor."

Fatigue

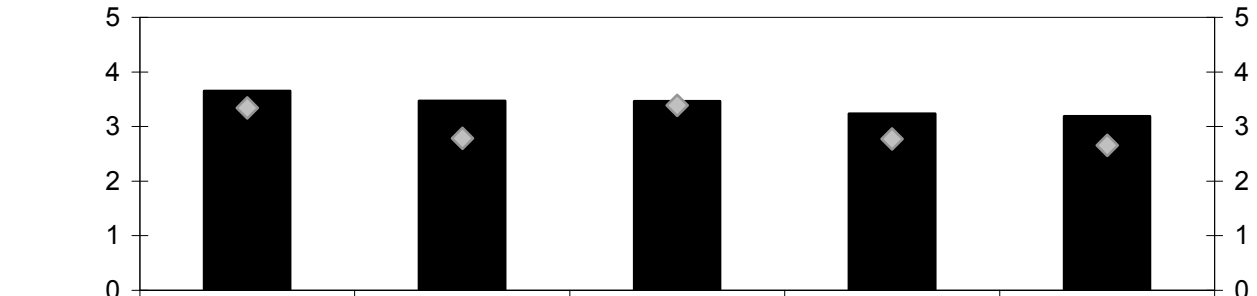
When asked if they experienced fatigue while on duty, 84% reported being fatigued in their previous bid period. More than half of the flight attendants who responded (52%) indicated they had "nodded off" while working on a flight segment/leg. Of those who reported being fatigued, 44% identified workload as a contributing factor, 42% indicated work pace, and 83% reported that work schedule contributed to fatigue. Flight attendants were given a list of 44 specific events (and an "other" option) believed to contribute to fatigue in aviation operations. They were asked to identify the frequency with which each event occurred (1=never, 2=rarely, 3=occasionally, 4=frequently, 5=always) and the extent to which each event contributed to their perceived fatigue (1=not at all, 2=limited extent, 3=moderate extent, 4=considerable extent, and 5=very great extent). A total of 24 factors were identified that contributed to fatigue to a moderate extent or greater (including early-morning report, continuous duty overnight, jet lag, meals with poor nutrition, flying 4 or more segments/legs in a day, and others). Figures 3 through 7 show the distribution of factors by category, the effect each factor has on fatigue, and the frequency of occurrence. The 10 reported factors with the most impact on fatigue, shown in Figure 8, are: 14 hr or longer duty day, quick shift turnaround (less than 9 hours), 10 to 13-hr duty day, 14 or more consecutive duty days, short layovers, no breaks, missed meals, long delays (3 hr or more), missed breaks, and 8-13 consecutive duty days. Examining the fatigue effect rating in conjunction with the frequency of occurrence, 4 of the top-10 factors received frequency ratings greater than "occasionally," including: 10-13 hr duty day, missed meals, no breaks, and short layovers.

Of the flight attendants experiencing fatigue while on duty, 71% reported their safety-related performance was affected. Of those, 60% believed their ability to respond to passenger needs (including service and safety-related items) was compromised, 36% reported cabin safety performance (e.g., arming/disarming doors, verifying seatbelts fastened) was affected, 34% felt their vigilance regarding cabin security (e.g., passenger risk assessment) was impeded, and 14% indicated preflight safety briefings were affected.



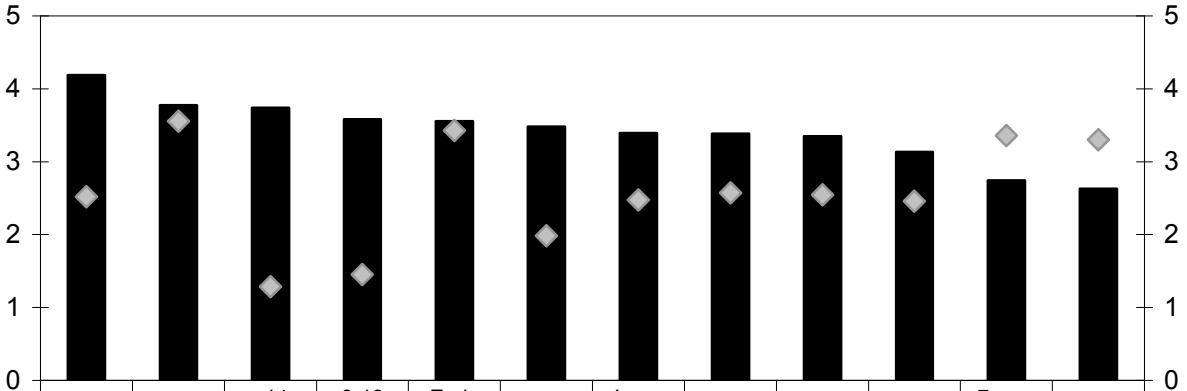
	Lack of crew rest	Contamin. cabin air	Weather conditions	Faulty cabin	High cabin temp	Severe turb	Loud noises	Low cabin temp	Moderate turb	Light turb
■ Effect	3.45	2.80	2.52	2.45	2.43	2.38	2.36	2.14	2.09	1.87
◇ Frequency	2.68	2.22	3.05	1.59	2.61	1.82	2.38	2.62	2.67	3.34

Figure 3. Highest-rated fatigue factors associated with the work environment.



