Fatigue Factors of Concern for Current Air Transport Pilots

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INTRODUCTION

Circadian disruption and partial sleep loss have been a major safety concern in aviation. Past studies have indicated that 2 hrs of sleep loss can result in "impairment of performance and levels of alertness" (Carskadon & Roth, 1991)[1]. A study by Balkin et al. (2000)[2] suggested that sleep durations of 6.3 hrs per night are associated with significant reduction in psychomotor vigilance. In 1983, comparing the regulations of different countries, Wegmann and colleagues[3] stated that, a "duty of 12 h appears a rather long 'normal' working day…for a person to sleep 8 h and be awake 16 h" and that "2 or more hours must be added to the 12 h of duty to arrive at the total journey time."

While sleep duration, which is quantifiable, has been widely studied, other factors that decrease sleep length or induce poor sleep quality can also affect the overall restorative function of sleep, resulting in cognitive decrements which potentially decrease the safety margin. This research examined some fatigue-inducing factors that are of concern for current air transport pilots from three different countries.

METHODS

- **378 Current air transport pilots anonymously completed the "Pilot Fatigue Countermeasures and Scheduling Survey"**
  - Canada (n = 86); Spain (n = 168); USA (n = 124)
  - domestic (n = 83); international (n = 150); domestic/int'l (n = 145)
  - captain (n = 195); first officer (n = 164); flight engineer/second officer (n = 15); unidentified (n = 4)
  - 360 men; 18 women (mean age = 44; ranging from 24 to 61)
- **Survey**
  - The survey included 45 items; distributed anonymously in dusters at different airlines' locations using either paper format & website
    - Paper survey was enclosed in a sealed envelope
    - Password and website to access the survey were included in a sealed envelope
  - Participating pilots self-selected the sealed envelope to complete the survey or to obtain information to access survey website
- **Data Analyses**
  - **Fatigue-inducing factors identified** from the following open-ended question: "Please indicate any other fatigue factors relating to your scheduled duty time", using keywords (see Table 1)
  - **Paired-sample t tests** were performed to compare the "typical" and "most" flight hours per month, number of flight segments in a day, and "typical" and "longest" duration in a flight/duty day
  - **One-way ANOVAs** were performed for comparisons between countries for flight hours per month, number of segments in a day, duration in a flight/duty day

TABLE & FIGURES

Table 1: Fatigue-inducing factors compiled from keywords

Fatigue Factors	Keywords
Airport delay	check-in delay, security check delay, ATC delay, departure delay, enroute delay
Circadian desynchronization	early sign-in, time zone changes, shift rotation/changing, late to early sign-in, schedule change from day to night or night to day
Crew & aircraft	crew change, crew attitude, meal schedule, aircraft noise / dryness, insufficient bunk /sleep area
Hotel discomfort	hotel check-in delay, noise, quality
Increased workload	abnormal procedures, inadequate ground resources, aircraft maintenance / mechanical problem, aircraft change, bag loading delay, disruptive passengers
Long commute time	layover commute to & from airport, waiting for transportation, traffic
Personal problem	home / work relationships, management pressure, social activities, physical illness, exercise and sleeping difficulties
Schedule regulation	unsafe duty regs., company ignoring circadian cycle, increased pilot productivity, maximum flight/duty time, maximum multiple flight segments, lack of relief pilots / augment crew, insufficient layover time to allow for rest
Sudden schedule change	unpredictable schedule change, reserve duty, 24-h standby, different wake up calls
Wait between flights	long wait at airport between flights -- block-in/block-out
Weather	bad weather conditions, turbulence

