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Full Length Research Paper

Fatigue factors among regional pilots in Malaysia

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Fatigue among pilots and aircrew has been acknowledged as a human factor safety issue since commercial aviation started. The first objective of this study is to investigate the promoting and interfering factors that are involved in pilots' sleep patterns. Meanwhile, the second objective of this study is to understand pilots' duty hours and delay factors that eventually lead to fatigue. The findings from the study demonstrate that most pilots have no difficulty in getting to sleep and most had never taken any sleeping aid. The study found five sleep-interfering factors, all of which can be categorised as either environmental or physiological factors. Environmental interfering factors include heat, noise and lighting. Physiological factors include biological needs and personal worries. Personal worries top the list of the five interfering factors that were identified in this study. The study also found that flight delays can easily fatigue pilots and aircrews. Fatigue is a serious problem because 93% of pilots have admitted that they had nodded off while in control of their flights. It can be concluded that pilots have no problem with sleeping; however, their duty hours and, especially, flight delays cause them to experience fatigue.

Key words: Fatigue, survey, aircraft fatigue, pilots, aircrew.

INTRODUCTION

Regional airline operations within Malaysia and neighbouring countries are a growing segment of the commercial air-transport industry. The increasing frequency of air travel causes fatigue and a lack of alertness among the aircrew, especially pilots. Significant evidence has shown that aircrew and pilot fatigue has been the primary factor in several air incidents and accidents around the world (Neville et al., 1994; Samel et al., 1995; Caldwell, 2001). Fatigue which includes sleepiness and tiredness is the largest identifiable cause of accidents in transport operations (Akerstedt, 2000). Recently, Petrie et al. (2004) suggested that fatigue is a major problem for many pilots especially for those who are operating regional and international routes.

Caldwell (2001) reported a results from surveys on pilots and aircrew members reveal that fatigue is an important concern throughout today's 24/7 non-stop flight operations. Scheduling factors sleep deprivation, circadian rhythm disruptions and extended duty periods continue to challenge the alertness and performance levels of pilots. Limiting flight hours and ensuring at least minimal periods of crew rest have mitigated pilots' fatigue problems to some extent; however, these precautions have not completely removed the risk of this air safety threat (Caldwell 2001; Sexton and Klinect, 2001).

A review study by Williamson et al. (2011) revealed that fatigue is mainly affected by a combination of time of day and sleep related factors. Sleep physiology can be categorised into homeostatic factors and circadian factors. Homeostatic factors are related to the level of sleepiness. It is important to understand that sleep loss accumulates, and the only way to restore it is through restorative and adequate sleep. Another physiological factor that can control and regulate body functions is the circadian rhythm, which is otherwise known as the 'internal clock'. The human body is programmed to sleep and wake up in accordance to this 'internal clock'. This 'internal clock' cannot be rescheduled and resynchronised immediately;

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however, it is a well-known fact that pilots always fly to different time zones and are, therefore, subjected to fatigue due to the circadian rhythm factor. Petrilli et al. (2006) found that sleep is very important and it is a countermeasure for fatigue during international flights that involve not only long hours but also irregular sleep schedule and multiple time zone changes.

In summary, pilot fatigue can be a major flight safety concern and, therefore, demands special attention. Civil aviation started in Malaysia, then Malaya, in 1937 (Fyfe, 2002). Before the emergence of the low cost carrier concept, Malaysia Airlines primarily monopolised aviation in Malaysia. In the past, many studies have investigated pilot and aircrew fatigue, but none has been conducted in the context of the Malaysian aviation environment (Caldwell, 2004; Goode, 2003; Gander, 2001; Janic, 2000). Regulatory requirements, scheduling practices, sleep patterns and other factors have been suggested as potential fatigue factors for regional air operators in the world. For example, the work on short-haul operations in UK by Powell et al. (2007, 2008) have shown that pilot fatigue among others are caused by the duty length, time of day and its impact on the timing of sleep. Before objective measurement like studying the sleeping patterns could be done on specific number of pilots, a survey is inevitable. Hence, the objectives of this study are twofold: first, to identify sleep patterns and their promoting and interfering factors that impact pilots, and second, to investigate pilots' duty hours and the delay factors that eventually lead to fatigue. This study is limited to pilots in Malaysia who fly narrow-body aircraft and fly to regional destinations that are within 4 h of flight time.