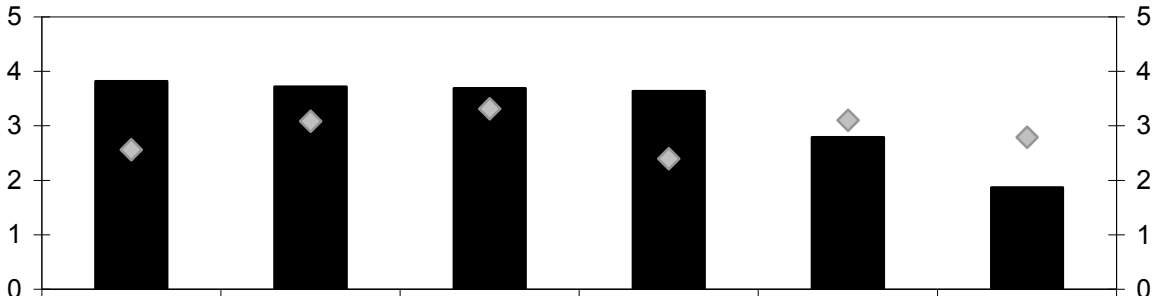
	Missed meals	Jet lag	Meals with poor nutrition	Personal health	Dehydration
Effect	3.65	3.47	3.46	3.24	3.19
Frequency	3.34	2.78	3.39	2.77	2.65

Figure 4. Highest-rated fatigue factors associated with health.



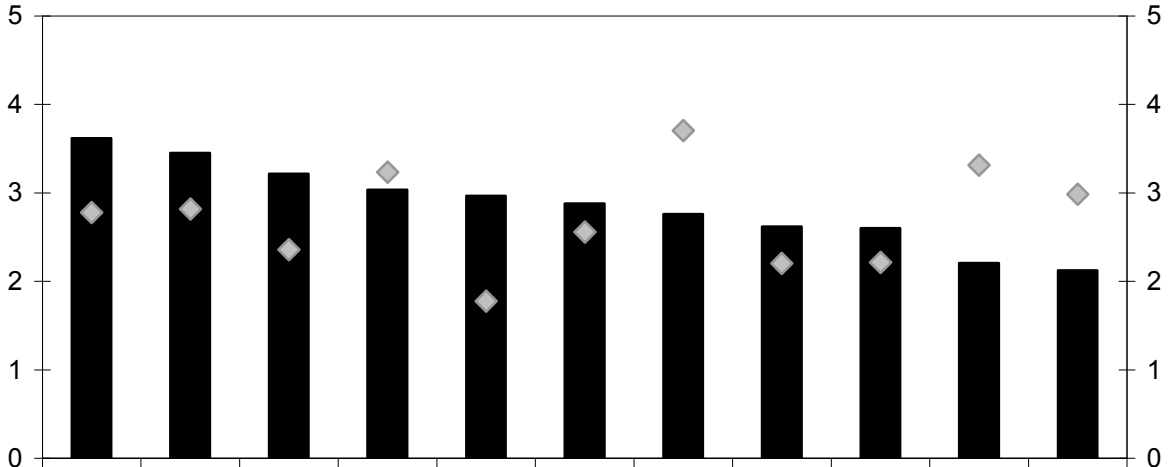
	≥14 hr duty day	10-13 hr duty day	≥14 cons. duty	8-13 cons. duty	Early AM report	Cons. CDO	Long flights (> 5 hr)	Night flying	Rotating sched	Unpred sched	≤7 cons. duty days	6-9 hr duty day
Effect	4.19	3.77	3.74	3.58	3.56	3.48	3.39	3.38	3.35	3.13	2.75	2.63
Frequency	2.52	3.56	1.29	1.45	3.43	1.99	2.48	2.57	2.55	2.46	3.36	3.30

Figure 5. Highest-rated fatigue factors associated with scheduling patterns.