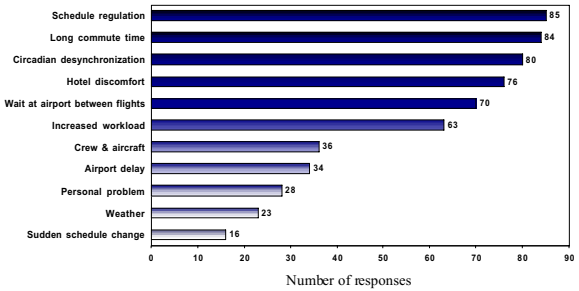

Fig. 1. N = 595 identified responses compiled into 11 fatigue-inducing factors

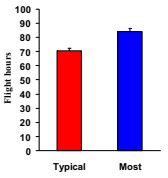

Fig. 2. Paired-sample t test for "typical" and "most" flight hours per month

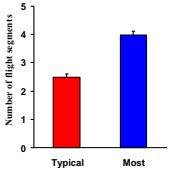

Fig. 3. Paired-sample t test for "typical" and "most" flight segments in a day

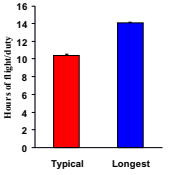

Fig. 4. Paired-sample t test for "typical" and "longest" duration in a flight/duty day

RESULTS

Fatigue-inducing factors identified:

- N = 595 responses identified and compiled into 11 factors (see Table 1)
- n = 6 factors most often expressed among the 378 respondents: Schedule regulations, long commute time to and from airport, circadian desynchronization, hotel discomfort, waiting at airport between flights, and increased workload (see Fig.1)

Paired-sample t tests for categories of "typical" and "most" or "longest" :

- flight hours per month ($t_{(357)} = 6.98$, $p < .001$) (Fig. 2)
- number of flight segments in a duty day ($t_{(363)} = 13.78$, $p < .001$) (Fig. 3)
- duration of a duty day ($t_{(367)} = 32.33$, $p < .001$) (Fig. 4)

One-way ANOVAs for reports among pilots from three countries: Canada, Spain, and USA

- flight hours per month *(n.s.)*
- typical number of flight segments in a day ($F_{(2, 360)} = 6.66$, $p < .001$); pilots of Spain reported higher number of segments as compared to reports from pilots of Canada and USA
- typical duration in a flight/duty day ($F_{(2, 375)} = 12.84$, $p < .001$); pilots of Spain reported the shortest duration as compared to reports from pilots of Canada and USA

CONCLUSIONS

Six fatigue factors most often expressed among the 378 respondents:

- **Scheduling regulations**, which allow for extended flight/duty time and segments, lead to disruption of restorative sleep and are reported concerns of the transport pilots sampled.
- **Long commute time** between airport and rest facility (hotel) is reported to be a factor in extending the work schedule, and potentially contributing to fatigue.
- **Circadian desynchronization** is inevitable in aviation and is a concern and possibly could be lessened with better scheduling techniques.
- **Hotel discomforts** such as check-in delay, quality, and noise prevent restorative (quality and quantity) sleep during layover that can potentially contribute to increased fatigue.
- **Waiting time at airports between flights** lengthens the work schedule and adds monotony, which contribute to fatigue.
- **Increased workload** adds various unnecessary schedule delays which result in fatigue in pilots.

These factors, among other fatigue-inducing factors (see Table 1), are reported most frequently by the current air transport pilots sampled in retrospection of their physiological condition during their critical performance to ensure safe flight operations.

[1] Carskadon, M.A .and Roth, T. (1991). Sleep Restriction. In Monk, T.H. (Ed.) *Sleep, Sleepiness and Performance* (p.p. 155-167). New York: John Wiley & Sons.

[2] Balkin, T., Thorne, D., Sing, H., Redmond, D., Wesensten, N., Williams, J., Hall, S., and Belenky, G. (2000). *Effects of Sleep Schedules on Commercial Motor Vehide Driver Performance.* DOT Report No. DOT-MC-00-133. Washington DC: Department of Transportation Federal Motor Carrier Administration.

[3] Wegmann, H.M., Conrad, B., and Klein, K.E. (1983). Flight, flight duty, and rest times: A comparison between the regulation of different countries. *Aviation, Space, and Environmental Medicine, 54(3),* 212-217.

Research supported by NASA's Airspace Operations System Project of the Airspace Systems Program

ACKNOWLEDGEMENTS

We thank the airlines for their support in the distribution of the survey to the pilots. We thank all participating pilots for completing the survey.