STUDY ON THE EFFECTS OF SLEEPLESSNESS OF AIRLINE FLIGHT CREW AND ASSOCIATED SAFETY CONCERNS IN UAE

By

Jibran Abbas
SAP ID : 500072003

Guided By
Mr. Ahmad Qinawi
General Manager
MSI Aircraft Maintenance Services International

A DISSERTATION REPORT SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR

MBA (AVIATION MANAGEMENT)

CENTRE FOR CONTINUING EDUCATION

UNIVERSITY OF PETROLEUM & ENERGY STUDIES, DEHRADUN, INDIA

ACKNOWLEDGEMENT

This is to acknowledge with thanks the help, guidance and support that I have received during the Dissertation.

I have no words to express a deep sense of gratitude to the management of UPES for giving me an opportunity to pursue my Dissertation, and in particular Mr. Ahmad Qinawi, for his able guidance and support.

Signature

Jibran Abbas

508, Kamco Building Muweilah Commercial Sharjah UAE

+971 50 9387 856

Jibranabbas84@hotmail.com

Date: 30 April 2020

Place: Sharjah, UAE

A DECLARATION BY THE GUIDE

Declaration by the Guide

This is to certify that the Mr. Jibran Abbas, a student of MBA Aviation Management, Roll No 500072003 of UPES has successfully completed this dissertation report on "STUDY ON THE EFFECTS OF SLEEPLESSNESS OF AIRLINE FLIGHT CREW AND ASSOCIATED SAFETY CONCERNS IN UAE" under my supervision.

Further, I certify that the work is based on the investigation made, data collected and analyzed by him.

Signature

Ahmad Qinawi

General Manager

MSI P.O. BOX 17462 DUBAI - U.A.E. Aircraft Maint. Services Int'l

MSI Aircraft Maintenance Services International

MSI · P.O. Box 17462 · Dubai · United Arab Emirates

30.04.2020

Declaration by the Guide

This is to certify that the Mr. Jibran Abbas, a student of MBA Aviation Management, Roll No 500072003 of UPES has successfully completed this dissertation report on "STUDY ON THE EFFECTS OF SLEEPLESSNESS OF AIRLINE FLIGHT CREW AND ASSOCIATED SAFETY CONCERNS IN UAE" under my supervision.

Further, I certify that the work is based on the investigation made, data collected and analysed by him.

Ahmad Qinawi
General Manager

MSI P.O. BOX 17462 DUBAI - U.A.E. Aircraft Maint. Services Int'l

MSI Aircraft Maintenance Services International
FZS1 BH 02
Jebel Ali Free Zone
P.O. Box 17462, Dubai, UAE

Tel (+971) 4-886-1122
Fax (+971) 4-886-1121
SITA ZPSMSCR
Internet: www.msiair.com
e-mail: info@msiair.com

Managing Director
Marga Blivier

Trade Licence 1940
Industrial Licence 104249

Bank
Commercial Bank of Dubai · Jebel Ali Branch
AED-Account N°. 1000714095 · IBAN N°. AE530230000001000714095
US $-Account N°. 1000177160 · IBAN N°. AE660230000001000177160
Swiftcode: CBDUAEAD · Tax Registration Number: 100373642600003

INDEX

Table of Contents

LIST OF TABLES AND ILLUSTRATIONS

LIST OF FIGURES

EXECUTIVE SUMMARY

The International Civil Aviation Organization (ICAO, 2011) characterizes fatigue as 'a physiological condition of diminished mental or physical execution capacity coming about because of sleep misfortune or expanded wakefulness, circadian stage, or workload (mental or potentially physical action) that can debilitate a crew member's sharpness and capacity to securely work an aircraft or perform wellbeing related obligations'. However, advances in aircraft technology now allow flights longer than 16 h, which have the potential to increase fatigue (particularly during approach and landing) if they lead to greater acute sleep loss, extended periods of wakefulness and/or greater accumulation of time- on- task fatigue.

Given this situation, the fatigue and sporadic and long working hours (usually above eight hours per day) of pilots raises concern about the safety of air operations (Broadbent, Holland, Spencer, Petrie, Powell, 2007; Caldwell, 2005). The crossing of different time zones change the sleep-wake cycle are common in the night flights, flights that start at dawn also flights that end at late night, which disturb alert levels, and the decision-making of pilots during flights (Ingre, Leeuwen, Klemets, Ullvetter, Hough, Kecklund, et al. 2014).

The study results highlight the need to implement preventive actions related to the organization of work, aiming at improving working conditions and health, especially in aspects related to the sleep of Airline flight crew members in UAE. Aircraft flight team member should be aware of the signs of sleeplessness which include a reduction in alertness what's more, consideration, absence of focus, expanded reaction times, little slip-ups, a decrease of social communications, and poor comprehension. Airline Flight Crew Members can use simple strategies such as developing a good sleep routine, only using the bedroom for sleep, not ingesting alcohol or caffeine before going to sleep to improve sleep and reduce fatigue.

Human Fatigue is caused by lack of sleep and circadian factors and aviation schedules exert a powerful influence on both. Unfortunately, the regulations designed to reduce fatigue are not robust enough and do not weigh these factors sufficiently. With Technological developments like computerized fatigue models and sleep-tracking autography, it is now easier to study the impact of scheduling factors on flight crew. These tools, when used together with behavioural counter-fatigue strategies, can significantly mitigate fatigue and improve operational safety.

When analysing daytime sleepiness, where the main cause is usually irregular work hours influencing the biological clock and the homeostatic regulation of sleep and wakefulness, variables that were associated were encouraging starts, fatigue and sleep protests, albeit just the last two had a predictive value for sleepiness.

Most of the reported incidents of sleeplessness by flight crew are due to successive early wake ups, jet lag, night flights etc. Fatigue with increased sleeplessness can also be attributed to pressure, stress, overworked, long-haul flights, and number of flight legs per day, and consecutive days on duty. There is strong need to consider chronobiology in the development of aircrew scheduling rules, as well as flight and duty time limitations to allow for the additional fatigue effects of multi-leg flights and work constraints in long-haul flights. At long last, pilots ought to be made mindful that the impacts of fatigue incorporate not only the self-reported reduction of alertness and attention, and lack of concentration, but also produces in them the signs that they observed in other crewmembers, including increased response times, small mistakes, a reduction of social communications, and bad air traffic control message reception.

CHAPTER 1 INTRODUCTION

1.1 Introduction

The International Civil Aviation Organization (ICAO, 2011) characterizes fatigue as 'a physiological condition of diminished mental or physical execution capacity coming about because of sleep misfortune or expanded wakefulness, circadian stage, or workload (mental or potentially physical action) that can debilitate a crew member's sharpness and capacity to securely work an aircraft or perform wellbeing related obligations'. Airline crew fatigue has been overseen through prescriptive administrative cut-off points on flight and obligation times; including a 16- h flight time limit for non- stop flights in commercial aviation (Flight Safety Foundation, 2005). However, advances in aircraft technology now allow flights longer than 16 h, which have the potential to increase fatigue (particularly during approach and landing) if they lead to greater acute sleep loss, extended periods of wakefulness and/or greater accumulation of time- on- task fatigue. Long haul flights cause greater fatigue, and in order to reduce the fatigue, rest period is required for recovery sleep on layovers and when crew members return home, before their next trip.

Flight operations where a flight time of 16 h and above on a single sector are increasing with the greater range of new-generation aircraft and the commercial demand for nonstop services. These are defined as "ultra-long-range" (ULR) operations and require flight crew to be on duty for up to 22 h. These long duty periods have the potential to increase safety risks, operational risks during the critical phases of flight especially during approach and landing phase.

In Long-haul flights with less than 16 h duration, it has been observed that occasions like sleepiness have frequently occurred through flight crew or observer notes and objective measures such as the occurrence of micro sleeps. Extreme sleepiness can likewise be surmised from the degree of sleep misfortune experienced, term of times of alertness required, and the need for flight crew to work through the nadir of their circadian mood.

The essential strategy set up to address the fatigue-related hazard in ULR tasks is the utilization of increased crew, which empowers flight crew to pivot through crew rest offices during booked rest breaks and utilize the chance to sleep. In Flight rest breaks are effective in extended wakefulness on ULR flights provided the sleep quality is good which they obtain during the rest period.

Subjective reports indicate that sleeping on board the aircraft is more difficult than sleeping at home, and that sleep during flight is disturbed by a range of factors with the most frequently cited being noise, turbulence, and having "thoughts on the mind." In previous studies of long-haul flights of between 6.2-15 h duration, retrospective surveys and in-flight questionnaires indicate that the average amount of sleep obtained is relatively short, averaging between 2.2 & 2.4 h.

Limited objective data is available on the sleep during in flight breaks and the factors which influence the sleep in that environment. A few studies used polysomnography to record sleep during flight. Findings from these studies indicate that rest opportunities earlier in a flight result in less sleep than later rest opportunities and that, not surprisingly, sleep is influenced by the timing of the rest time frame comparable to circadian stage and length of earlier alertness

Banks and Dinges et al. (2007) say that sleep is a crucial as well as complex part which is essential for normal human functioning which takes 33% part of our life. Waters and Bucks (2011) and Scott et al. (2006) say an impaired cognitive, motor and physiological functioning can significantly afflicted with sleep deprivation or sleep loss. It can also negatively influence one's emotions and mood states. Lieberman et al. (2002) says the decreases in perception which is the result of sleep misfortune and sub consecutive fatigue, Harrison and Horne et al. (2000) say in the working environment sleep loss act as resistance, Gander et al. (2014) say increment in an error rates and Akerstedt et al. (2003) say this lead to decreases in safety. Sleep hardship increases the likelihood of human-error related accidents at regular exercises. Horne and Reyner et al. (1995) say the workers sleep disruption and deprivation is generated serious consequences which are identified in various catastrophic accidents and incidents. For example, fatigue has been found to play a key role in well-known serious aviation accidents. Such as the Air India Express Flight 812 (2010), Go! Airlines Flight 1002 (2008) and Corporate Airlines Flight 1566 (2004) to name a few MooreEde, et al. (2003) say, due to sleep loss there is a high chance of human error in any industry which operates 24-h industries.

On the off chance that an individual staff member is fatigued and hence bound to make errors, Crew Resource Management (CRM) can help alleviate the impacts of fatigue so the errors are made less oftentimes or are gotten rapidly before they lead to an expanded safety hazard. In particular, the act of CRM requires a staff member to screen other staff members, air ship robotization, and the general flight circumstance and to recognize any presumed errors with a verbal test that must be recognized. Such crew coordination rehearses have been appeared which show pilot errors because of fatigue (Foushee et al., 1986; Helmreich and Foushee, 2010; Petrilli et al., 2007; Thomas and Ferguson, 2010; Thomas et al., 2006).

1.2 The Biological Clock, Sleep, and Performance

Organic rhythms adjust our body capacities with the earth. The periods of these rhythms vary from less than a second (e.g. firing of neurons) to close to a month (e.g. menstrual cycle). Because of the adaptation to the daily rotation of the earth and its accompanying light/dark cycle, the most common rhythms repeat approximately every 24 hours (Figueiro, White, 2013; Arendt, 2010). Within the human body, these circadian rhythms (circa=approximately, die=day) regulate multiple body systems (e.g. temperature, alertness, and hormone production), coordinated by the biological clock, which is situated in the suprachiasmatic nuclei (SCN) of the hypothalamus. Although circadian rhythms are generated endogenously, they are influenced by external factors, ensuring synchronization with the environment (Figueiro, White, 2013; Arendt, 2010). Sunlight, received through the eye, is the most important time cue for the biological clock, directing us to sleep at night and to be active during the daytime. Other cues, such as physical exercise, social activities, and nutrition, have a synchronizing effect that is much weaker (Harrington, 2001; Arendt, 2010; Haus, Smolensky, 2006).