MATERIALS AND METHODS

The questionnaire

A survey was carried out based on the questionnaire that was used in the survey conducted by Co et al. (1999) for National Aeronautics and Space Administration (NASA) technical report. Some modifications were implemented to adapt the questionnaire to the Malaysian aviation environment and to suit to the primary objectives of this study. The survey questionnaire used in this study consisted of 37 questions and was divided into 4 sections: General, Sleeping Pattern, Duty, and Fatigue. The questions are mainly open-ended and also in the form of 5-point Likert items. The phrasings that were used were similar to the original version of the questionnaire by Co et al. (1999). For example, under the sleeping pattern section, the pilots were asked to rate the frequency with which they napped based on a 1 to 5-scale, ranging from ''never' to 'very often'.

Survey distribution

The survey questionnaires were distributed to randomly selected pilots via email and hard copy. A cover letter was attached to the survey that explained the objectives of the survey and what was required from the participants. It was highlighted to the participants that the survey was voluntary, anonymous and confidential. The respondents included pilots from 3 regional air operators in Malaysia. The respondents were not required to identify themselves, and they were asked in the cover letter to provide truthful answers. The data collection took almost 3 months to compile because many of the participants did not reply to the first email request.

RESULTS AND DISCUSSION

This section is divided according to the main components of the survey: sleeping pattern, duty-related factors and fatigue. One hundred fifty-nine (159) questionnaires were distributed via email and hard copy. From the 125 returned survey questionnaires, 8 were eliminated because only parts were filled out; therefore, only 73.6% of the total number of distributed questionnaires was used in the analysis.

Respondents' demographic

The mean age of the respondents was 31.8 years, with ages ranging from 19 to 55 years old. All of the respondents were males, 44% of whom were single and 56% were married. The respondents' designations are according to their ranks; 38.5% of the subjects were commanders (captains) and 61.5% were co-pilots. Among the respondents, 80 pilots held an Airline Transport Pilot Licence (ATPL) and 37 held a Commercial Pilot Licence (CPL). The ATPL is the highest level of license whereas CPL is for beginner. The respondents levels of experience ranged from less than 1 year up to 33 years of experience with an average of 10.2 years as an aviator, and the total flight hours recorded ranged from 300 to 20,000 h.

Sleeping pattern

In order to evaluate pilot normal sleeping pattern, the first section of the questionnaire ask on sleeping pattern. It is important to highlight that these respondents were asked to rate the questionnaires based on the average night of sleep for at least two days after returning home after a trip. The results show that on average, the pilots go to bed at 0010 h (12:10 am) in the morning and rise at 0756 h (7:56 am). Most pilots had normal sleep profiles of 7 h and 46 min on average. The pilots reported that they fell asleep after an average of 14.8 min after going to bed. Because this survey was a self-reported survey, this claim was only an estimate. The results also demonstrated that there was an average of 1.04 awakenings per night. Only three of the respondents, who were aged 53, 52 and 39, reported being awakened 3 times a night.

From the answers alternatives given in the questionnaire, the primary causes of the reported awakenings included 43.6% who had a 'need to use the bathroom', 22.2% who reported that they were awakened by their children or spouse, 13.7% who were awakened by 'other factors', 12.9% who were unable to sleep, and 7.7% who were awakened due to 'noise'. The results are depicted in Figure 1. For 'other factors', 9 out of 117 respondents