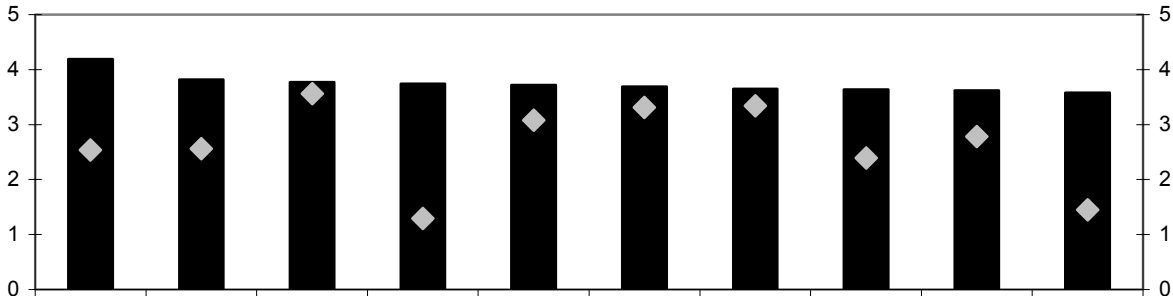
	Quick turns (<9 hr)	Short layovers	No breaks	Long delays (≤3 hr)	Short delays (15 min-2 hr)	Long layovers
Effect	3.82	3.72	3.69	3.64	2.79	1.87
Frequency	2.56	3.08	3.31	2.39	3.10	2.79

Figure 6. Highest-rated fatigue factors associated with layovers and delays.



	Missed breaks	Flying ≥4 seg/leg	Inadeq. staffing	Luggage handling	Emerg. situation	Unruly / hostile PAX	Food / bev carts	PAX with medical problem	Ineb. PAX	Flying ≤3 seg/leg	Crew interact.
Effect	3.62	3.45	3.22	3.04	2.97	2.88	2.76	2.62	2.60	2.21	2.12
Frequency	2.78	2.82	2.36	3.23	1.78	2.56	3.71	2.20	2.21	3.31	2.98

Figure 7. Highest-rated fatigue factors associated with workload.



	≥14 hr duty day	Quick turns	10-13 hr duty day	≥14 cons. duty days	Short layover	No breaks	Missed meals	Long delays	Missed breaks	8-13 cons. duty days
Effect	4.19	3.82	3.77	3.74	3.72	3.69	3.65	3.64	3.62	3.58
Frequency	2.54	2.56	3.56	1.29	3.08	3.31	3.34	2.39	2.78	1.45

Figure 8. Highest-rated fatigue factors overall and frequency of occurrence.

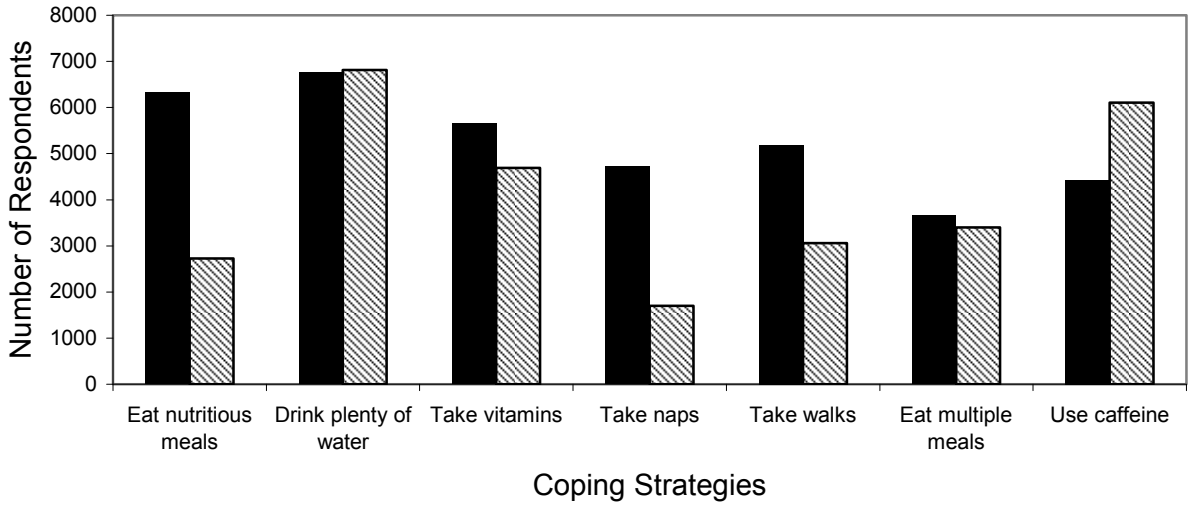


Figure 9. Fatigue coping strategies used by flight attendants.