The increased health risk of workers exposed to irregular working hours is predominantly ascribed to disturbance of the biological clock (circadian disruption) (Figueiro, White, 2013; Arendt, 2010). Rotating between day and night shifts and travelling across time zones can both lead to a disturbance of the normal sleep/wake pattern and accompanying body functions. The biological clock attempts to adjust to the new sleep/wake pattern, but rarely reaches full adaptation because of its ability to adjust about 1.5 hour per day (Zee, Goldstein, 2010). Moreover, because peripheral organs have a rhythm of their own that can have another readjustment speed, the human body is not only out of phase with its environment, but it is internally desynchronized as well. These consequences induce digestive problems, fatigue, and sleep loss (Costa, 2003; Figueiro, White, 2013; Haus, Smolensky, 2006). The latter two, fatigue and sleep loss, are the most prominent effects of being exposed to irregular working hours, and vary depending on duty hours, work schedules, the number of time zones crossed, and individual tolerance (Zee, Goldstein, 2010; Åkerstedt, 2003; Sallinen, Kecklund, 2010). In addition, sleep can be disturbed as a result of noise or light or because of domestic and social responsibilities during the nonconventional sleeping times (Zee, Goldstein, 2010). The effects of sleep loss accumulate over time; several weeks with less than 6 hours of sleep may yield levels of fatigue that mimic total sleep deprivation (Åkerstedt, 2003). This can have detrimental effects on human performance and decision making, and might result in an increased number of errors and accidents (Arendt, 2010; Maislin, Mullington, Dinges, 2003; Folkard, Lombardi, Tucker, 2005).

1.3 Sleep and the Circadian Rhythm

Sleep performance plays a crucial role in our wellbeing as it is a biological need. It is in this manner not astonishing that fast travel across time-zones can make disturbance sleep designs with suggestions for wellbeing in flight. In this manner, just as evaluations of circadian stage (for example melatonin), circadian musicality considers have additionally utilized conduct evaluations of stream slack, for example, sleep execution. Many studies (e.g. Lowden & Akerstedt, 1999) have used altered sleep parameters (objective and subjective) to represent the process of adaptation of the circadian rhythm following trans meridian travel.

In any case, as sleep conduct can be impacted by a few factors other than a dislodged body clock (e.g. cognition) sleep disruption alone may not be used as a marker of circadian desynchronise. Nevertheless, sleep disruption is the primary complaint of jet lag in the general population (Arendt, 2009; Waterhouse et al., 2000; 2002) and in long-haul cabin crew (Lowden & Akerstedt, 1999; Sharma & Srivastava, 2004). Both objective parameters such as displaced sleep times and subjective symptoms such as difficulty initiating, maintaining sleep and poor waking alertness are strongly associated with jet lag (Lowden & Akerstedt, 1999; Sharma & Schrivastava, 2000; Waterhouse et al., 2000; 2002; 2004).

One of the causes is that following Tran's meridian travel, adjusting sleep to the new local time is not favoured by the slow adapting circadian rhythm so that the two rhythms become uncoupled and sleep suboptimal. For instance, following eastbound travel, people may think that its hard to propel their sleep during a period of their circadian musicality when BCT is high and melatonin low, properties that invigorate sharpness. Alternately, sleep endeavoured on the rising period of the BCT and falling period of the melatonin is related with more enlightenments and shorter sleep (Lamond et al., 2003). The trouble in propelling sleep is likewise due to a limited extent to directional asymmetry. The connection between the sleep/wake cycle and the circadian musicality isn't unidirectional. Proof proposes that the SCN controls sleep through neural and hormonal pathways depicted before however sleep conduct itself impacts the SCN.

1.4 Behavioural Causes of Circadian Disruption: Sleep Disruption

The sleep wake/cycle and the endogenous circadian planning are firmly related and both influence readiness levels and other physiological rhythms. There is likewise proof that proposes that the sleep/wake cycle applies effect on the SCN. For instance, intense sleep misfortune (one episode of broadened attentiveness) can straightforwardly impact neural movement in the SCN (Deboer, Detari, and Meijer, 2007) and longer continuous hours alert influence the adequacy of circadian swaying in execution. There is evidence that altered sleep patterns typical of shift work and jet lag can cause a reduction of melatonin levels. Burch et al. (2005) assessed melatonin levels in night, swing (day and night) and day workers post-work and post-sleep. They found that compared to day workers, night workers had altered melatonin excretion (45% lower), disrupted sleep, and greater symptom prevalence (e.g. feeling tired, sleepy, not alert). Subjects were also ranked on their sleep: work urinary 6-

sulphatoxymelatonin ratio which is between 5 and 20 in day workers and close to one in non-day workers (Burch et al., 2005). In addition, workers with a ratio close to or less than one were 3.5 to 8 times more likely to experience symptoms (Burch et al., 2005). In a similar vein, Grajewski et al. (2003) assessed melatonin rates in cabin crew and teachers over a month and found that cabin crew experience increased circadian disruption, as measured by higher melatonin variability, than teachers. In addition, melatonin desynchronization was related to sleep displacement and number of time zones crossed.

Besides, Roach and partners (2002) found that constant wake up times anticipated melatonin DLMO at pattern in an investigation of mimicked move work. They likewise found that filling in for late shifts essentially postponed the circadian cadence perhaps on account of introduction to light. After seven nights of simulated shift work, a cumulative phase delays of 5.5 h (decimal time) was observed which corresponded to an average delay of 0.8 h (decimal) per day (Roach et al., 2002). Similarly, in a cross-sectional study, Papantoniou et al. (2014) demonstrated that night workers had lower levels of urinary melatonin compared to day workers and peak time occurred three hours later (08:42 h and 05:36 h respectively). In addition, phase delay was stronger among subjects with higher exposure to light at night and number of nights worked, indicating that behaviours such as exposure to light and disrupted sleep (e.g. night work) have important implications for circadian disruption. As chronic sleep disruption (e.g. sleep debt) associated with long-haul operations has serious implications for alertness and safety.

1.5 Function of Sleep

Sleep is defined as a state which is characterised by changes in brain wave activity which involve many areas of the nervous system and two different phases, NREM (Non-Rapid-eye-movement) and REM (Rapid-Eye-movement) sleep (Pressman & Orr, 1997). The function of sleep is not clear. However, different theories have been put forward. According to the restorative function (Horne, 1988), sleep may serve to restore the natural chemical balance in the nervous system. Evidence for this is that processing of information is impaired by lack of sleep as shown by sleep deprivation studies (Horne, 1998) and the secretion of sleep dependent hormones such as growth hormone involved in tissue synthesis and repair discussed earlier (Toates, 2002). The defensive capacity lays on the idea that we are idle when we are generally defenseless (poor night vision) along these lines sleep builds our endurance possibilities (Toates, 2002). As per the re-programming capacity, sleep serves to merge data in our memory (Toates, 2002). While the three procedures may join to clarify sleep work, the helpful hypothesis is the one that has suggestions for the prosperity of long stretch lodge crew as ceaseless circadian disruption of the sleep/wake cycle as a result of jet lag leads to chronic sleep disturbances, daytime fatigue and reduced performance (Lowden & Akerstedt, 1999; Arendt et al., 2000; Waterhouse et al., 2000; Cho et al., 2000; 2001).

1.6 Regulation of Sleep, Wakefulness, Alertness and Performance

As indicated by the Three-Process Model (Folkard, Akerstedt, Tucker, and Spencer, 1999), sleep/wake designs are managed by the homeostatic procedure (S) a circadian procedure (C) and the wake-up process (W). Procedure S speaks to the impact of routine sleep/wake times which increments during alertness and diminishes during sleep. Procedure C speaks to the circadian drive for sleep/wake dictated by the SCN (autonomous of homeostatic procedure). Finally process W reflects sleep inertia, the feeling of sleepiness experienced on waking. Parameters are obtained from rated sleepiness after sleep/awake manipulations (visual analogue scale range 1 - 21, 3 = extreme sleepiness, 7 = sleepiness threshold, 14 = high alertness). Validity of the model was tested by laboratory studies as well as field studies using subjective alertness and EEG alpha and theta activity (typical of Stages 1 and 2 of sleep, Folkard et al., 1999). Overall, medium increased alpha activity was noted in subjected alertness below 7 (Folkard et al., 1999). The interaction of these three processes determines the timing of sleep and the degree of alertness, fatigue and performance. For example, from experimental studies Folkard et al. (1999) predicted sleep latency to start at around 0.5 minutes for the lowest level of predicted alertness (e.g. 1). Thus, sleep latency of more than 20 min is predicted by very high levels of predicted alertness (13 - 17). A refined estimation of procedure C (anticipated from wake-up times) and different factors have expanded the prescient intensity of the model in representing readiness on an assortment of changed sleep/wake designs (for example move work) (Folkard et al., 1997). For instance, the first model neglected to foresee the watched increment in mishap hazard more than four progressive night shifts (Knauth, 1995) as the model appeared to anticipate an expansion in alertness as a result of the adjustment of process C (circadian component) over successive shifts. However, examination of alertness ratings in different night-shift patterns revealed a "first night compensatory effect" whereby subjects rated themselves more alert during the first night shift at the expense of the second night which had substantially lower ratings. A "time on shift" decline in alertness in subsequent night shifts was therefore noted and incorporated in the model. Despite the increase in predicted power, the model has two main limitations. The first relates to the notion that the phase of process C can be predicted by wake up time. While there is evidence that the circadian oscillator influences wakefulness more than sleep (Edgard, Dement and Fuller, 1993, p. 395) (i.e. spontaneous alertness early evening despite sleepless night), it is dicey that wake times can reset process C as quickly as proposed by the model, as proof recommends that circadian adjustment to stage shifts is more slow than wake up times (a few days following westwards travel and at least four after eastwards travel, Cho et al., 2000; Arendt et al., 2000). Also, the model just predicts 60% of the appraised sharpness in move work and between 25 - 96% of readiness in an example of lodge crew (Suvanto, Harma, Ilmariner, and Partiner, 1993b) which suggests that there may be individual differences in the regulation of sleep related to genetic factors (e.g. age, whether subjects are "morning" or "evening" types, neuroticism), or the interaction between social/domestic factors and psychological factors (e.g. coping)

1.7 Characteristics of Sleep Propensity

There are three features of sleep propensity (sleepiness) that may help explain sleep problems and decreased alertness experienced in long-haul flying: the sleep gate, the forbidden zone and the mid-afternoon peak. The circadian rhythm (process C) affects sleep propensity, which means that sleepiness reaches its peak at night and is lowest during the day. Sleepiness increases in the late evening leading to a sleep gate, a window of opportunity where sleep is facilitated. This is associated with DLMO which further promotes sleep onset. It is worth noting that sleep onset latency (SOL) longer than 30 minutes is used in clinical settings to diagnose insomnia (Morin, 1993). As found in the past area, constant sleep times (process S) likewise influence DLMO and sleepiness. Besides, there is an illegal zone for sleep whereby sleep penchant is exceptionally low in the early night (for the most part between 18:00 h and 20:00 h), which closes at the opening of the sleep entryway. Thirdly, there is a mid-evening top in sleepiness (post-lunch dunk in sharpness). Of relevance is the notion of sleep consolidation (the ability to maintain sleep) which follows the rhythm of sleep propensity. That is, sleep consolidation has its peak after BCT minimum and starts to decrease as BCT increases until it reaches its nadir during the day. Sleep inertia (process W) refers to a feeling of confusion and cognitive dysfunction on awakening from sleep, especially deep sleep (SWS), during the night and following sleep deprivation, it can last up to two hours (Buysse, Barzansky, & Dinges, 2003). Thus, the ability to fall asleep, maintain sleep and feeling refreshed after sleep is the result of a fine balance between many processes.