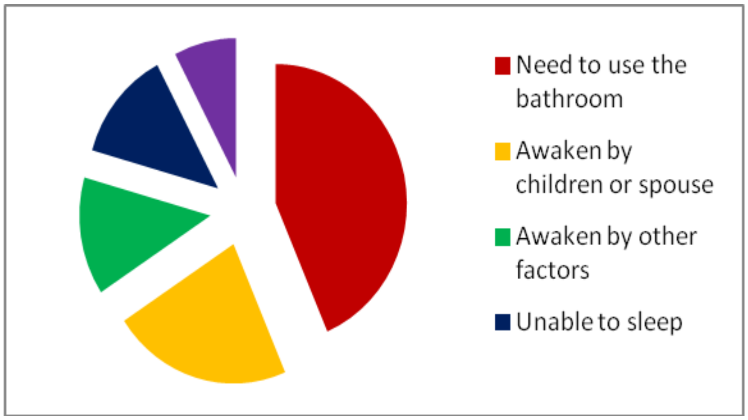

Figure 1. Primary causes of awakenings

Table 1. The averages of top 5 sleep promoting and interfering factors.

Number	Sleep promoting factor	Mean value	Sleep interfering factor	Mean value
1.	Comfort of clothing	4.16	Heat	1.60
2.	Pillows	3.97	Thoughts running through your head	1.65
3.	Bed sheets	3.64	Trips to bathroom	2.07
4.	Ventilation	3.59	Random noise events	2.24
5.	Quality of sleep surface	3.54	Background lighting	2.33

stated that they awoke to perform prayers, thereby accounting for 7.7% of all respondents.

Meanwhile, 4 respondents listed dreams and nightmares as their primary cause of waking. After waking, the respondents reported that it took them an average of 10.9 minutes to return to sleep.

In order to investigate the history of napping behaviour and sleeping problems, several questions regarding the frequency of naps taken during off-days and problems faced when getting to sleep were asked. 'Very often' is defined as napping 5 to 7 times a week. The middle rating of 'rarely' is defined as 1 to 10 times a year, 'sometimes' as 1 to 3 times a month, and 'often' as 1 to 4 times a week. The results indicate that 45.3% of the respondents reported 'never', 6% reported 'rarely', 21.4% reported 'sometimes', 12.8% reported 'often' and 14.5% reported 'very often'. The average reported nap length was 1 hour and 17 minutes.

In terms of sleeping problems, 66.5% claimed that they 'never'' or 'rarely' had problems falling asleep, whereas 20.5% reported that they 'sometimes' did, and 12.8% reported that they 'often' or 'very often' had problems falling asleep. Exactly 94% of the respondents never used any medications to aid sleep, whereas 5.9% said they rarely or sometimes used medication to aid sleep. Regarding alcohol use to aid in sleep, 88% reported 'never', 4.3% reported 'rarely, 4.3% reported 'sometimes', and 3.4% said they use it 'often' or 'very often'.

Subjects were asked an open-ended question to identify which types of foods or beverages, aside from alcohol or medication helped them fall asleep. Exactly 74% of the participants responded to this question, with most suggesting hot beverages, such as hot milo, hot milk and fibre-rich dishes similar to oatmeal.

Next, respondents were asked about 16 factors that might have effects on sleeping. Respondents had to rate these using a Likert scale that included '1-inteferes' through '3-no effects' to '5-promotes'. The top five promoting and interfering factors based on these averages are shown in Table 1. In another open-ended question where respondents were asked to list 5 factors that promoted or interfered with their sleep, 46% responded with 'thoughts running through your head' as their main interfering factor, whereas 39% of the respondents quoted 'pillows' as a promoting factor. The responses are illustrated in figure 2.

In addition, a Likert scale that ranged from '1= strongly interferes' to '5= no effects' was used to ask respondents how these factors affected them. The results demonstrate that personal worries were the most interfering factors identified by the respondents: 24.8% of the 117 respondents rated these factors as a 1, where the mean score was 2.82. Meanwhile, hunger was rated first by 11.1% of the total respondents (mean of 2.91), followed by thirst (10.3% and a mean of 3.24) and, lastly, respiratory factors (10.3% and a mean of 3.33). These findings

