Too Tired

Wake, sleep and alertness measurements reveal a serious underestimation of cabin crew fatigue.

BY WAYNE ROSENKRANS

Less-than-optimal fatigue and alertness levels prevail among U.S. flight attendants even before they report for duty, says a new report. The independent research team behind a field study of 202 cabin crewmembers at 28 airlines collected, for the first time, objective data that corroborate subjective perceptions of "ubiquitous fatigue across the U.S.-based flight attendant community," reported in 2009 by a separate national survey.[1]

"On average, seemingly few, if any, flight attendants begin their workday at their well-rested best," the latest report concludes. Few differences were found among study participants from network, low-cost and regional airlines, or between domestic and international operations when the study was conducted in May–November 2009 and February–June 2010 for the Civil Aerospace Medical Institute (CAMI) of the U.S. Federal Aviation Administration (FAA).

Left for future research, however, was the question of exactly how the newly measured impairments of vigilant attention and neurocognitive performance induced by fatigue — the so-called functional consequences — affect everyday cabin safety. "That is, what does a 20 percent increase in reaction time or doubling of lapse rate [on a psychomotor vigilance test (PVT)] mean in terms of routine passenger safety, crisis prevention and management, and employee health?" the researchers asked.

An assumption that flight attendant fatigue is inconsequential to airline safety historically has influenced a low level of attention from fatigue scientists, the report notes. Fatigue in this context means "a state of tiredness due to prolonged wakefulness, extended work periods and/or circadian misalignment … characterized by decreased alertness, diminished cognitive performance and impaired decision making." A consensus has been growing that safety/security duties of cabin crews have intensified in the past decade.

"In addition to routine safety procedures and negotiating passenger welfare during acute emergencies due to weather, mechanical problems or human error, the heightened threat of organized terrorist events and other disruptive passenger activities, coupled with a generally increasing workload, requires today's cabin crew to possess an unprecedented level of perceptiveness, interpersonal skill and sustained vigilance," the report said.

The latest study is groundbreaking within the scope of research mandated in 2005 and 2008 by the U.S. Congress. It introduced wristwatch-like actigraphy devices — worn by participants to measure sleep/wake patterns — and PVT inputs and other participant responses to customized software prompts on personal digital assistant/smartphones. The devices captured what typical flight attendants experienced during three to four consecutive weeks of real-world flight operations and off-duty rest periods.

"The objective sleep/wake and PVT performance data echo and extend previous survey work suggesting that fatigue is a pervasive condition across the flight attendant community," the report said. "In fact, with sleep/wake patterns similar to those of industrial shift-workers, U.S.-based flight attendants appear to share a state of chronic sleep restriction and fatigue that is considerably worse than their own perceptions. … Regardless of workday activities, virtually all [participating] flight attendants reported for duty in an already compromised state, compared with their own individualized optimal performances. … Sleep/wake parameters and performances across the workday were still systematically affected to some extent by the broad factors of [air] carrier type, seniority and flight operations."

Most important, the study's results fill gaps in the scientific groundwork that informs discussions involving flight attendant unions, airlines and the FAA regarding specific risks, mitigations, resource investments, quantification of fatigue, and design of fatigue risk management systems. Stakeholders also are better positioned to apply the same terminology, scientific knowledge and empirical rigor to addressing fatigue in flight attendants that already has led to science-driven proposals for addressing fatigue in airline pilots (see "New Proposal, Old Resistance," p. 23) and maintenance technicians.

Specific Findings

The report mainly paints a picture of the quantity and quality of sleep obtained, and the impairment of neurocognitive performance. "On average, flight attendants slept 6.3 hours per sleep episode on days off and 5.7 hours on workdays, fell asleep 29 minutes after going to bed, awoke four times per sleep episode, and spent 77 percent of each episode actually sleeping," the report said. "After statistically controlling for any effects of reserve status, gender and age, junior-level flight attendants [relative to mid-level and senior-level flight attendants, as self-reported] had the shortest sleep latencies [that is, time to fall asleep] during their days off, and flight attendants working international operations slept significantly less per episode (4.9 hours versus 5.9 hours) and less efficiently [75 percent of the time available per sleep episode versus 79 percent] during work trips compared to their colleagues working domestic operations.

"In terms of performance, all flight attendants exhibited significant impairments during pre-work PVT test sessions when compared to their own optimum baseline performance, including a 21 percent increase in reaction times, a 14 percent decrease in response speed, and three more lapses [reactions taking 500 milliseconds or longer] on average."

Methodology

Sleep/wake data were collected automatically with devices worn 24 hours a day, seven days a week, with few exceptions. PVT components included timed responses to various types of visual and aural stimulus signals, subjective mood self-assessments and speech analysis, all validated in the field of sleep science. "Participants were required to complete up to four [five-minute PVT] test sessions per day: pre-sleep, post-sleep,

Flight attendants wore a Fatigue Science ReadiBand (previous genration) and performed tests on an AT&T Tilt.