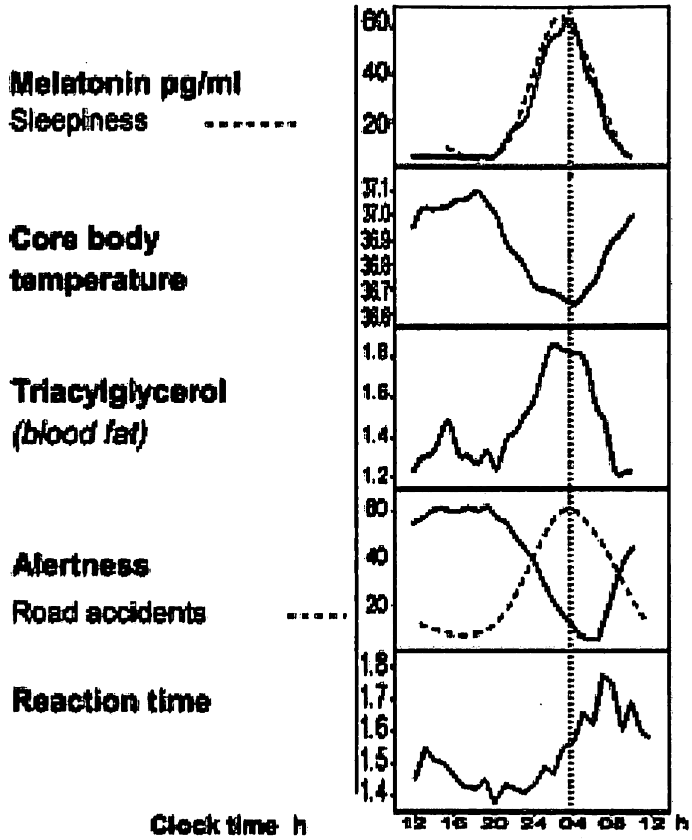


Figure shows that in entrained individuals alertness and performance reach their nadir at night during peak sleep propensity and fatigue and close to the low point of BCT and the peak of melatonin secretion. This explains why sleep that is attempted out of phase is shorter or split (e.g. 5 hours night-time and two, three hours diurnal) or troublesome (for example missed sleep door) and of low quality and why the danger of mishaps increments when working out of stage.

1.8 The Issue on Hand

The aircraft staff team is performing various tasks which are physically demanding. Many air passenger carrier report; in their feet they can invest majority energy of their flight. In any case, air passenger carriers are additionally conducting an emotional test to play out various undertakings on a tight calendar, and by being the (Point of Contact) POC that all travellers look to for data, help, and backing. To lay it out simply, one of the stressors of flight attendants is that they are consistently "on". Roehrs, Carskadon, Dement and Roth et al. (2000) say that an amassed sleep misfortune turns into a sleeper obligation prompting expanded sleepiness to finish work.

Long Haul flights of above 8 hrs, crew expansion, including additional on board staff, can help minimize fatigue hazard. Werfelman et al. (2009) and Rosekind et al. (1994) say that the controlled rests are acting as an entrenched fatigue-alleviation system in short duration flights

Given this situation, the fatigue and sporadic and long working hours (usually above eight hours per day) of pilots raises concern about the safety of air operations (Broadbent, Holland, Spencer, Petrie, Powell, 2007; Caldwell, 2005). The crossing of different time zones change the sleep-wake cycle are common in the night flights, flights that start at dawn also flights that end at late night, which disturb alert levels, and the decision-making of pilots during flights (Ingre, Leeuwen, Klemets, Ullvetter, Hough, Kecklund, et al. 2014). These factors can cause excessive sleepiness throughout the workday, which increases the propensity for unintentional sleep at work and risk of incidents or accidents at work (Caldwell, 2005; Goode, 2003). As per Ingre (2014), he says reflection of the work conditions is observed in unintentional sleep at work and organization of pilots. Ingre et al. (2014) say have also shown that the safety of flights may be compromised due to unintentional sleep at work.

1.9 Dissertation Objectives

- To study the effect of sleeplessness on Airline Flight Crew at UAE Location
- To study the various safety issues emerged due to sleeplessness of Airline Flight Crew in UAE.
- To investigate the level of sleeplessness among Airline Flight Crew at UAE Location
- To investigate the presence of any sleep disorders among Airline Flight Crew in UAE.
- To find the solution for sleeplessness of Airline Crew in UAE.

CHAPTER 2 INDUSTRY PROFILE

2.1 Introduction

Throughout the following hardly any years, the division, which at present contributes 15 percent to the nation's GDP, is required to represent 20 percent of the economy as national carriers Emirates Airline, Etihad Airways, Air Arabia and flydubai keep on extending their global connectivity, frequencies and limit in the background of a progressing Dh85 billion speculation on aviation and tourism infrastructure by governments of different emirates.

While the four national carriers are proceeding with their extension in different outside markets, governments are burning through billions on development and overhauling of airports and tourism infrastructure fully expecting a noteworthy hop in guest traffic to the UAE during Expo 2020 in Dubai. The guest stream to Dubai, the fourth most visited city in the world after London, Paris and Bangkok, alone is anticipated to cross 20 million out of two years from the as of now assessed more than 16 million.

As per ongoing industry assesses, the aviation part is required to contribute about Dh200 billion to the nation's economy by 2020, giving up to 750,000 occupations. Right now, the UAE is putting Dh85 billion in different airport advancement and extension extends that will see its airports build up a consolidated ability to deal with in excess of 300 million passengers every year.

The UAE's national carriers fly to 108 nations and 224 urban areas around the globe, and the nation's civil aviation division is upheld by 8,752 pilots, 37,972 flight crew, 4,472 engineers, 352 air transporters, 49 maintenance places, 18 expert clinical focuses and 56 preparing and consulting focuses.

UAE added up to $270 billion in the aviation sector, while the quantity of international organizations that work aircraft in Emirati airports is 1,048. A year ago, 883,000 flights were taken care of by Emirati airports, with Dubai Airport positioning 6th globally as far as shipment, moving 68,658,083 kilograms of products.

As per the ICAO, the UAE is positioned first globally in quite a while of both aviation safety and aviation security principles, just as far as air transport infrastructure, as indicated by the

Global Competitiveness Report gave by the Administrative Development Institute. It likewise positions first in quite a while of the quantity of air transport services agreements, with an aggregate of 176 agreements.

The UAE is among the main nations as far as the quantity of passengers going through national airports in 2018, representing 134 million passengers, with Dubai Airport positioning first globally in quite a while of the quantity of passengers in 2018, with more than 89 million passengers.

2.2 Airlines' Performance

The continuous airport improvements will assist the UAE's four national carriers, with a joined fleet size of more than 500 aircraft, to serve in excess of 75 million passengers every year. In 2018, while all the four airlines enrolled improved execution contrasted with the earlier year regardless of the global local headwinds influencing the aviation industry, passenger traffic additionally indicated a rise. As indicated by Boeing, airlines in the Middle East, drove by the four UAE carriers, will require 2,990 new aircraft worth $754 billion throughout the following 20 years, to satisfy rising need as the district keeps on developing its business aviation industry.

Interest for wide body aircraft, a classification commanded by Emirates, will represent the mass (52 percent) of new prerequisites, as per Boeing's most recent Commercial Market Outlook. In accordance with International Air Transport Association projections, Boeing estimates 5.2 percent development in traffic throughout the following 20 years, bolstered by a 4.9 percent expansion altogether territorial fleet size. The size of the Middle East market is relied upon to be worth $660 billion out of two decades, with the four UAE carriers expected to represent an enormous piece of it

2.3 Aviation Industry Employment Overview

A great many people associated with air transport work for the overall bunch of organizations that qualify as significant airlines. Most airline workers are not pilots or experts, two specific occupations that the warning gathering was unequivocally charged to consider

Three particular aviation-related transportation occupations: airline pilots, aircraft mechanics, and plane design specialists. Pilots and experts are locked in vigorously despite the fact that not only in air transport; aeronautics designers are bound to work in aircraft fabricating. As well as can be expected decide from looking at data from changed sources, the airlines utilize among half and 66% of the people utilized as pilots and a littler extent of aircraft mechanics.

A significant explanation individuals are worried about ensuring that the aviation industry has the representatives it needs and that all people have equivalent access to employments in this industry is that aviation occupations are generally seen as steady employments—energizing, fulfilling, and, maybe generally significant of all, lucrative. The airlines have been seen as paying high wages comes from the decreased motivators for cost control that existed under guideline. There is high pace of efficiency development.

Deregulated rivalry has brought lower passages to passengers and has extended travel, however it has additionally put weight on the industry to change the terms and states of work. In the post-deregulation period, airlines are not obliged to charge similar tolls and are permitted to enter new markets, much of the time nearly voluntarily. There is presently a solid motivating force to diminish work costs and to utilize lower work costs as a focused device. In the event that an airline can bring down its work costs, it can charge lower passages in its current markets and go into new markets.

With the decrease in passengers, airlines that had not as of now been working proficiently either failed or came exceptionally near that. The organizations that endure were those that taken up some slack and cut expenses however much as could reasonably be expected. Low-charge bearers did similarly well during this troublesome time post-September 11, and for the individuals who needed to fly, both on business and for individual reasons, kept on buying tickets. The airline industry turned out to be increasingly proficient in general, since it had to do as such, and the long-term influences of this are very positive – higher benefits because of lower costs. Work remains its greatest expense, and for certain airlines, it's 40 percent of their general spending plan. Worker's organizations that speak to the different portions of aviation, including mechanics, pilots, flight chaperons, and others, have as of late been in savage dealings with airlines over representative advantages and pay rates. This will probably proceed for a long while.

CHAPTER 3 LITERATURE REVIEW

Introduction

An especially significant part of avionics safety improvement with the end goal of the advisory group's work has been the joint utilization of procedural, social, and technological frameworks to recognize crew errors on the flight deck and to encourage their remedy or relief. Such blunders can emerge out of a collection of human elements including weakness. One methodology known to diminish risks from blunders is grouping resource the officials (CRM). CRM preparing is commanded by the Federal Aviation Administration (FAA) for the pilots of all Part 121 administrators to encourage compelling crew correspondence, coordination, and the utilization of fitting assets to forestall error. This efficient preparing is expected to redesign the limit of airplane teams to execute as a gathering in order to reduce the potential for human mistake and improve safety on the flight deck. Such getting ready underscores the noteworthiness of correspondence and meeting with each other concerning potential wellbeing risks (tallying team individuals' own exhaustion state), directing such threats, avowing moves being made, and cross-checking information from the two instruments and external sources. The expectation is to improve situational mindfulness, critical thinking, and dynamic.