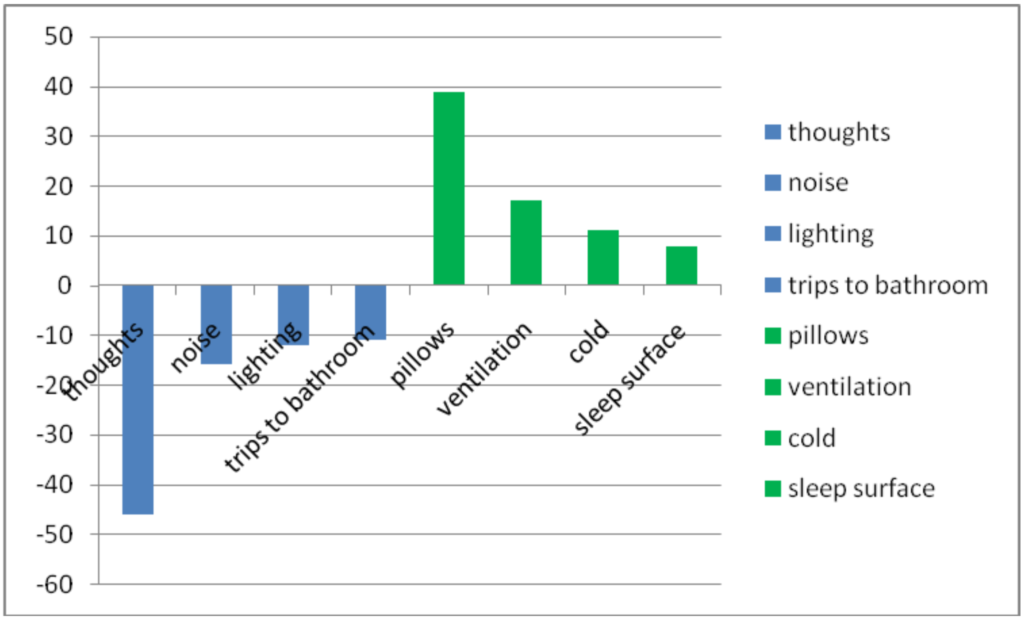

Figure 2. Sleep promoting and interfering factors.

strongly suggest that emotional and psychological factors, such as thoughts and personal worries, genuinely affect pilots' rest days.

Duty-related factors

In this section, the respondents were asked questions about their duty-related matters over the past 2 months. These data encompassed a large timeframe, from August 2009 through early December 2009; therefore, the data range was very wide. Surprisingly, the data showed an almost even distribution. On average, the pilots worked for 19.04 days in a month, with 10 days being the least, and 23 days are the most. The average number of flying hours among the respondents was 76.8 h (76 h 48 min). Sixty hours of flight time was the lowest clocked in a month, whereas 95 hours was the most.

When asked about how many hours the pilots work in a single duty day, the average typical day was 9.32 h (9 h 19 min), the shortest day was 4.34 h (4 h 20 min), and the longest was 13.10 h (13 h 6 min). All of the respondents reported that delays do somehow affect their daily flights. The average typical delay duration was identified to be 10.1 min, with the shortest and longest being 5.4 and 81.7 (1 h 22 min) minutes, respectively. Out of all of the collected data, 2 respondents reported maximum delays of 4 h, whereas 34% reported a maximum delay of more than 2 h. Most of the time, these types of delays are unavoidable; however, certain mechanisms for handling such delays, such as a standby aircrew or pilots, should be made available beforehand.

An average of 8.7 delay occurrences per week derives from air traffic control (ATC). ATC delays only refer to departure delays, as most of the arrival delays follow from previous delays. Departures that are held up by weather, such as rain, wind or poor visibility, account for 5.21 delays per week. Meanwhile, mechanical delays due to technical defects on the airplanes occurs an average of 1.03 times per week. From the data collected, it can be concluded that ATC-related delays are a major concern in extending the crew duty day and eventually lead to fatigue. Respondents were asked to report the number of times they typically operate in high-density terminal control areas (TMAs), which are separate from Kuala Lumpur International Airport (KLIA), and the number of times they operate in a no-radar environment. In high-density TMAs, such as Singapore Changi, Bangkok Suvarnabhumi or Hong Kong Airport, the amount of traffic that is departing and arriving is so high that pilots need to be highly alert and at their best performance; however, these places have radar assistance, which means that the aircraft is positively controlled by the air traffic controllers and that the separation between airplanes and terrain clearances are almost guaranteed by the ATC. In contrast, in a no-radar environment, pilots have to be highly alert to make sure that they maintain separation between other airplanes and the terrain. In both conditions, pilots must always be on high alert and at their best performance. The respondents reported that they flew into high-density airports and no-radar TMAs almost 7.3 times and 6.4 times on average, respectively. Therefore a total of 13.7 instances of high stress and fatigue could be induced in a week. Because the average number of duty days in a month is 19 days, the pilots fly into these types of places almost 3 times a day. It can be said that these pilots are

Table 2. Suggestions and strategies to overcome fatigue before and during a flight.