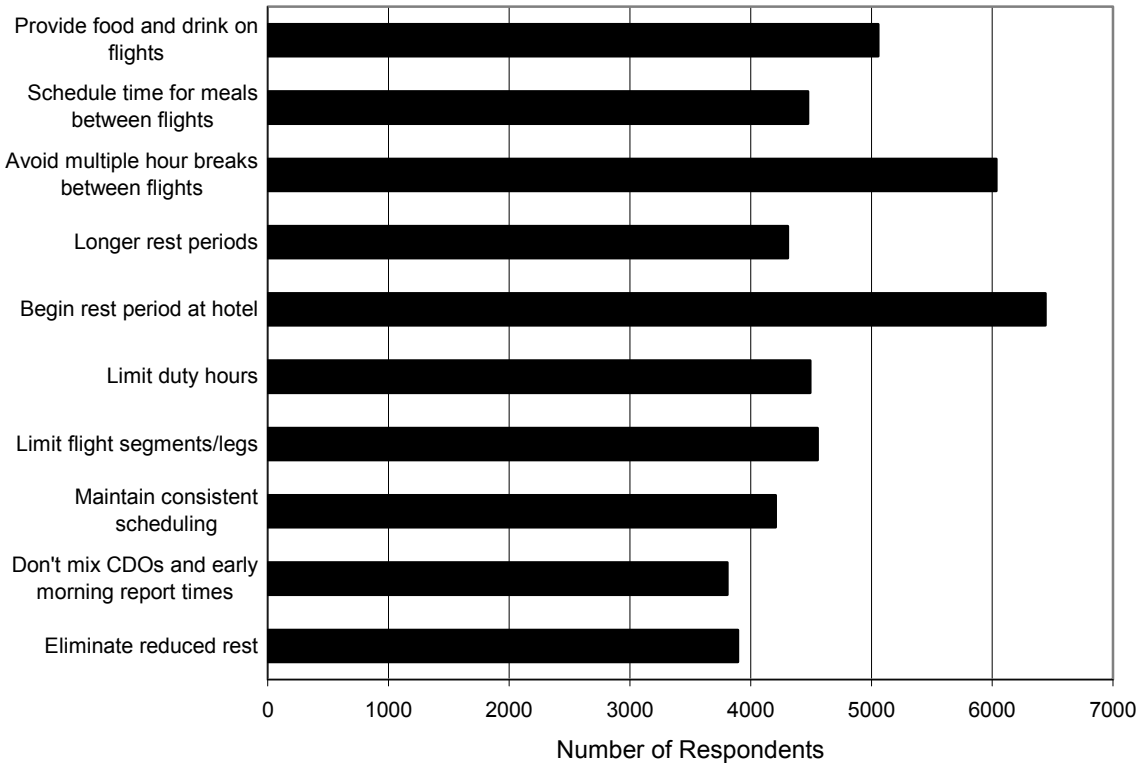


Figure 10. Flight attendant recommendations for reducing fatigue.

Flight attendants utilize a number of coping strategies to cope with fatigue. The top-5 most commonly used coping strategies for "on duty" and "off duty" are shown in Figure 9. More flight attendants appear to utilize coping strategies when "off duty" than "on duty." It should also be noted that the type of coping strategies flight attendants use "off duty" are not available for use "on duty" (e.g., nutritious meals, naps, walks).

Flight attendants were asked to provide suggestions and changes to reduce fatigue in cabin crew operations. Figure 10 shows the 10 most commonly recommended operational changes to reduce fatigue, along with the number of times each change was cited. Three changes were recommended more often than the others: Begin rest period on arrival at hotel, avoid multiple-hour breaks between flights, and provide food and drink on flights. Flight attendants echoed these recommendations in their comments. Some examples include:

> *…[R]est time should start when we get to the hotel and not when we arrive at the gate on the plane. There are times that we are waiting for almost an hour for transportation and it's completely out of our control as a crew.*

There are so many factors that happened between arrival and closed hotel doors. Late shuttles, figuring out meet time, finding food, and just relaxing and unwinding...you can not do all this in an 8 hour rest... and you can't fall asleep that fast either.

The long sit times over 3-4 hr do create huge fatigue for flight attendants and pilots.

To have to work these long days with nothing nutritious to eat and some time to have a break without interruption, is very difficult... Either the airline should provide a nutritious meal or give us the ability to store and cook food we have had to prepare and bring to work. Traditionally, the airline has carb. loaded food available, which causes drowsiness.

Work Environment

The majority of flight attendants indicated they were satisfied with their job overall (83%) and satisfied with the kind of work they do (91%). Despite these high levels of satisfaction, 25% reported that they frequently thought of quitting. When asked to what extent the airline shows concern for employees' overall health, only 18% indicated "considerable extent" or "great extent." Similarly, only 9% of flight attendants perceived the airlines adjusting schedules to minimize fatigue to a "considerable extent" or "great extent." That said, airlines do appear to be providing flight attendants with some type of fatigue training. Thirty-five percent of flight attendants reported receiving training or information regarding fatigue from their airline. The majority of flight attendants (79%) who received training, however, indicated it was only helpful to a "limited extent" or "not at all." In fact, the results suggest little consistency between airlines regarding the coping strategies they are suggesting to employees. The most frequently reported recommendations were to drink plenty of water (30%) and eat nutritious meals (26%). Given the benefits of fatigue countermeasure training in other industries, the evidence seems to suggest that a more standardized and scientifically based, fatigue countermeasure training is needed in flight attendant operations. Avers et al. (2009) provides a detailed evaluation of fatigue training programs with recommendations on specific components required for effective development and implementation.