Weariness and lack of sleep have been generally tried in the aviation business utilizing the Psychomotor Vigilance Task (PVT) created by Dinges and Powell (1985) (see likewise Lim and Dinges 2008). Dinges et al. (1997) and Russoetal et al. (2005) PVT execution has been appeared to reliably decrease with diminished rest. In any case, in spite of being considered the "best quality level" for estimating weariness in an aeronautics setting, much stays obscure about the undertaking and what it measures with a scarcity of findings featuring its relationship with genuine assignments. McNair et al. (1971) say a few measures may have guarantee, including the Profile of Mood States (POMS) poll, a rating scale used to assess transient, unmistakable disposition states. Terry et al. (2003) say this measure has been demonstrated to be substantial among solid grown-up populaces, has a high inner consistency and is delicate to weakness. Further, POMS might have the option to help in the estimate of flight execution changes since Previc (2009) discovered flying errors following 24–28 h consistent attentiveness crested in accordance with tops in abstract fatigue, controlled by the POMS

Truth be told, the work exercises of pilots are perplexing and require different skills, both technical and social ones. Among them we can make reference to the capacity to think, adapt to operational changes, work under pressure, work as a team, anticipate the consequences of a set of signals, and interpret these signals for fast decision making (Itani, 2009). The safety of flights as well as some of these skills can be compromised with excessive sleepiness.

Expending right around 33% of our lives, sleep is a fundamental and complex segment which is basic for human working (Banks and Dinges 2007). Thus, sleep misfortune or sleep hardship can significantly meddle with and impair psychological, engine and physiological working (Scott et al. 2006; Waters and Bucks 2011). It can likewise adversely influence one's feelings and disposition states. Sleep misfortune and sub successive fatigue are related with decreases in cognizance (Lieberman et al. 2002), impairments in execution in the work environment (Harrison and Horne 2000), more noteworthy mistake rates (Gander et al. 2014) and at last decreases in wellbeing (Akerstedt, 2003). Sleep hardship can have a profoundly adverse eff ect on regular exercises, improving the probability of human-mistake related mishaps. Sleep hardship or disturbance among these laborers can have genuine results as has been seen in a few disastrous occurrences and mishaps (Horne and Reyner 1995). For example, fatigue has been found to play a key role in well-known serious industrial events such as the Chernobyl (1986) and Three Mile Island (1979) nuclear power plant explosions, when the Exxon Valdez ran aground (1989), the Challenger space shuttle crash (1986) and the running aground of the Shen Neng on the Great Barrier Reef (2010) (Reason 1990). Any industry which works 24-h exercises is profoundly defenseless to human mistake because of sleep hardship (Moore Ede, 2003, for example, the nursing, clinical, mining, oceanic, and transport ventures.

One industry which has gotten generally restricted consideration, in spite of the high dangers in question, is the commercial aviation industry. Commercial airline pilots are subjected to highly demanding, complex and stressful work environments, long duty periods and disrupted circadian rhythms as a result of round-the-clock operations – all key factors which add to administrator fatigue (Sadeghniiat-Haghighi and Yazdi 2015). Moreover, sleep disruption and fatigue are proposed to be overflowing among the business pilot populace with a 2012 review directed by the European Cockpit Association expressing that over half of pilots reported encountering fatigue levels which they found to impair their capacities while on obligation (European Cockpit Association 2012). Loss of sleep and fatigue are proposed as significant reasons for pilot blunder (Helmreich 2000). Furthermore, pilot fatigue has been on the U.S. National Transport Safety Board's Most Wanted Transportation Safety Improvements list since its inception in 1990 (National Transportation Safety Board 1990). From a flying performance perspective, as fatigue increases, accuracy and timing decline, attention narrows, reductions in performance are accepted and pilots abilities to integrate information from individual flight instruments into a significant overall pattern decreases (Caldwell and Caldwell 2003). Lapses or disregard for vital aspects of flight tasks ensue and reductions in ability to efficiently time share mental resources occur. Following 20–24 h ceaseless alertness, pilots' control of even essential flight parameters has been appeared to significantly weakens (Previc et al. 2009). As result, it is basic to all the more likely anticipate when administrators are probably going to encounter fatigued-based decreases in execution using substantial and dependable mental and additionally subjective tests which are snappy and simple to-regulate (Lopez et al. 2012).

An assortment of studies has exhibited significant decreases in execution on essential subjective undertakings in sleep-denied and fatigued people (Dinges et al. 1997; Caldwell et al. 2003). According to Lopez et al., (2012) use of such tasks hold great promise as potential predictors of declining performance among sleep-deprived and fatigued individuals in real-world tasks such as driving long-haul trucks or flying an airplane. Nevertheless, the degree to which simple cognitive tasks can be utilised to predict reductions in performance in "real-world" tasks remains unclear, warranting further investigation. Prior research has found that physiological measures acquired from eye-tracking and electroencephalogram (EEG) tests are often difficult and expensive to implement in real-world environments. Furthermore, these measures do not appear to reliably predict sleep deprived and fatigued-related impairments or performance on criterion tasks (Caldwell et al. 2004). Even with greater reliability and validity, these measures still have little connection between the theoretical constructs underlying those assessments and errors in real-world tasks those assessments and errors in real-world tasks.

According to the International Civil Aviation Organisation's (ICAO) manual of evidence-based training, problem-solving and decision-making is a key construct required by pilots for safe and effective flight (ICAO Manual, 2013). Pilots can be required to innovatively respond to unique challenges, novel task demands and makes timely and correct decisions in chaotic situations (Adams 1993), without which the outcome could have catastrophic effects. Besides, during flight, pilots are required to lead various undertakings simultaneously. For example, pilots must manage the status of the aircraft system and anticipate future tasks as well as conduct their primary tasks such as flying, navigation and communications. There might be the motivation to accept that critical thinking and performing various tasks may connect well with flight execution during sleep hardship and fatigue. Solving mathematical calculations has been employed in previous sleep deprivation and fatigue research have been found to indicate declines in problem-solving performance with increasing time awake (Thomas et al. 2000; Kaliyaperumal et al. 2017). Furthermore, divergent tasks such as multi-tasking and flexible thinking have consistently been found to be susceptible to loss of sleep and fatigue (Goel et al. 2009). General subjective capacity is viewed as the best indicator of pilot by and large execution (Olea and Ree 1994; McHenry et al. 1990; Ree et al. 1994). Also, fluid insight is related with the prefrontal cortex, as are official capacities, of which incorporate dissimilar reasoning and imagination and are especially defenceless against sleep hardship (Harrison and Horne 2000; Crisp and Meleady 2012). Regardless of whether these factors are identified with execution under states of sleep hardship and fatigue are yet to be resolved.

Keeping up familiarity with the workplace, appreciating the data it holds and anticipating how the circumstance will create are a portion of the basic factors in the avoidance of modern mishaps (Jones and Endsley 2000; Stanton et al. 2001). Situational mindfulness is one more of the center capabilities identified by the ICAO are fundamental for sheltered and effective flight (International Civil Aviation Organization 2013). Pilots need to have an awareness of the aircraft state in its environment and be able to project and anticipate changes (International Civil Aviation Organisation 2013). It is viewed as a basic standard for the protected and effective activity of complex powerful frameworks, for example, an aircraft (Sarter and Woods 1991). Situational mindfulness has reliably been seen as powerless to sleep hardship and fatigue (Caldwell et al. 2004; Sexton et al. 2000; Tucker et al. 2010). Not only does situational awareness fall under the realm of executive functions which are associated with the prefrontal regions of the brain (Thomas et al. 2000), loss of situational awareness manifests itself in the operator as the failure to continue responding appropriately or even in responding to the situation completely inappropriately. Furthermore, decreased situational awareness has been referred to as a casual factor in several aviation mishaps (Taylor 1990). It is therefore proposed that situational awareness may also have the ability to predict flight performance changes.

Sleep deprivation and fatigue have been widely tested in the aviation industry using the Psychomotor Vigilance Task (PVT) developed by Dinges and Powel (1985). PVT performance has been shown to consistently decline with reduced sleep (Dinges et al. 1997; Russo et al.2005). However, despite being considered the "gold standard" for measuring fatigue in an aviation context, much remains unknown about the task and what it measures with a paucity of findings highlighting its relationship with real world tasks. Several measures may have promise, including the Profile of Mood States (POMS) (McNair et al. 1971) questionnaire, a rating scale used to evaluate transient, distinct mood states. This measure has been proven to be valid among healthy adult populations, has a high internal consistency and is sensitive to fatigue (Terry et al. 2003). Further, POMS may be able to help in the forecast of flight execution changes since Previc et al. (2009) discovered flying blunders following 24–28 h ceaseless wakefulness crested in accordance with tops in emotional fatigue, controlled by the POMS.

Lindbergh's observations and circadian rhythm imbalances are familiar phenomena to aircrew. DE synchrony occurs when changing environmental cues (e.g., meals, daylight, work-sleep schedules) conflict with existing biological rhythms. Problems commonly associated with desynchronise usually manifest after transoceanic and transcontinental flights.

Air crew sleep is extremely significant in the current scenario of commercial operations. With the given speed and range of current aircraft operations, aircrew fatigue is becoming a limiting factor in aircraft operations. Current business aircraft cross time zones at nearly a similar rate as the earth turns, and it is these quick Trans meridian advances that lead to the syndrome commonly referred to as Jet Lag or Rapid Time Zone Change Syndrome. On arrival at their destination, individuals find themselves out of synchrony with the social and time cues of their new surroundings. It is usually associated with excessive daytime sleepiness; sleep onset insomnia and frequent arousals from sleep, particularly in the latter half of the night. Gastro - intestinal discomfort is common.

Cabin crew structure a significant piece of the business airlines, they structure a significant piece of the flight crew liable for flight safety. To the extent the passenger is concerned, maybe more significant than the aircrew; the business passenger comes in contact just with the lodge crew and structures an impression about the airline through this association. Sleeplessness corrupts consideration, transient memory, and basic leadership; quickly the whole occupation substance of lodge crew endures. In actuality, lodge crew would little be able to bear to be 'fly slacked' and present a poor picture of the airline.

The relationship between psychological wellness and prosperity, and work hours is of developing premium and worry with an expanding group of proof proposing longer work hours antagonistically influence emotional wellness over an assortment of occupations (Dembe, Erickson, Delbos, and Banks, 2005). Different examinations have distinguished a relationship among extra time and expanded work routines with expanded danger of specialist fatigue (Åkerstedt, Fredlund, Gillberg, and Jansson, 2002; Park, Kim, Chung, and Hisanaga, 2001), stress (Maruyama and Morimoto, 1996), and discouragement (Proctor, White, Robins, Echeverria, and Rocskay, 1996; Shields, 1999). A few meta-investigations, for example, those by Sparks, Cooper, Fried, and Shirom (1997) and Spurgeon, Harrington, and Cooper (1997) condensed these examination discoveries. The writing recommends that longer work hours are related with antagonistic impacts on labourers' emotional well-being. Further examination concerning work hours and attending factors adding to labourers' emotional wellness is justified.