Before and during flight	Suggestion and strategy
Before flight	1. Sufficient sleep 2. Good duty and day-off rostering and scheduling by the company 3. Fewer legs in a duty day 4. Nutritious food and meal before flight 5. Maintaining a high fitness level 6. Transport: not having to drive to the airport. Starting one's rest period upon arrival to the hotel (transportation is not counted as part of the rest period) 7. Smoking before a flight 8. Avoiding unnecessary domestic confrontations before a flight
In-flight	1. Allowing a control nap/sleep break in the cockpit 2. The company should provide nutritious food/refreshments 3. Drinking a lot of water 4. Practicing good communication/crew resource management (CRM) skills in the cockpit to create a stress free cockpit environment 5. Reading the newspaper while cruising to avoid boredom and increase alertness 6. Taking a brisk walk in the cabin and performing a light stretching exercise after a few hours of cruising 7. Suggesting that smoking be allowed in the cockpit

exposed to these issues almost every time they fly.

Fatigue

Fatigue in aviation was investigated in Section D of the survey. The respondents were required to rate their concern and view regarding the effects of fatigue. From the findings, 86% considered fatigue to be a 'moderate' to 'serious' concern, whereas 14% considered it to be a 'minor' concern or not a concern at all. Another worrying finding is that 91% of the respondents described fatigue as a common occurrence during flight operations. Up to 92% of the respondents indicated that when crew fatigue occurs, it is a 'moderate' to 'serious' safety issue.

The result demonstrates that 51% of the respondents reported fatigue that mostly occurred 'en-route', whereas 27% reported it during 'descent' and 10% during 'landing'. Meanwhile, 'taxi' and 'take-off' flight phases scored 4 and 8%, respectively. From these data, the approach phase, which encompasses the 'descent' and 'landing' phases, accounted for 37% of the reported fatigue. Another alarming response was that 93% of the respondents admitted that they had experienced nodding off during a flight at some time.

Subsequently, a 4-point scale, which included '1-not at all', '2-slightly', '3-moderately' and '4-seriously', was used to rate 16 factors regarding the extent to which each factor affects the fatigue levels depicted in Figure 3. The frequency of when each factor occurs was also presented on a similar 4-point scale, including '1-very rarely', '2-sometimes', '3-often' and '4-very often'. Each scale item was defined as follows: 'very rarely' was defined as 1 to 10 occurrences a year, 'sometimes' was defined as 1 to 3 occurrences a month, 'often' was defined as 1 to 4 occurrences per week, and 'very often' was defined as 5 to 7 occurrences per week. According to Figure 3, the top 10 factors that affect fatigue levels are: flying without an autopilot, aircraft dispatch with major deferred defects, flying multiple sectors of 4 or more, a lack of available nutritious food, dehydration, a high ambient temperature, flying multiple sectors of 1 to 3 sectors, flying following actual instrument flight rules (IFR), severe turbulence and ATC interactions.

According to Figure 1, it can be seen that the most frequent cause of fatigue is flying using actual IFRs, which means flying completely based on instruments. The fatigue effect from this factor is midway between 'slightly' to 'moderately'. It is an important fact that most Malaysian regional pilots fly in an area with high meteorological activity, due to Malaysia's being geographically located near the equator. Thus, flying into clouds and making an IFR approach in poor visibility due to rain and fog is a common contributor to fatigue.

The next question was an open-ended one, wherein the respondents were asked about their strategies for overcoming fatigue before and during a flight. A number of the suggestions and strategies that were mentioned by the respondents in the survey are depicted in Table 2.