DISCUSSION

Limitations

Before turning to the broader implications of the present report, certain methodological limitations and conceptual issues should be noted. Survey studies, in particular, are methodologically limited by the subjective nature of the data. Responses depend on perceptions, memory, and respondent understanding of the question. To mitigate the potential for error in these areas, three preventative measures were taken for this survey: 1) the survey questions were beta-tested with flight attendants and revised if commonly misunderstood; 2) flight attendants were primarily asked to answer questions that referenced their previous bid period (~30 days) to optimize the accuracy of memory; and 3) numerous response options were quantified to minimize interpretation using descriptors (e.g., "very rarely": "1 to 2 times in previous bid period"). In addition to the methodological limitations associated with surveys, research has demonstrated that individual's subjective perception of their sleep is discrepant from physiological measures (Sasaki, Kurosaki, Mori, & Endo, 1986). Self-assessed estimates of sleep latency times, sleep durations, awakenings, and other parameters are often inaccurate. The subjective responses to sleep questions are typically underestimated and provide a conservative approximation of objective measures (e.g., Hall, Johnson, & Watson, 2001). Nevertheless, interpretation of the findings should allow for the limitations of subjective data.

Fatigue in Cabin Crew Operations

Even bearing these limitations in mind, however, we believe that the results obtained in the present study have some noteworthy implications for understanding fatigue in cabin crew operations. Overall, responses indicated that flight attendants consider fatigue to be a significant issue. According to reports from the surveyed flight attendants, most have experienced fatigue while at work and agree that it is a common experience. Further, a great majority of cabin crew members consider fatigue a safety risk. Most indicated safety-related aspects of their performance such as cabin safety (e.g., arming/disarming doors), cabin security (e.g., passenger risk assessment), and attending to passenger needs (including service and safety-related duties) were affected by fatigue.

More than half of flight attendants reported that they had nodded off (i.e., micro-sleep) during flight during the previous bid period. Despite the numerous indicators of fatigue occurrence and fatigue risk in cabin crew operations, only about one-third of flight attendants reported they received training about fatigue from their airline.

Fatigue Factors Identified

Responses from flight attendants corroborated many of the fatigue issues that are typically reported anecdotally. Holcomb et al. (2009) provides evidence of flight attendant ASRS reports that highlights the significance of fatigue and possible safety-related issues. This survey found that long duty days, consecutive duty days, length of layovers, long delays, breaks, and nutrition were reported as concerns. Of the fatigue factors that had the most effect on fatigue, the most frequently identified factors were length of duty day, number of consecutive duty days, missed meals, lack of breaks, and short layovers as significant.

Scheduling Factors

Scheduling factors made up 8 of the top-10 factors contributing to fatigue (see Figure 8). Several specific issues concerning cabin crew scheduling practices were identified through responses to questions on CDOs, flying reserve, duty report times, length of layovers, and breaks. Flight attendants reported average work days of 9.6 hr, with an average minimum of 6.4 hr and an average maximum of 12.9 hr. Of the top-10 contributors, length of duty day (10 – 13 hr) was the most frequently cited factor contributing to fatigue. Duty days longer than 14 hr were identified as most contributing to perceived fatigue. The most commonly recommended operational change to reduce the risk of fatigue in cabin crew operations was to start the scheduled rest period on arrival at the hotel or sleep accommodation. Three other top-10 recommendations related to limiting duty hours, eliminating reduced rest, and extending rest periods.

Continuous duty overnights (CDO) involve flying during much of the night and sleeping during the day, especially when CDOs are scheduled consecutively. Approximately one-third of flight attendants reported working CDOs in the previous bid period. Most airlines provide accommodations, usually hotels, for flight attendants flying CDOs. However, the majority of flight attendants working CDOs are receiving less than their average home sleep. Almost one-third of the respondents who had scheduled ground time during a CDO indicated there was no time available for sleep during that time. This suggests that flight attendants working CDOs may have started early-morning flight segments with a substantial sleep loss, regardless of the sleep they may have had later in the day. This sleep loss may magnify the performance decrements that normally would occur during the early morning circadian low. CDOs contributed to fatigue more than a moderate extent (M = 3.48). One of the top-10 recommendations made by flight attendants was to eliminate CDOs combined with early morning reports in the same duty period or sequence.

The approximately 20% of flight attendants who reported flying reserve may face another set of challenges. The nature of flying on reserve means that they must be on call either "on reserve NOT at airport" or "on reserve at airport" and respond when called for duty. The unpredictability associated with reserve status can lead to sleep loss – for instance, if a call for duty occurs when a sleep period was planned. Most flight attendants on reserve (56%) reported getting less than 7 hr of sleep before reporting for duty, when the average sleep for flight attendants was reported as nearly 8 hr when at home. In addition to sleep loss, flying reserve may result in an increased workload, since the majority who flew reserve were required to perform other duties when "on reserve" at the airport. However, the top-10 flight attendant recommendations for reducing fatigue did not include changes to reserve practices – likely because less than half of the respondents fly reserve.