Psychological wellness issues, which can be inconvenient to personal satisfaction, can likewise impact work execution (Butcher, 2002). Contingent upon occupation, psychological wellness issues can have genuine boundless results. The emotional wellness of business airline pilots has been found to impact flight execution (Butcher, 2002). Inside the aviation industry, the potential occurrence of emotional well-being issues among pilots is a genuine worry because of activity of multi-million euro airframes and the lives of at least 500 passengers. This death toll and gear was as of late featured on March 24, 2015, when co-pilot Andreas Lubitz, having kept the skipper out of the cockpit, slammed Germanwings Flight 9525 into the French Alps murdering 150 passengers and crew. Further examination found that Lubitz had a background marked by serious melancholy. This deadly episode isn't secluded. On October 31, 1999, 30 minutes after take-off from New York City, an Egypt Air Boeing 767 encountered a quick drop killing 217 people. Uncertain proof proposed that the accident was intentionally brought about by the help first official (Aviation Safety Network, 1999). Besides, on December 19, 1997, Silk

Air Flight 185 smashed after a fast drop from cruising elevation on course from Jakarta, Indonesia to Singapore murdering 104 ready. In the resulting occurrence report, it was recommended that the commander was experiencing "multi-business related challenges" (Aviation Safety Network, 1997). As indicated by Butcher (2002), psychological wellness issues among pilots have been recognized, yet the degree, inceptions, or level of these issues among dynamic airline pilots is as of now obscure in light of the fact that no unequivocal epidemiological investigations on paces of mental issue have been led for this gathering.

One factor proposed to strongly affect psychological well-being, explicitly melancholy, is long work hours (i.e., over 8 hours; Proctor et al., 1996). Pilots flying for European-based air transporters can fly as long as 13 hours for each obligation day (European Union Air Operations [EU-OPS]-Subpart Q). Business pilots appointed to U.S.- based flights can fly as long as 9 hours for each obligation day dependent on a two-pilot crew (Federal Aviation Administration [FAA]-14 CFR Part 117). Pilots flying for U.K. - based transporters are allowed to fly as long as 13 hours for every obligation day (Civil Aviation Authority [CAA-UK]-CAP 371) while business pilots working Chinese-based flights can go through as long as 14 hours on obligation for each day, in spite of the fact that flight time can't surpass 10 hours (China Civil Aviation Regulations [CCAR]-Section 135). These flight time restrictions executed by different aviation guideline specialists recommend further assessment is required worldwide with respect to pilot work hours

Various past examinations have explored the connection between work hours and wellbeing (Proctor et al., 1996; Sparks et al., 1997; van der Hulst, 2003). The psychological well-being of move labourers has additionally gotten some consideration (Harrington, 2001; Kim et al., 2002). Conversely, investigate looking at amount of work hours and labourers' emotional wellness is a lot sparser (Spurgeon et al., 1997). In any case, existing proof causes worry about the negative effect of longer work hours on the wellbeing and prosperity of labourers (Harrington, 2001; Spurgeon et al., 1997; van der Hulst, 2003). In a meta-investigation dependent on 21 examinations, Sparks and associates (1997) found a little however critical positive connection between longer work hours and less fortunate mental wellbeing. Besides, subjective examination of an extra 12 investigations bolstered these discoveries (Sparks et al., 1997). Utilizing the outcomes from the Third European Working Conditions Survey, finished by 21,703 labourers in up close and personal meetings over the 15 European Union member states in 2000, Boisard, Gollac, Valeyre, and Cartron (2003) found that of the individuals who worked 30 to 35 hours out of every week, 27% and 19% reported encountering pressure and generally speaking fatigue, separately, because of work. While, of those representatives who worked 45 hours or more for every week, 39% and 33% reported encountering pressure and by and large fatigue, separately, because of work. The scientists presumed that the recurrence of reported emotional well-being issues was altogether related with work time

Albeit long work hours seem, by all accounts, to be related with emotional well-being issues, the potential impact of jumbling factors (i.e., statistic factors, work requests, work attributes, and character) may likewise assume a job in this relationship (Spurgeon et al., 1997; van der Hulst, 2003). Past research has utilized the quantity of hours functioned as a pointer of assignment requests (van der Hulst, 2003). Notwithstanding, such a methodology can't unmistakably isolate the impacts of employment requests and long work hours. Essential relationships between work hours and wellbeing impacts give restricted data. As per van der Hulst (2003), inability to control for covariates may add to uncertain discoveries in examinations of work hours and psychological well-being.

As per the writing, a few variables related with long work hours and wretchedness or nervousness incorporate sleep disruptions, sentiments of fatigue, and signs of fatigue (e.g., micro sleeps; Samel, Wegmann, and Vejvoda, 1997; Sirois, Trutschel, Edwards, Sommer, and Golz, 2009). As of not long ago, no distributed examinations have researched to what degree self-reported gloom or tension because of work hours may be clarified by sleep disruption and fatigue balanced for singular pilots' statistic qualities. The motivation behind the present examination was in this way to research the distinctions in self-reported wretchedness or uneasiness among European-enrolled business airline pilots, and afterward to additionally explore the degree to which these distinctions could be clarified, at first by singular statistic attributes (e.g., age, position, business), and accordingly by their encounters of fatigue in the cockpit, encounters of micro sleeps in the cockpit, and sleep aggravation because of work routine.

Inadequate sleep has recently been related with expanded danger of mental issue (Vandeputte and de Weerd, 2003). The sleep aggravations a few times each month or every week, coming about because of pilots' failure to receive ordinary sleeping examples that elevate appropriate rest because of work routines, almost multiplied and significantly increased, individually, the respondents' likelihood of reporting gloom or uneasiness, featuring the solid relationship between these two factors. Raggatt (1991) discovered sleep aggravations among long-separation mentor drivers, due most eminently from long hours in the driver's seat (50 hours or more for each week), were reliably related with pressure results and negative wellbeing outcomes. Besides, Raggatt (1991) proposed that fatigue is communicated in a recurrent example where endeavours to manage long hours improves the probability of maladaptive adapting endeavours, bringing about upset sleep, fatigue, and in the end pressure results.

Utilizing drug to tackle the issue can cause issues as well. Dr. Neil Kline, a sleep doctor and chief of the American Sleep Association, told The Huffington Post: 'A considerable lot of the drugs and OTC items utilized for a sleeping disorder and stream slack can cause daytime sleepiness and lead to impaired daytime execution.

Therapeutically alluded to as 'desynchronises' and delegated a circadian beat sleep issue, stream slack is an integral part of long haul flights. Momentary issues from fly slack incorporate fatigue, loss of fixation, touchiness and loss of hunger. All the more worryingly, an examination distributed in The Lancet in 2007 found that steady disruption of body rhythms could prompt intellectual decay, insane and state of mind issue and potentially coronary illness and malignant growth.

Beside the stressing sleep insights, the examination found that practically 50% of those included said they had worked in any event one day while debilitated. A significant explanation was to maintain a strategic distance from the organization's disciplinary procedure (39.4 percent) and 28.6 percent said that they felt their sickness wasn't not kidding enough to warrant a free day work. Also, more than 80 percent said they hadn't had the open door for a supper break while working, and said this had occurred, by and large, multiple occasions during the 28 days that the study was directed.

Effect aide general secretary Michael Landers said on the association's blog: 'During the overview time frame a vast lion's share worked flight obligation times of over nine hours, while just about a third had worked at any rate one flight obligation time of over 13 hours. 'Most experienced flight delays, troubles in taking supper breaks and obligation swaps were likewise hard to accomplish. 'Most lodge crew reported acquiring the base rest time frame (12 hours off between shifts under flight time impediment rules) in any event once in the period.'

The association state the investigation will be utilized to help guarantee the airline is consenting to wellbeing and security aviation laws. Aer Lingus stated: 'Aer Lingus and every single other airline work in one of the most exceptionally directed businesses in the world and give specific consideration and regard for guarantee the wellbeing and prosperity of our representatives. 'The in-flight working condition is profoundly directed at national, European and worldwide levels and Aer Lingus agree to all the applicable codes and gauges. The creators of the report charged by the Impact worker's guild have not counselled nor looked for any contribution from Aer Lingus in the incorporating of their archive.'

Impacts of Fatigue on Aviation Performance

Pilot fatigue has long been a safety and security issue (Caldwell and Caldwell, 2003). Flight crews are incessantly tested by schedules that are unusual, obligation periods that frequently stretch past 10 or 12 hours; work periods that call for evening time sharpness and delays in new time zones that spot sleep openings at wrong occasions. The exhibition of aviation staff, similar to that of modern move labourers, is incessantly compromised by fatigue brought about by schedule-driven sleep misfortune. Be that as it may, in aviation, the stakes are regularly higher on the grounds that they include multimillion-dollar airframes and the lives of up to 555 passengers.

Ongoing occasions have featured fatigue-related safety issues in civil aviation. In 2004, Corporate Airlines Flight 5966 smashed on way to deal with Kirksville Regional Airport after its fatigued pilots, who were on their 6th flight of the day, had been on obligation for 14 hours. Since they were drained, these pilots disregarded distributed methodology, neglected to react to cautions that the aircraft was excessively near the ground, and collided with trees subsequent to losing attention to the area of their aircraft concerning the moving toward airport area and its environment. In February 2008, the Honolulu-based pilots of Go! Airline Flight 1002 overshot their goal by in excess of 30 miles since they nodded off on the flight deck during an excursion that was just 50 minutes long. In October 2009, a comparable occasion happened when the pilots of Northwest Airlines Flight 188 stayed lethargic to interchanges from air traffic control for just about an hour and a half and overflew their goal by 150 miles since they clearly had napped off at the controls.

Such episodes are not astonishing, given that pilot fatigue has been on the U.S. National Transportation Safety Board's (NTSB) Most Wanted List of wellbeing related needs since 1990. The Federal Aviation Administration (FAA) tried to refresh constraints on flight times and obligation hours a couple of times over the previous decades, however the 2009 accident of Continental Connection Flight 3407, in which 50 individuals were killed, revived the office's source of inspiration. Crash specialists verified that before that portentous flight, one of the two pilots had been conscious throughout the night, and the other had reported for obligation following an extensive drive and a nonrestorative sleep period. The NTSB reasoned that "the pilots' exhibition was likely impaired in view of fatigue" (National Transportation Safety Board, 2010, p. 153), which drove the FAA to contract an Aviation Rulemaking Committee (ARC) to refresh flight guidelines for pilots. An essential charge of the ARC was to give science based proposals to new flight-obligation guidelines; at present, in any case, the guidelines keep on concentrating more on work-hour limits than on the sleep and circadian elements that are at the foundation of the issue of pilot fatigue

Sleep and fatigue checking

One inconvenience of inspecting obligation schedules independent from anyone else is that the sleep expected to be picked up by work force must be assessed as opposed to really estimated—and, obviously, the exactness of these estimations legitimately impacts the precision of fatigue-hazard counts. Nonetheless, immediate, experimental estimations of sleep and sleep/wake timing can be acquired utilizing wrist ACTi graphs (Morgenthaler et al., 2007; Sadeh and Acebo, 2002, for example, the Fatigue Science (Honolulu, HI) ReadiBand (see Fig. 1). The exactness of ReadiBand sleep/wake orders was checked in an investigation of 50 patients experiencing polysomnographic assessment (Russell et al., 2010); results showed 92% weighted precision of the understanding between ReadiBand ACTi graphic age by-age sleep/wake figuring's contrasted and highest quality level polysomno realistic conclusions of sleep/wake status. In spite of the fact that actigraphy isn't safeguard since it can't precisely recognize loose (development free) wakefulness or micro sleeps (i.e., slips into sleep that keep going for 30 seconds or less), it is obviously better at following sleep times, wake-up times, and sleep times than are emotional sleep logs. ACTi graphically estimated sleep accounts can give a strong sign of hazard levels for operational fatigue inferable from sleep misfortune and disturbed sleep/wake cycles.