DISCUSSION

Pilots work hard every month. Pilots clocked an average of 76 h and 48 min per month and an average duty day that lasted 9 h and 19 min. Flight hours start when an

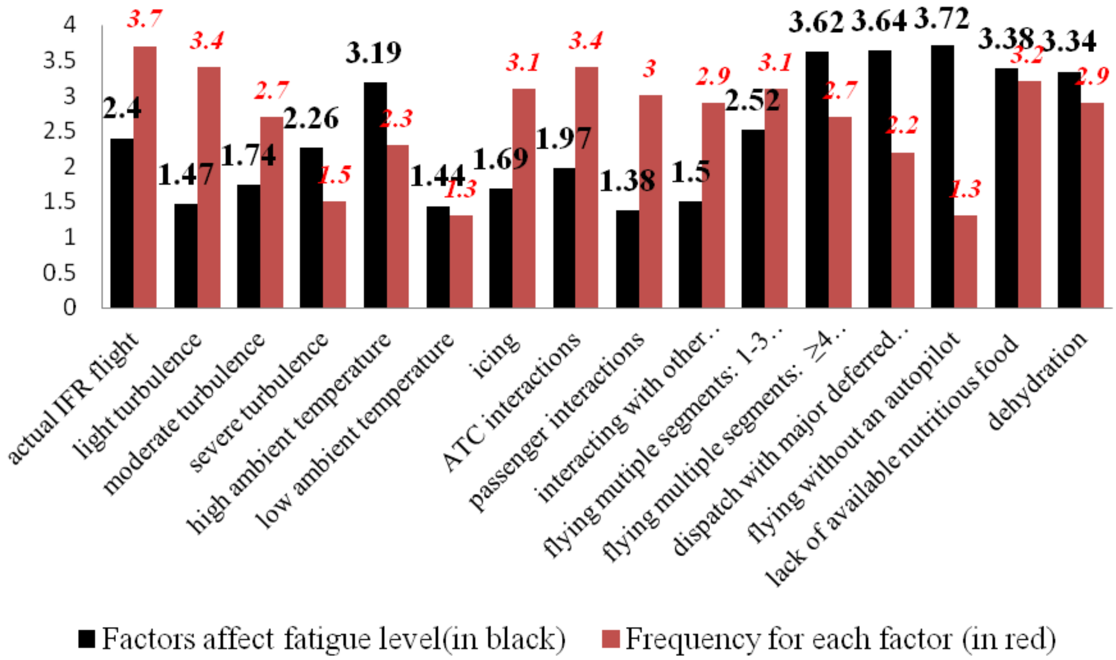

Figure 3. The mean values and frequencies of factors that impact fatigue

aircraft moves on its own power and end when it comes to a complete stop. Flight hours and duty hours are two different things and both affect pilot performance. Delays also induce fatigue, as they lengthen the duty period. Delays were experienced by 100% of the respondents, the shortest delay being 5.4 min and the longest delay being 1 h 22 min. More than half of the respondents reported experienced delays of between 1 and 2 h. The most critical delay-causing factors were ATCs and the weather. Another matter that could contribute to pilot fatigue is the nature of Association of Southeast Asian Nations (ASEAN) regional aviation in which pilots frequently fly into many high-density airports and also through no-radar assisted environments.

There is a great deal of concern that pilot schedules could lead to fatigue and an increased chance of an aviation accident or incident (Folkard and Monk 1979; Dinges, 1991). According to Goode (2003), the Federal Aviation Administration (FAA) of the US proposed a rule to clarify and simplify flight and duty time limits and rest requirements to ensure that flight crews receive adequate rest. Air operators in the US are subject to different sections of the Federal Aviation Regulations (FARs) based on the number of passenger seats. FAR Part 135 applies to aircraft with 30 or fewer passenger seats, whereas Part 121 applies to those with more than 30 seats (Co et al., 1999). For air operators who fall under Part 121, their pilots are limited to 30 flight hours in any 7 consecutive days. Part 121 also limits flight crewmembers not to exceed 1,000 h in any 12 calendar months. Operators are currently required to provide each crew member with a minimum of 24 consecutive hours of rest each week.