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pre-work and post-work [the latter two sessions only on work days]," the report said. "[They] were informed that safety and fulfilling their professional duties supersede all research requirements, and were explicitly instructed to never engage in study-related activities (data entry, testing, etc.) while actively engaged in or responsible for any work-related activities."

All sleep/wake data were analyzed using mathematical formulas that identify which main effects or interaction effects among multiple factors are statistically significant.

Statistical Insights

Carrier type proved to be a factor in sleep amount. "This was presumably due to the network [flight attendants] losing more sleep from off-days to workdays [a decrease from 6.4 to 5.3 hours] compared to their low-cost colleagues [a decrease from 6.0 to 5.8 hours] and regional colleagues [a decrease from 6.4 to 5.9 hours; Figure 1]," the report said.

Another statistical insight was that time to fall asleep increased from off-days to workdays among senior flight attendants (29 to 31 minutes) and junior flight attendants (26 to 30 minutes) but decreased among the mid-level flight attendants (32 to 27 minutes). "[Mid-level participants'] latencies were significantly longer than their junior-level colleagues on off-days," the report said.

Analysis of sleep amount and sleep efficiency showed that flight attendants on domestic and international routes slept less during work trips than on off-days at home. "The international flight attendants slept significantly less than their domestic counterparts while away on work trips (4.9 versus 5.9 hours)," the report said. "Interestingly, sleep efficiency shifted significantly in both groups from off-days to workdays … but increased for the domestic group (76 to 79 percent), while decreasing for the international group (78 to 75 percent) such that sleep efficiency during work trips was significantly lower for the international flight attendants compared to their domestic colleagues."

Mean reaction times were significantly higher (by 21.3 percent), response speeds were significantly slower (by 14.1 percent) and lapses were significantly more frequent (2.8 per test session) during pre-work sessions compared with mean optimum baseline performance. "These data suggest that, regardless of variations in on-duty activities, all flight attendants manifest some degree of fatigue-relevant performance impairment even before the start of the workday," the report said.

Analysis of false starts revealed a main effect of the carrier type. "Whereas flight attendants from network and low-cost carriers were more likely to [have] false starts on workdays relative to [their mean] optimum baseline … simple contrasts revealed that regional flight attendants, who committed fewer false starts on workdays relative to [their] baseline … did so significantly less than their colleagues from network and low-cost carriers."

Analysis of pre-work to post-work reaction times showed effects attributable to seniority. "Mean reaction times significantly increased from pre-work to post-work [sessions] in flight attendants of mid-level … and junior seniority … whereas their senior-level colleagues were not affected," the report said. "Although the groups did not differ from each other at pre-work [sessions] … post-work reaction times were significantly higher in the [junior-level flight attendants] compared to their senior-level counterparts."

Pre-work and post-work neurocognitive performance also varied significantly for domestic versus international flight attendants. "Mean reaction times increased from pre-work to post-work [sessions] … however, pre-work reaction times were significantly higher in flight attendants working domestic operations compared to their international counterparts," the report said.

Sleep/wake data also documented "significantly less sleep and reduced sleep efficiency while away on trips in flight attendants working international operations versus their domestic colleagues. … [This] is likely a function of circadian misalignment as international crews attempt to sleep under light/dark schedules that differ radically from their own endogenous circadian rhythms," the report said.