Truth be told, actigraphs could be utilized to build up a preservationist qualification for-obligation program even without presenting the recorded later sleep-history information to a model examination. Since it is notable that the normal grown-up needs at least 8 hours of sleep so as to be completely refreshed (Van Dongen, Maislin, Mullington, and Dinges, 2003), the actigraphy record of pilots reporting to obligation could be inspected, and pilots appeared to have had under 8 hours of sleep in the first 24-hour time frame could be prohibited from up and coming flights (or possibly cautioned about their latent capacity level of impairment)

In-flight fatigue alleviation

Different methods can be executed either previously or during the obligation time frame to address remaining fatigue issues. Crew members ought to be taught about appropriate sleep cleanliness so they can upgrade the helpful idea of sleep before obligation or during delays (Caldwell, Caldwell, and Schmidt, 2008). The utilization of short-acting hypnotics for the advancement of value sleep ought to be permitted and even supported when the pre-duty or delay sleep period falls outside of the ideal circadian stage. Caffeine gum (which is by and by being remembered for the Army's First Strike Rations) could be utilized to briefly support in-flight readiness compromised by sleep obligation or circadian desynchronise (Committee on Military Nutrition Research, 2001). Controlled in-flight rest breaks (right now not approved under FAA guidelines) ought to be given to moderate cockpit crews' fatigue and weariness (Neri et al., 2002)

Instruction about logically legitimate fatigue countermeasures, along with administrative arrangements for their utilization, will enlarge the fatigue-relieving advantages of schedule advancement and fatigue following. In spite of the fact that there is no single enchantment slug, a blend of accessible methodologies will upgrade sharpness and improve aviation safety.

CHAPTER 4 RESEARCH METHODOLOGY

4.1 Introduction

Research methodology is that part of the research work that comprise of taking a systematic approach in solving a problem it is a science that concerns about how the research will be carried out. Researchers have mentioned methodology as "the procedure by which researchers go about their work of describing, explaining and predicting phenomena are called research methodology (Emory, 2010)." It is a process of studying different methods by which knowledge may be accumulated. The aim of the research methodology is to give the work plan of project.

There are different types of method which are applied in the process to collect data for conducting the study and meet with the objectives set in the first chapter. Methods according to Vander Stoep and Johnson (2009) help in creating the basic outline structure of the methods that should be employed in the study

Research strategy is an approach to manage intentionally manages the examination issue. Right now, get some answers concerning different advances that are for the most part gotten a handle on by the master in concentrating on his assessment to know the examination techniques and systems similarly as the procedure.

Experts furthermore need to understand the assumptions crucial procedures and they need to know the criteria by which they can pick that particular frameworks and techniques will be appropriate to explicit issues and others won't. This suggests it is central for the researcher to layout his framework for his issues as the equivalent may differentiate from issue to issue

4.2 Research Design

The research design is selected by the researcher strictly by evaluating the aim and objectives identified in the proposal. It is the apt design of the research that enables the researcher to complete the study in a systematic manner. There are three types of research designs specifically used in dissertation or applied for conducting academic research. These ate explanatory, exploratory and descriptive (Yin, 2003).

The design of the research venture famously known as the "Research design" decision with respect to what, where, when, how much, by what means concerning an inquiry or a research study constitutes research design. The research has concentrated each and every step of research design to design the project. The researcher wants to study the various safety concerns and effect of sleeplessness of airline crew members. Also the researcher wanted to determine the opinions of people working in aviation. The researcher wanted to study the sleeplessness of airline crew members. The researcher design is based on objective of research.

4.3 Data Source

Both auxiliary and essential information will be utilized right now. Essential information will be gathered legitimately from the Airline Staff individuals, utilizing meeting poll uncommonly arranged for this reason. Optional information will be gathered from different related books, magazines, reports arranged by business people, explore researchers, different sites, and so on.

4.4 Data Collection

There are two types of methods used for data collection which are

Primary Data

I collected primary data using methods such as interviews and questionnaires. The key point here is that the data that collected is unique to research. I have tried to collect the data using a questionnaire method.

Secondary Data

Secondary data was collected through the internet, company website, office records, etc.

4.5 Research Tool

The exploration apparatus utilized by the specialist is interview. The meeting comprises inquiries of different measurements identified with the STUDY ON THE EFFECTS OF SLEEPLESSNESS OF AIRLINE FLIGHT CREW AND ASSOCIATED SAFETY CONCERNS IN UAE

Questionnaire

I was using the questionnaire for collecting data. At first, a work in progress was readied remembering the goal of the research. A pilot concentrate was done so as to know the precision of the questionnaire. The last questionnaire was arrived simply after certain significant changes were finished.

4.6 Size of Sample

Straightforward arbitrary examining is utilized for this exploration. The example size is 50. The interviews with 50 flight crew members conducted at UAE location.

4.7 Statistical Research Tool

The information gathered will be grouped, classified, broke down and deciphered in rate to do the destinations of the examination. The streamlined information is then depicted in the types of tables and outlines

4.8 Interpretation

I have used interpretation on the basis of the analysed data and also some recommendations are given to fill the loopholes of the actual scenario

4.9 Likert scale

I have used Likert scale for data analysis. These comprise of various articulations which express either a favourable or unfavourable attitude towards the given object to which the respondents are asked to react. The respondent responds to in terms of several degrees of dissatisfaction or satisfaction.

4.10 Limitations

This investigation experience the accompanying confinements

- This study is constrained to Aircraft flight group individuals in UAE as it were.
- The consequence of the investigation depends on the perspectives on the members. Consequently the information gathered from them might be one-sided.
- The time assigned for the examination is constrained

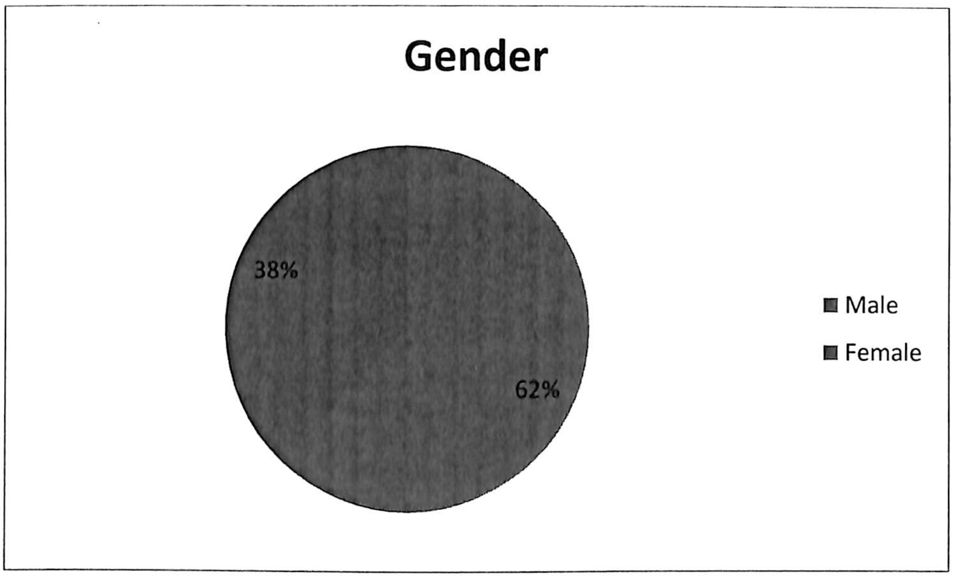
CHAPTER 5 DATA ANALYSIS

1. What is your gender?

Table 5.1 your gender

Option	No of Respondents	% of Respondents
Male	31	62%
Female	19	38%
Total	50	100%

Chart 5.1 your gender



Interpretation

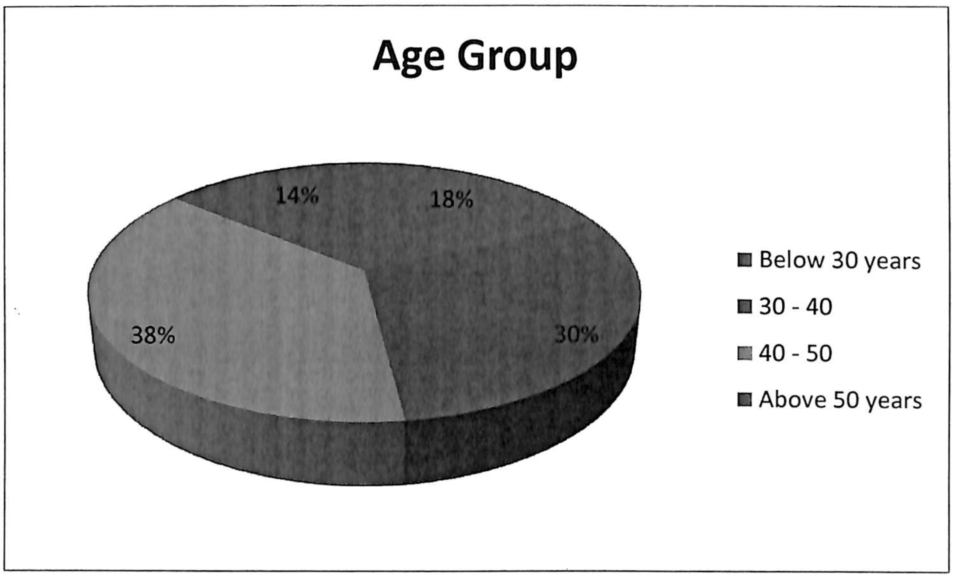
38% of respondents are Female while 62% of respondents are Male which is participated in this survey.

2. What is your age group?

Table 5.2 your age group

Option	No of Respondents	% of Respondents
Below 30 years	9	18%
30 - 40	15	30%
40 - 50	19	38%
Above 50 years	7	14%
Total	50	100%

Chart 5.2 your age group



Interpretation

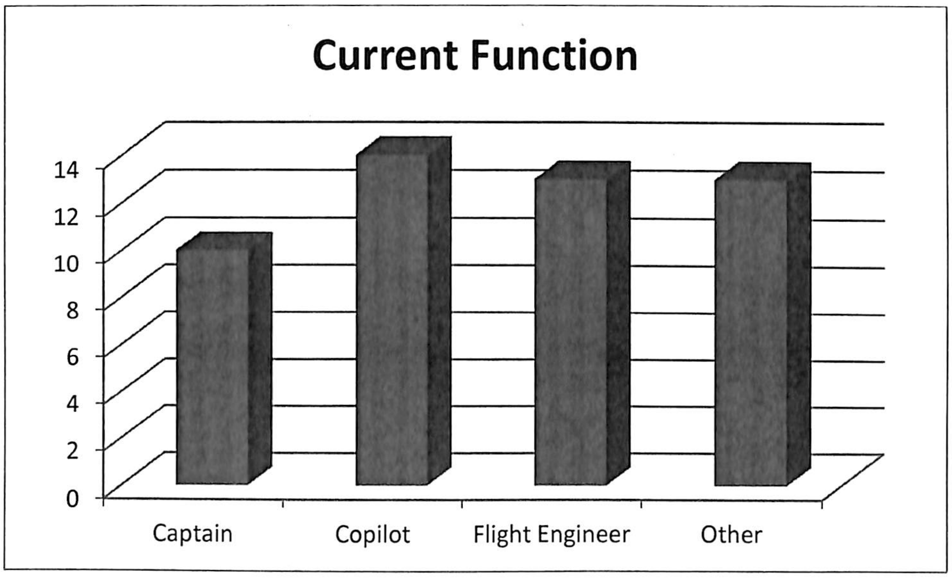
18% of respondents are Below 30 years, 30% of respondents are 30 - 40, and 38% of respondents are 40 - 50 while 14% of respondents are fell in Above 50 year's age groups.