On the other hand, in Malaysia, the governing body of civil aviation and air operators use the United Kingdom Civil Aviation Authority CAP371, 'The Avoidance of Fatigue in Aircrews', which was first published in 1975 (MAS, 2009). This publication represents the UK version of the FARs. CAP 371 contains duty limitations, flight time limitations and the minimum required rest period in addition to a set work pattern for the flight crew to prevent the onset of fatigue. It was made known from the responses in the pilot study that fatigue and scheduling practices are sensitive issues to the pilot community. Due to this sensitivity, this survey did not question the justification of scheduling practices, although scheduling practices and demands make up the majority of fatigue-related problems in aviation. As Caldwell (2004) suggested, human beings are simply not designed to operate effectively on the pressured 24/7 schedules that are becoming today's flight operations, whether these schedules consist of short-haul or long-haul commercial flights. The multiple flight legs, long duty hours, limited time off, early report times, less-than-optimal sleeping conditions, rotating and non-standard work shifts and jet lag have all become so common throughout modern aviation and pose significant challenges to the basic biological capabilities of pilots and crews. Scheduling and rostering have been the most talked-about concerns related to fatigue, especially length of duty and night time duties (Powell et al., 2008). Even though this survey did not investigate these factors, due to the reason mentioned above, this issue has to be addressed in order to enhance flight safety. An overall review of scheduling practices must be made without jeopardising air carriers' economic interests.

In the authors' point of view, awareness and education is the most effective tool in managing fatigue. Pilots, air carriers and all parties who are involved in Malaysia's regional flight operations should be well-equipped and aware of the effects of fatigue. Pilots and all concerned parties should be educated and trained regarding sleep requirements, circadian physiology and their safety concerns. Fatigue is a physiological issue that cannot be simply overcome by motivation, training, willpower or remuneration. Human beings cannot reliably judge their own fatigue level, and there is no one solution for all possible situations. Every human slightly differs in terms of fatigue. Awareness and knowledge are the most significant tools for improving regional flight safety fatigue issues. It actually has been confirmed in a survey done in New Zealand by Signal et al. (2008); the authors suggested that there is a need to raise the level of knowledge within the industry regarding the causes and consequences of fatigue and processes of its management.

As evidenced by the responses to the open-ended question, it can be seen that the most efficient strategy for minimising fatigue before flight duty is sufficient and adequate sleep at home. However, it is important to highlight that fatigue cannot be represented by simple summation of the individual factors but rather the complete interaction of the timing of duty related to the circadian rhythm of fatigue, and the duration of duty and its impact on the timing of sleep (Powell et al., 2007). Even though each individual's sleep requirements could be different, 8 hours of sleep will generally guarantee adequate alertness in most people. Sleep loss can degrade cognitive processes, vigilance, physical coordination, judgment and decision-making, communication and countless other parameters (Broughton and Ogilvie, 1992; Dinges and Kribbs, 1991). According to Co et al. (1999), 1 hour of sleep loss can affect waking alertness, and 2 h of sleep loss can significantly affect both alertness and performance. Nodding off is caused by sleep debt, and the length of unintentional sleep episodes, also known as micro-sleep, normally ranges from 3 s to a maximum of 15 s (Blaivas et al., 2006). Naps should also be considered by pilots to promote alertness during flights. In situations in which sleep is frequently disrupted or missed altogether, scheduled naps could be used as a countermeasure against fatigue until normal sleep is possible. According to research papers as quoted by Caldwell (2001), a short nap of 5 to 20 min has been found to enhance productivity and is an effective fatigue countermeasure in aviation. He has suggested that naps be taken at appropriate times, such as between 1 and 6 am or between 2 and 5 pm, such that they do not to disturb the circadian rhythm; however the effects of napping are relatively short and may only last for 10 to 30 min. Pilots must always be physically fit and regularly exercise. Besides keeping one's body healthy, exercise may be an effective method (probably temporarily) to increase alertness and arousal (Caldwell, 2001). Another recommendation would be to have a light stretching exercise while on board to boost alertness. In the survey itself, the pilots suggested reading a newspaper as a strategy to cope with fatigue. Boredom could also be a cause of sleepiness, especially while the aircraft is in cruising mode (sedentary activity). Reading a newspaper or any other material should be done in tandem, with priority being given to monitoring the flight progress. This recommendation should be practiced with caution. Aside from reading, another recommendation would be to engage in conversations and take rest breaks. The most common remedy to sleepiness is to have a cup of coffee for a temporary boost. A cup of coffee has approximately 100 mg of caffeine (Caldwell, 2001). Research has shown that 200 mg doses could reduce sleepiness for 1 to 2 h; however, this effect only occurs 30 min after consumption. It must be highlighted that Caldwell (2001) suggested that caffeine is less effective to those who consume caffeine regularly.