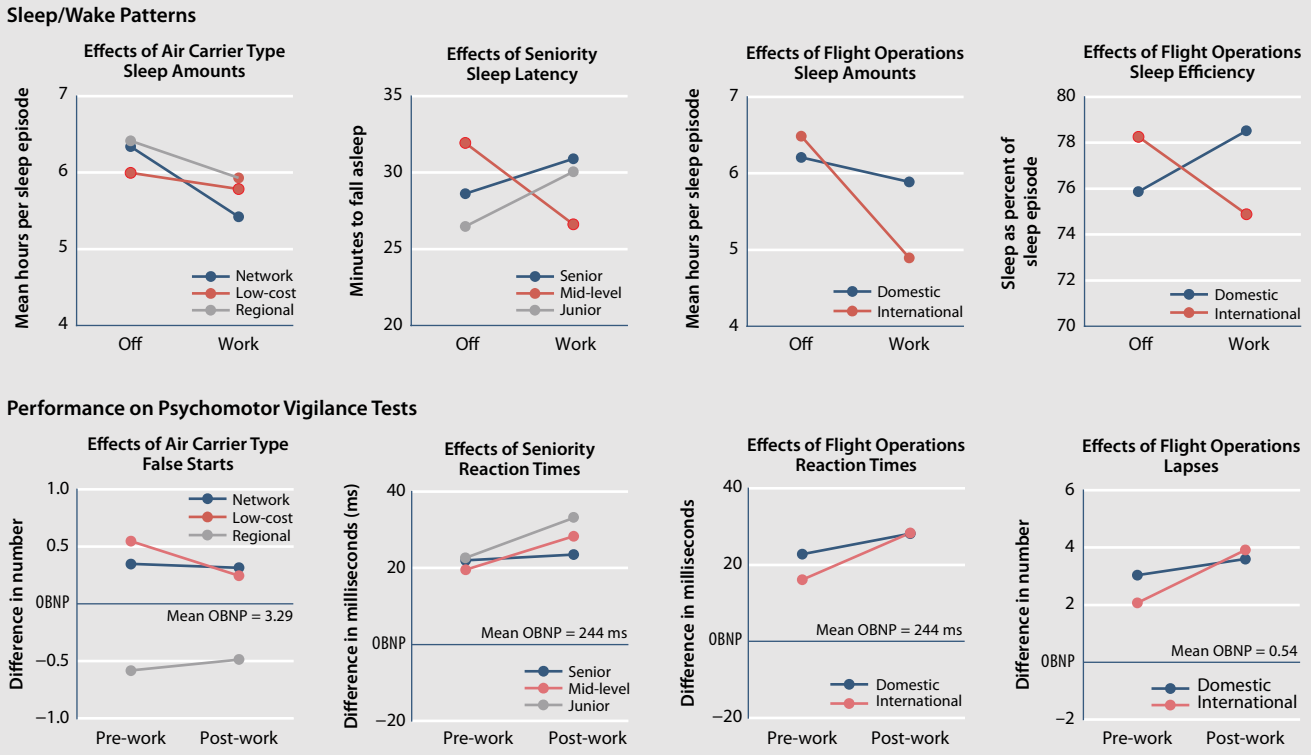
The research team was puzzled, however, by evidence that — despite obtaining less sleep than those working domestic routes — the international flight attendants had the best reaction times and fewest lapses before flight duty. "[These] performance results suggest a superior recovery process in between trips for the international group, yet the groups did not differ from each other in average sleep amounts during off-days," the report said.

Next Steps in Research

Based on what CAMI has learned to date from research under way on suitability of mathematical modeling of fatigue for redesigning FAA's cabin safety guidance and regulations, the report said that "validated evidence-based fatigue modeling tools are available to predict operational safety risks associated with variations in sleep/wake patterns, work schedules and circadian factors."

"Informed by insights from the flight attendant survey results and the current field study findings, the stage is now set

Statistically Significant Fatigue Indicators for U.S. Flight Attendants



Off = sleep during day off at home; Work = sleep during work trip; OBNP = optimum baseline neurocognitive performance

Notes: Actigraphy device–derived data were available from a total of 172 study participants. The sleep/wake pattern graphs use means for the subgroups.

Blue OBNP lines indicate mean individualized optimum baselines — the best neurocognitive performance measured during the study — on these selected components of the psychomotor vigilance test. False starts are reactions prior to stimulus onset. Lapses are reactions delayed by more than 500 ms. These means for subgroups reflect data available from a total of 201 study participants.

Source: U.S. Federal Aviation Administration Civil Aerospace Medical Institute

Figure 1

for in-depth analyses of the predictive relationships between specific operational variables and sleep/wake patterns and performance effectiveness across our entire sample of field study participants regardless of carrier type, seniority or flight destinations," the report added.

The research team is especially interested in total length of duty day, number of flight legs/segments per day, recovery time in the hotel during a trip, consecutive duty days/trip length, and number of days off in between trips.

"The [new] data also underscore the relevance of off-duty time when flight attendants are not under direct supervision, so a number of other issues beyond regulatory control and corporate management — such as distance between home and work base (initial commute) and the responsible use of off-duty time for adequate recovery sleep — are also worthy of consideration," the report said.

This article is based on Flight Attendant Fatigue Recommendation II: Flight Attendant Work/Rest Patterns, Alertness, and Performance Assessment *by Peter G. Roma, Melissa M. Mallis and Steven R. Hursh of the Human Performance Center, Institutes for Behavior Resources, Baltimore, Maryland, U.S.; and Andrew M. Mead and Thomas E. Nesthus of the FAA Civil Aerospace Medical Institute.*

Roma and Hursh also are affiliated with the Department of Psychiatry and Behavioral Sciences, Johns Hopkins University School of Medicine. The recommendation, Report no. DOT/FAA/AM-10/22, was published in January 2011 by the FAA Office of Aerospace Medicine, and is available from <www.faa.gov/library/reports/medical/oamtechreports/2000s/media/201022.pdf>.

Note

1. This sample of active flight attendants — from 6,454 online applications submitted by interested volunteers — was selected first according to the field study's eligibility criteria, then refined to balance demographic subgroups and types of airline operations.