3. As a crew member which one is your current function?

Table 5.3 your current function

Option	No of Respondents	% of Respondents
Captain	10	20%
Co-pilot	14	28%
Flight Engineer	13	26%
Other	13	26%
Total	50	100%

Chart 5.3 your current function



Interpretation

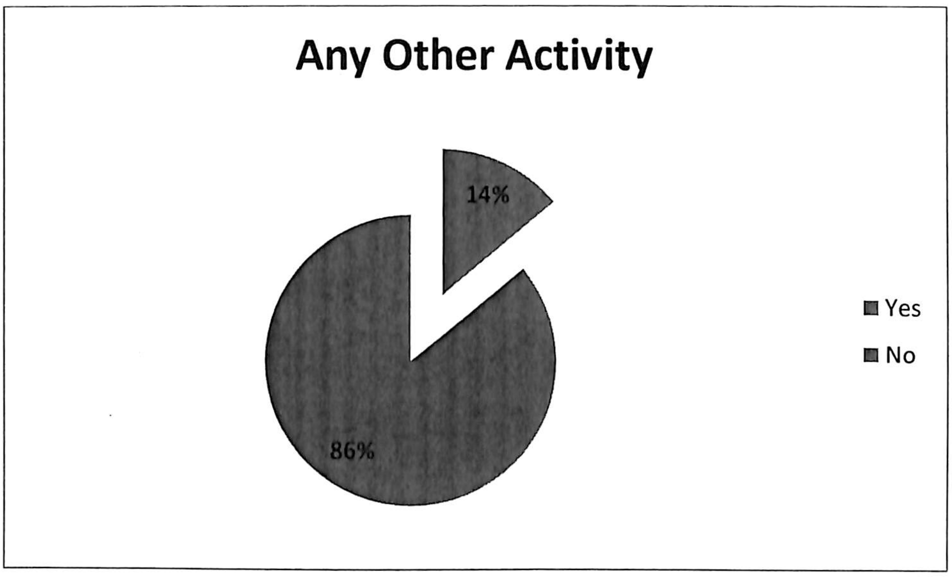
20% of respondents say Captain, 28% of respondents say Co-pilot, and 26% of respondents say Flight Engineer while 26% of respondents say other is their current function as a crew member.

4. Besides working as airline crew member, do you have any other activity?

Table 5.4 any other activity

Option	No of Respondents	% of Respondents
Yes	7	14%
No	43	86%
Total	50	100%

Chart 5.4 any other activity



Interpretation

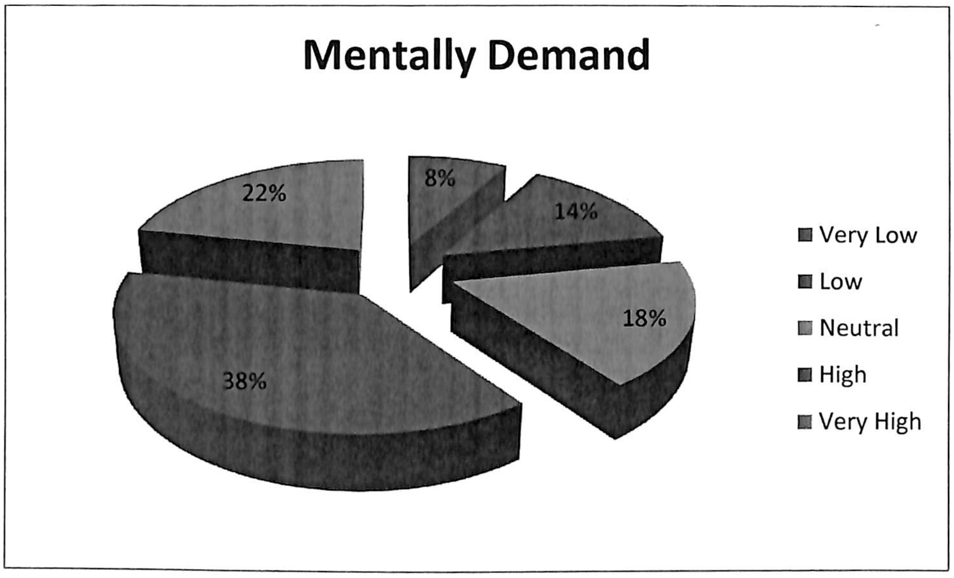
14% of respondents say Yes while 86% of respondents say No, they are working as airline crew member, and they have any other activity other than airline crew.

5. How mentally demanding was the flight?

Table 5.5 mentally demanding

Option	No of Respondents	% of Respondents
Very Low	4	8%
Low	7	14%
Neutral	9	18%
High	19	38%
Very High	11	22%
Total	50	100%

Chart 5.5 mentally demanding



Interpretation

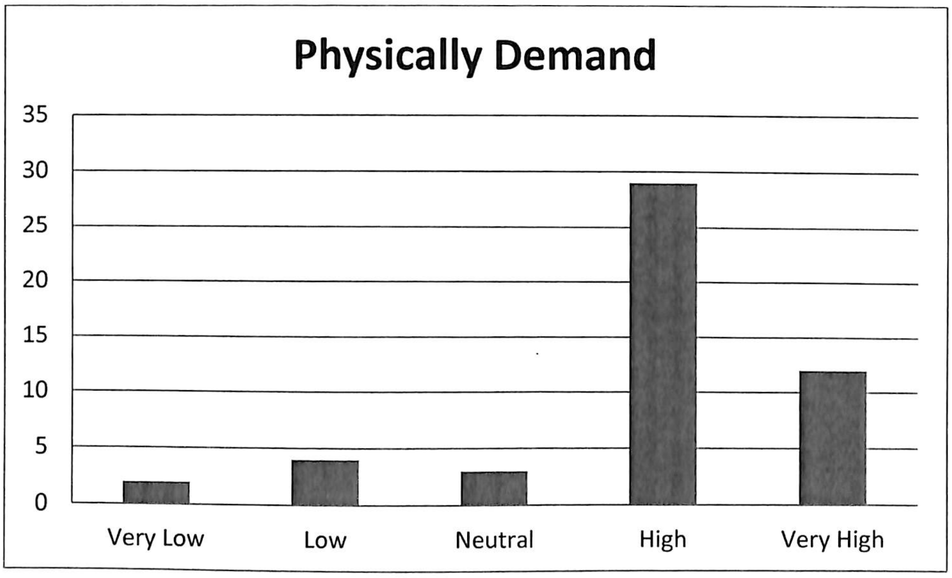
8% of respondents say Very Low, 14% of respondents say Low, 18% of respondents are Neutral, and 38% of respondents say High, while 22% of respondents say Very High for mentally demand workload during the flight.

6. How physically demanding was the flight?

Table 5.6 physically demanding

Option	No of Respondents	% of Respondents
Very Low	2	4%
Low	4	8%
Neutral	3	6%
High	29	58%
Very High	12	24%
Total	50	100%

Chart 5.6 physically demanding



Interpretation

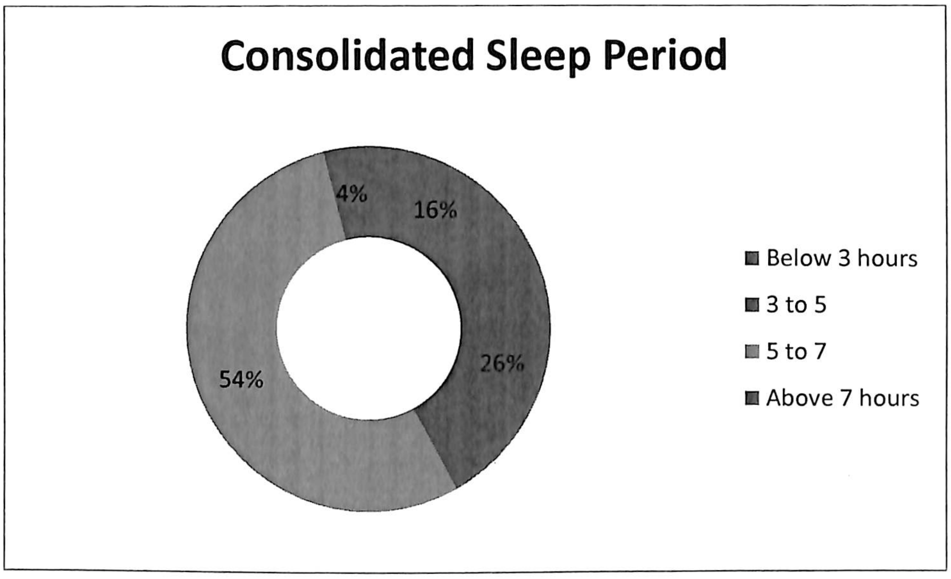
4% of respondents say Very Low, 8% of respondents say Low, 6% of respondents are Neutral, and 58% of respondents say High, while 24% of respondents say Very High for physically demand workload during the flight.

7. How long was last consolidated sleep period?

Table 5.7 consolidated sleep period

Option	No of Respondents	% of Respondents
Below 3 hours	8	16%
3 to 5	13	26%
5 to 7	27	54%
Above 7 hours	2	4%
Total	50	100%

Chart 5.7 consolidated sleep period



Interpretation

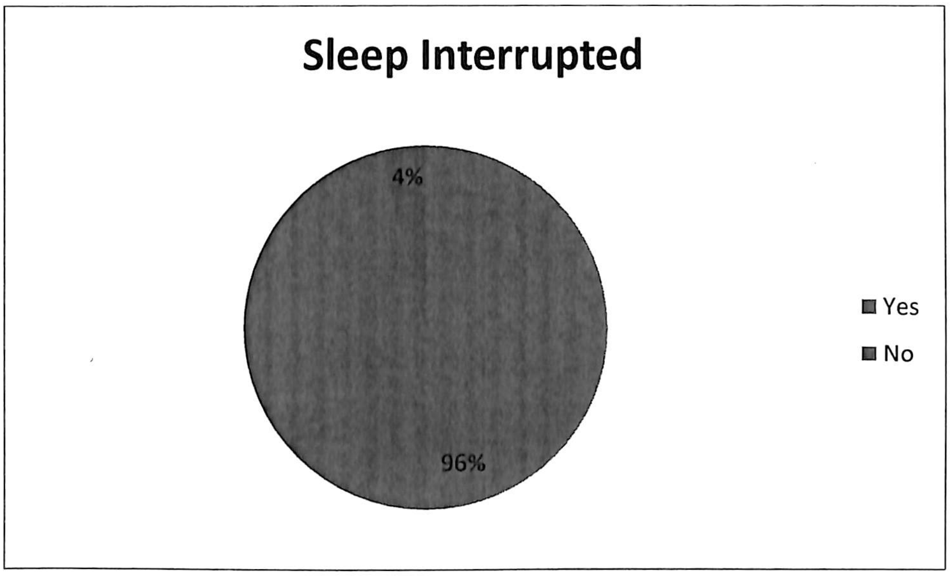
4% of respondents say Above 7 hours, 26% of respondents say 3 to 5, and 16% of respondents say Below 3 hours while 54% of respondents say 5 to 7 hours of last long consolidated sleep period.