Early-duty report times are another scheduling factor that may contribute to sleep loss among flight attendants. The most common report times were between 0400 and 0759, according to responses. Early-morning start times may shorten the normal sleep period and result in sleep loss, so to accommodate an early report time, crewmembers may attempt to go to sleep earlier than normal to get their usual amount of sleep. The natural tendency of the circadian rhythm, however, could physiologically prevent anyone from falling asleep earlier. Of concern, the type of sleep lost during early-morning reports is most likely to be REM sleep, which occurs for greater duration during the early mornings and is often credited with the restoration of cognitive functions. Early-duty report times were not identified by flight attendants as a top-10 contributor to fatigue but should be considered, given our understanding of circadian rhythms and the early-morning effects on shift workers (e.g., Cruz & Della Rocco, 1995).

The amount of time between flight legs, including short layovers, was identified as one of the top-10 contributors to fatigue that occurred frequently. Interestingly, 2 issues seem to be associated with layover length: first, short layovers that do not allow for meals or breaks; and second, extended waits between flight segments may contribute to long duty days with little flight time. Therefore, 2 of the top-10 recommendations to reduce fatigue were: allow time for meals between flights and avoid multiple-hour breaks between flights.

Finally, the availability of breaks accounted for 2 of the top-10 contributors to fatigue that occurred frequently. The majority of flight attendants do not receive scheduled breaks. Almost a third of flight attendants did not have the opportunity to leave the airplane in the previous bid

period, and almost half rarely left the airplane (1-20% of the time). Workload and time on task are known contributors to fatigue in other industries. Thus, it is not surprising that flight attendants reported missed breaks or no breaks as being strong contributors to fatigue.

Other Fatigue Considerations

Although 8 of the 10 highest-rated factors contributing to fatigue were clearly scheduling factors, the remaining 2 factors seem to be inherently tied to scheduling or organizational policy. Missed meals was one of the strongest contributors to fatigue and occurred frequently in cabin crew operations. Lack of food and dehydration are known contributors to fatigue (e.g., Nesthus et al., 2007) and appear to be an issue of substantial concern among flight attendants. Two of the top-10 recommendations were for airlines to provide food and drinks on flights and to allow enough time between flights for meals.

Shared Responsibility

The key fatigue issues identified in this study, for the most part, seem to be managed by regulators and/or airlines – though examination of commuting and second-job impact remains to be examined. Even so, it should be noted that the issue of fatigue is a shared responsibility amongst flight attendants, regulators, and airlines. For example, more restrictive duty time limitations or risk management driven scheduling may provide longer rest periods. While this may be a solution, it can only be effective if flight attendants commit to getting the sleep they need to be safe and fit for duty. In turn, flight attendants may need fatigue countermeasure education to effectively manage fatigue and be prepared for duty. In other words, effective fatigue management cannot be successful without everyone's commitment (government, airline, flight attendant).

Fatigue Countermeasure Education

Although the results of this study indicated that fatigue training was considered of limited effectiveness, it is most likely a function of the inadequacy or inconsistency of the current fatigue training materials used in this industry. Education plays a significant role in managing fatigue whether the fatigue factors concern regulations, flight schedules, physiological needs, or personal sleep habits (e.g., Co, Gregory, Johnson, & Rosekind, 1999; Caldwell, 2005). If all industry members were equipped with basic information concerning fatigue, its causes, and its consequences for aviation safety and security, it could improve attention toward more effective fatigue management in cabin crew operations. Recent research indicates that flight attendants and pilots may benefit from additional training on fatigue countermeasures, including strategic caffeine use, how to create a suitable sleep environment at home and on trips, and how to develop good sleep habits (see Avers et al., 2009).

Recommendations

Flight attendants identified a number of fatigue factors in their responses. Some of these factors can be easily resolved, while others may require more effort. The primary factors can be broadly categorized as deriving from 2 key areas: scheduling and physiological requirements.

Scheduling factors accounted for 8 of the highest-rated fatigue factors and 9 of the strongest recommendations by participants for reducing fatigue. An overall review of scheduling practices may be an important part of any attempt to address fatigue. An examination of duty duration, continuous-duty overnights, reserve practices, reduced rest, breaks, rest periods, and duty report times may be warranted. Identification of ways to improve schedules from a science-based fatigue standpoint, while meeting operational and economic needs of the airlines, would be constructive and may be possible in the form of fatigue risk management.