Nevertheless, these techniques would only help increase alertness for short periods of time. If sleepiness is a problem, cockpit naps should be allowed. In Malaysia, aviation regulations have not yet approved cockpit napping. This matter should be seriously investigated. Cockpit napping can only be practiced while in cruising mode when one pilot stays awake and takes control of the flight while another naps on his seat. This activity is often referred to as called 'control sleep' or 'planned sleep' (Rosekind et al., 1995). A study by Rosekind et al. (1995) has shown that naps of up to 40 minutes in length are both safe and effective for long-haul pilots. Roach et al. (2011) indicated that long-haul pilots could obtain substantial sleep during duty periods, however not likely for shorter flights for example, regional flights.

Nonetheless, survey studies are limited by the subjective nature of the data in which the responses depend on respondents' perceptions, memories and understanding of the questions. Sasaki et al. (1986) and many other research papers have indicated that individuals' subjective perceptions of their sleep often differ from physiological parameters. Self-assessed estimates of sleep latency; sleep duration, the number of awakenings, fatigue level, and other measures are mostly inaccurate; therefore, the interpretation of these findings should account for the limitations of these subjective data

Further studies that conduct objective studies on psychological and physiological aspects should be conducted to verify the findings obtained by this survey.

CONCLUSION

It was found that the majority of the respondents have normal daily sleep profiles of approximately 7 hours and 46 min. Most of the respondents did not have any problems concerning their ability to fall asleep and had never taken any sleeping aid, such as alcohol or medication; however, 5 interfering factors were identified, as per the suggestions of the respondents. The top 5 interfering factors included heat, noise, lighting, biological processes and personal worries. Personal worries topped the list of factors that interrupted a pilot's sleep at night. A compromised night of sleep can eventually lead people to fatigue.

According to the survey itself, the issue of fatigue in Malaysia's regional aviation industry can be considered to be very significant. Almost all of the respondents agreed that fatigue is a common occurrence in their flight operations and is a serious safety issue when fatigue really occurs. Most fatigue occurs in the cruising phase, and more than one third of instances occur during the approach and landing phases. The latter is the most crucial phase and requires the highest level of crew alertness. Moreover, 93% of respondents reported that they have nodded off while in control. This finding is a serious matter, as fatigue sets in without a pilot realising it. This phenomenon could jeopardise the lives of passengers and crew members and is also a risk to aircraft safety itself. It was identified that 5 factors highly affect fatigue, including two dietary factors (dehydration and a lack of nutritious food), one aircraft factor (dispatch with major deferred defects), one environmental factor (a high ambient temperature), and one scheduling and rostering factor (flying more than 4 sectors). Interestingly, when asked to provide suggestions of improvement, many pilots brought up the issue of scheduling and rostering. Many pilots want scheduling practices to be re-evaluated. The scheduling of flights and also the number of required flights to be operated by the same crew in a single day have been long-standing issues between airline companies and pilots. Many want the regulations to be amended such that control sleep or napping in cockpit seats is allowed to reduce fatigue. Most pilots also acknowledged that physical fitness, good food and a good diet, in addition to sufficient sleep, are generally well-accepted ways to reduce fatigue. This study only touches some surface issues regarding fatigue in aviation. Future studies regarding this issue must be conducted to understand and minimise fatigue further for pilots and aircrews.

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