Missed meals accounted for the other key fatigue factor that was commonly identified by flight attendants. To some extent, this issue may be addressed by both flight attendants and by airlines. For example, airlines might provide fresh, healthy meals when flights have food service. Flight attendants, in turn, could plan ahead and generally bring healthy snacks on board (although this is difficult during reduced rest conditions with limited access or time to purchase food). Similarly, airlines could provide beverages, or flight attendants could bring some bottled water or other non-caffeinated beverage, but the issue of missed meals seems to be inherently tied to missed breaks or no breaks. In other words, preparation of a healthy meal can only be beneficial if the flight attendant has the opportunity to eat the meal.

Fatigue countermeasure training does not appear to be widely used and provides limited value to flight attendants in its current form. The use of a comprehensive, science-based fatigue countermeasure training program may prove to be more beneficial to both flight attendants and airlines and is documented in a companion report (see Avers et al., 2009).

REFERENCES

Åkerstedt, T. (1995a). Work hours and sleepiness. *Neurophysiologie Clinique*, *25*, 367-375.

Akerstedt, T. (1995b). Work hours, sleepiness and the underlying mechanisms. *Journal of Sleep Research*, *4*, 15-22.

Åkerstedt, T., Knutsson, A., Westerholm, P., Theorell, T., Alfredsson, L., & Keckland, G. (2004). Mental fatigue, work and sleep. *Journal of Psychosomatic Research*, *57*, 427-433.

Arnedt, J.T., Wilde, G.J.S., Munt, P.W., & MacLean, A.W. (2001). How do prolonged wakefulness and alcohol compare in the decrements they produce on a simulated driving task? *Accident Analysis & Prevention*, *33*, 337-344.

Avers, K.B., Hauck, E., Blackwell, L., & Nesthus, T. (2009). Flight attendant fatigue, part VI: fatigue countermeasure training and potential benefits (Technical Report DOT/FAA/AM-09/20). Washington, DC: Federal Aviation Administration, Office of Aerospace Medicine.

Billiard, M., & Kent, A. (2003). *Sleep: Physiology, investigations, and medicine*. New York: Kluwer Academic/ Plenum Publishers.

Brown, L. (2009). *The efficacy of flight/attendant /pilot communications in a post 9/11 environment: Viewed from both sides of the fortress door*. Unpublished draft manuscript.

Caldwell, J.A. (1997). Fatigue in the aviation environment: An overview of the causes and effects as well as recommended countermeasures. A*viation, Space, & Environmental Medicine*, *68*, 932-938.

Caldwell, J.A. (2005). Fatigue in aviation. *Travel Medicine and Infectious Disease*, *3*, 85-96.

Carskadon, M.A., & Roth, T. (1991). Sleep restriction. In T.H. Monk (Ed.), *Sleep, sleepiness and performance* (pp. 155-167). Chichester: Wiley.

Co, E.L., Gregory, K.B., Johnson, J.M., & Rosekind, M.R. (1999). *Crew factors in flight operations XI: A survey of fatigue factors in regional airline operations*. (NASA/TM-1999-208799). Moffett Field, CA: National Aeronautics and Space Administration, Ames Research Center.

Code of Federal Regulations. (2003a, January 1). *CFR §121.467 Flight attendant duty period limitations and rest requirements: Domestic, flag, and supplemental operations* (Publication No. 14CFR121.467). Retrieved May 29, 2009 from the U.S. Government Printing Office via GPO Access: www.gpoaccess.gov/cfr /index.html

Code of Federal Regulations. (2003b, January 1). *CFR §135.273 Duty period limitations and rest time requirements* (Publication No. 14CFR135.273). Retrieved May 29, 2009 from the U.S. Government Printing Office via GPO Access: www.gpoaccess.gov/cfr /index.html

Costa, G. (1997). The problem: Shiftwork. *Chronobiology International*, 14(2), 89-98.

Cruz, C. & DellaRocco, P.S. (1995). *Sleep patterns in air traffic controllers working rapidly rotating shifts: A field study* (DOT/FAA/AM-95/12). Washington, DC: Federal Aviation Administration, Office of Aviation Medicine.

Dinges, D.F. (1995). An overview of sleepiness and accidents. *Journal of Sleep Research*, *4(suppl.2)*, 4-14.

Dinges, D.F., Graeber, R.C., Rosekind, M.R., Samel, A., & Wegmann, H.M. (May, 1996). *Principles and guidelines for duty and rest scheduling in commercial aviation*. (NASA Technical Memorandum 110404). Moffett Field, California: Ames Research Center, National Aeronautics and Space Administration.

Dinges, D.F., Pack, F., Williams, K., Gillen, K.A., Powell, J.W., Ott, G.E., Aptowicz, C., & Pack, A.I. (1997). Cumulative sleepiness, mood disturbance and psychomotor vigilance performance decrements during a week of sleep restricted to 4-5 hours per night. *Sleep*, *20(4)*, 267-277.

Dodge, R. (1982). Circadian rhythms and fatigue: A discrimination of their effects on performance. *Aviation, Space, and Environmental Medicine, 53,* 1131-1136.

Enck, P., Muller-Sacks, E., Holtman, G., & Wegmann, H. (1995). Gastrointestinal problems in airline crew members. *Zeitschrift für Gastroenterologie, 33*, 513-516.

Ewing, T. (1999, March 7). *Your mind is trying to fight it, but your body won't move*. Retrieved July 29, 2009, from www.aopis.org/Australia TheAge-Mar99 Your mind is trying to fight it, but your body won't move.html

Galipault, J.B. (1980). *A study of airline flight attendant sleepiness, fatigue, and stress* (Rep. No. 80-2). Worthington, OH: The Aviation Safety Institute.

Hall, S., Johnson, W.B., & Watson, J. (2001). *Evaluation of aviation maintenance working environments, fatigue, and human performance: Phase III.* Washington, DC: Federal Aviation Administration, Office of Aviation Medicine.

Haugli, L., Skogstad, A., & Hellesoy, O.H. (1994). Health, sleep, and mood perceptions reported by airline crews flying short and long hauls. *Aviation, Space, and Environmental Medicine*, *65*, 27-34.

Holcomb, K., Avers, K.B., Dobbins, L., Banks, J., Blackwell, L., & Nesthus, T. (2009). *Flight attendant fatigue, part IV: Analysis of incident reports.* (Technical Report DOT/FAA/AM-09/25). Washington, DC: Federal Aviation Administration, Office of Aerospace Medicine.

Hunt, E.H., & Space, D.R. (1994). *The airplane cabin environment: Issues pertaining to flight attendant comfort.* Retrieved July 29, 2009, from www.boeing.com/commercial/cabinair/ventilation.pdf.

Lamond, N., & Dawson, D. (1999). Quantifying the performance impairment associated with fatigue. *Journal of Sleep Research*, *8*, 255-262.

Maruff, P., Falleti, M.G., Collie, A., Darby, D., & McStephen, M. (2005). Fatigue-related impairment in the speed, accuracy and variability of psychomotor performance: Comparison with blood alcohol levels. *Journal of Sleep Research, 14*, 21-27.

Mitler, M.M., Carskadon, M.A., Czeisler, C.A., Dement, W.C., Dinges, D.F., & Graeber, R.C. (1988). Catastrophes, sleep, and public policy: Consensus report. *Sleep*, *11(1)*, 100-109.

Nagda, N.L., & Koontz, M.D. (2003). Review of studies on flight attendant health and comfort in airliner cabins. *Aviation, Space, & Environmental Medicine*, *74*, 101-109.

Nesthus, T.E., Schroeder, D.J., Connors, M.M., Rentmeister-Bryant, H.K., & DeRoshia, C.W. (July, 2007). *Flight Attendant Fatigue*. (Report No. DOT/FAA/AAM-07/21). Washington, DC: Office of Aerospace Medicine, Federal Aviation Administration.

Rayman, R.B. (1997). Passenger safety, health, and comfort: a review. *Aviation, Space, and Environmental Medicine, 68,* 432-440.

Rosekind, M.R., Gander, P.H., Gregory, K.B., Smith, R.M., Miller, D.L., Oyung, R., Webbon, L.L., & Johnson, J.M. (1996). Managing fatigue in operational setting 1: physiological consideration and countermeasures. *Behavioral Medicine*, *21*, 157-165.

Rosekind, M.R., Neri, D.F., & Dinges, D.F. (1997). From laboratory to flightdeck: Promoting operational alertness. In *The Proceedings of the Royal Aeronautical Society*, 7.1-7.14.

Samel, A., Wegmann, H.M., & Vejvoda, M. (1995). Jet lag and sleepiness in aircrew. *Journal of Sleep Research*, *4*, 30-36.

Sasaki, M., Kurosaki, Y., Mori, A., & Endo, S. (1986). Patterns of sleep-wakefulness before and after transmeridian flight in commercial airline pilots. *Aviation, Space, and environmental Medicine, 57,* B29-42.

Shappell, S.A., Patterson, J.M., & Sawyer, M.W. (2007). Crew rest and duty restrictions for commercial space flight: Recommendations based upon the scientific literature. (Report No. DOT/VNTSC/FAA-07/21). Cambridge, MA: Office of the Associate Administrator for Commercial Space Transportation.

Simonson, M.D. (1984). Problem areas in flight attendants health. Presented at the First Annual International Aircraft Cabin Safety Symposium, University of Southern California, Los Angeles.

Smolensky, M.H., Lee, E., Mott, D., & Colligan, M. (1982). A health profile of flight attendants (FA). *Journal of Human Ergology, 11,* 103-119.

Tashkin, D.P., Coulson, A.H., Simmons, M.S., & Spivey, G.H. (1983). Respiratory symptoms of flight attendants during high-altitude flight: Possible relation to cabin ozone exposure. *International Archives of Occupational and Environmental Health, 52,* 117–137.