8. Was your sleep interrupted?

Table 5.8 sleep interrupted

Option	No of Respondents	% of Respondents
Yes	48	96%
No	2	4%
Total	50	100%

Chart 5.8 sleep interrupted



Interpretation

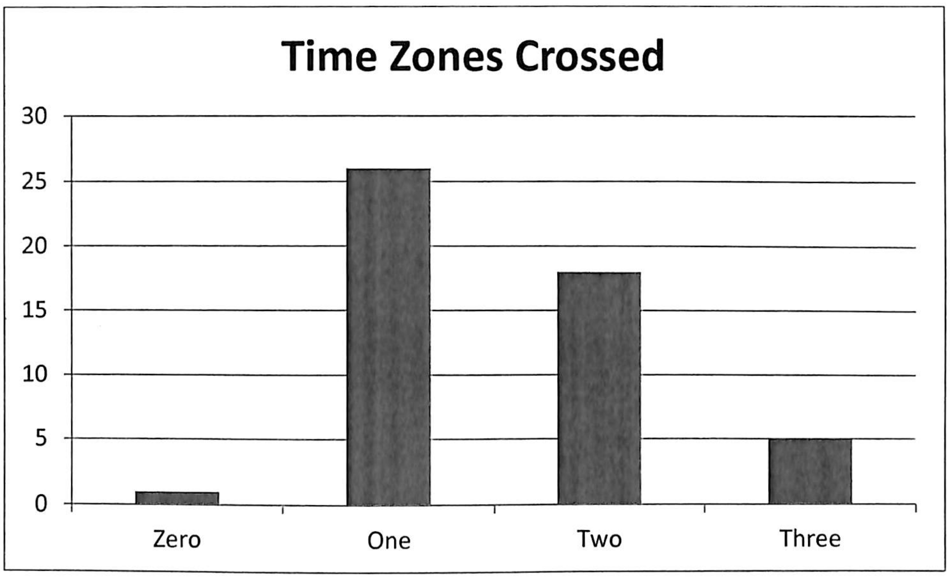
4% of respondents say No, while 96% of respondents say Yes, their sleep was interrupted during long-haul flight.

9. Number of time zones crossed?

Table 5.9 time zones crossed

Option	No of Respondents	% of Respondents
Zero	1	2%
One	26	52%
Two	18	36%
Three	5	10%
Total	50	100%

Chart 5.9 time zones crossed



Interpretation

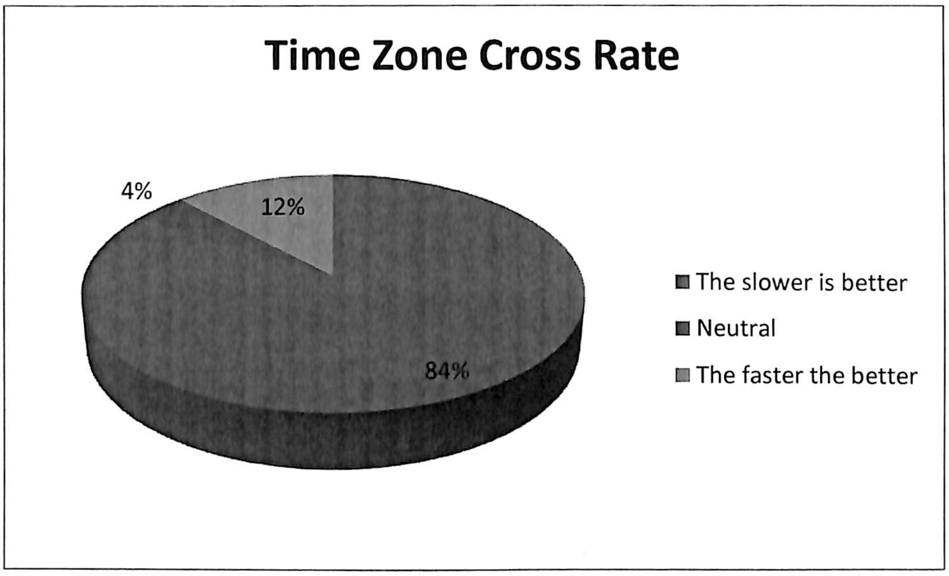
2% of respondents say Zero, 52% of respondents say One, 36% of respondents say Two and 5% of respondents say Three time zones crossed in single flight.

10. If more than one, at what rate were they crossed?

Table 5.10 rate were they crossed

Option	No of Respondents	% of Respondents
The slower is better	42	84%
Neutral	2	4%
The faster the better	6	12%
Total	50	100%

Chart 5.10 rate were they crossed



Interpretation

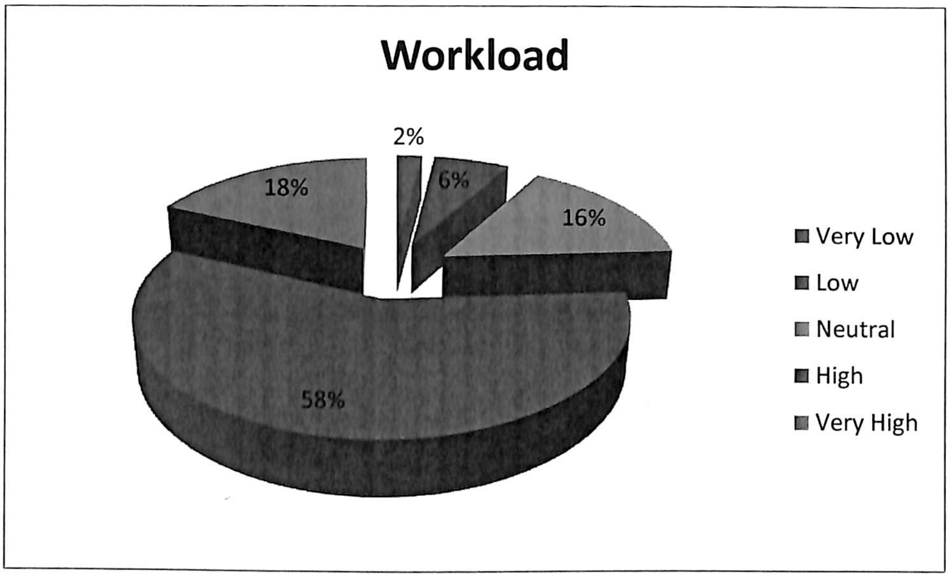
84% of respondents say the slower is better, 4% of respondents are Neutral and 12% of respondents say the faster the better, if more than one time zone crossed in single flight.

11. Do you feel significant workload during flight operation?

Table 5.11 workload

Option	No of Respondents	% of Respondents
Very Low	1	2%
Low	3	6%
Neutral	8	16%
High	29	58%
Very High	9	18%
Total	50	100%

Chart 5.11 workload



Interpretation

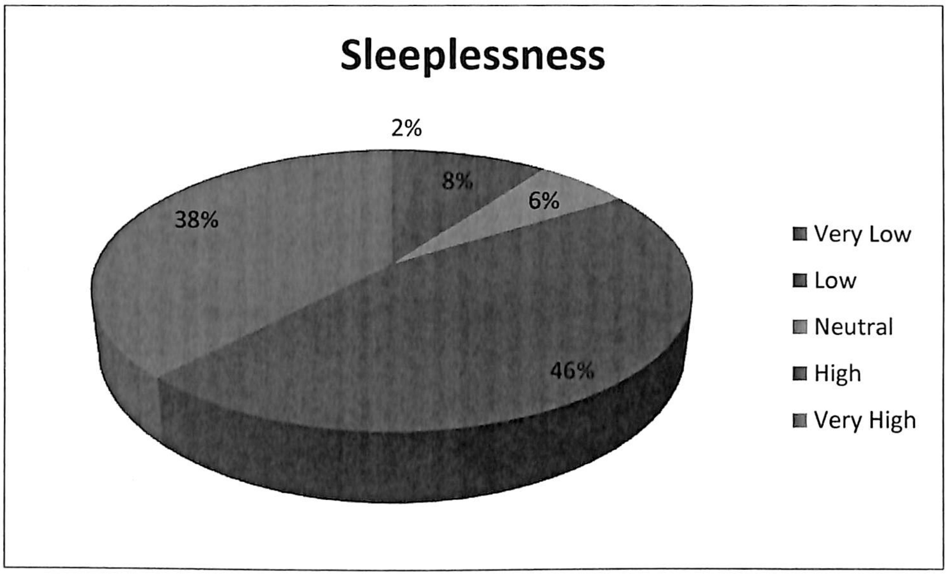
2% of respondents say Very Low, 6% of respondents say Low, 16% of respondents are Neutral, and 58% of respondents say High, while 18% of respondents say Very High workload during flight operation.

12. In your opinion, to what extent sleeplessness is a concern in-flight operation?

Table 5.12 sleeplessness is a concern in-flight operation

Option	No of Respondents	% of Respondents
Very Low	1	2%
Low	4	8%
Neutral	3	6%
High	23	46%
Very High	19	38%
Total	50	100%

Chart 5.12 sleeplessness is a concern in-flight operation



Interpretation

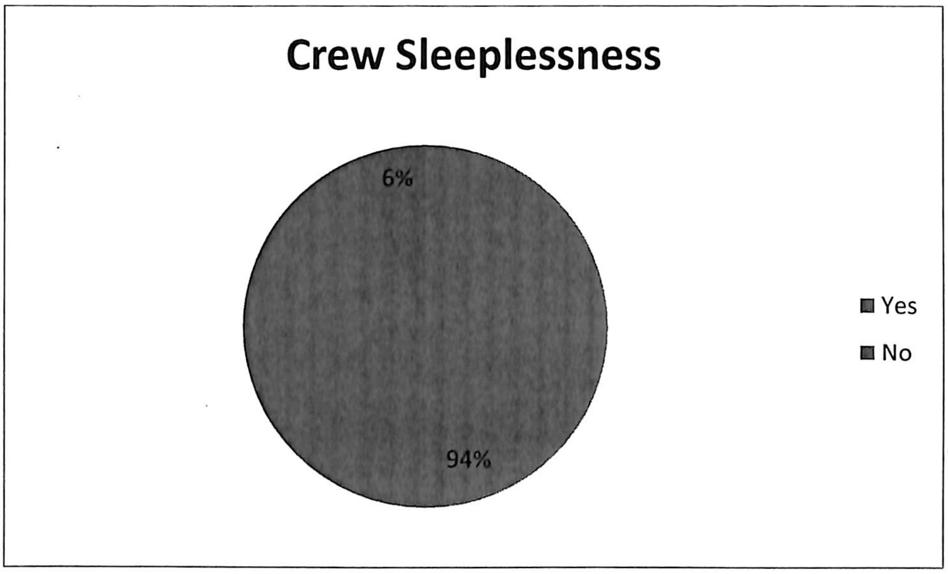
2% of respondents say Very Low, 8% of respondents say Low, 6% of respondents are Neutral, and 46% of respondents say High, while 38% of respondents say Very High in their opinion, to sleeplessness is a concern in-flight operation.

13. Is crew sleeplessness is a common occurrence in long haul flight operation?

Table 5.13 crew sleeplessness

Option	No of Respondents	% of Respondents
Yes	47	94%
No	3	6%
Total	50	100%

Chart 5.13 crew sleeplessness



Interpretation

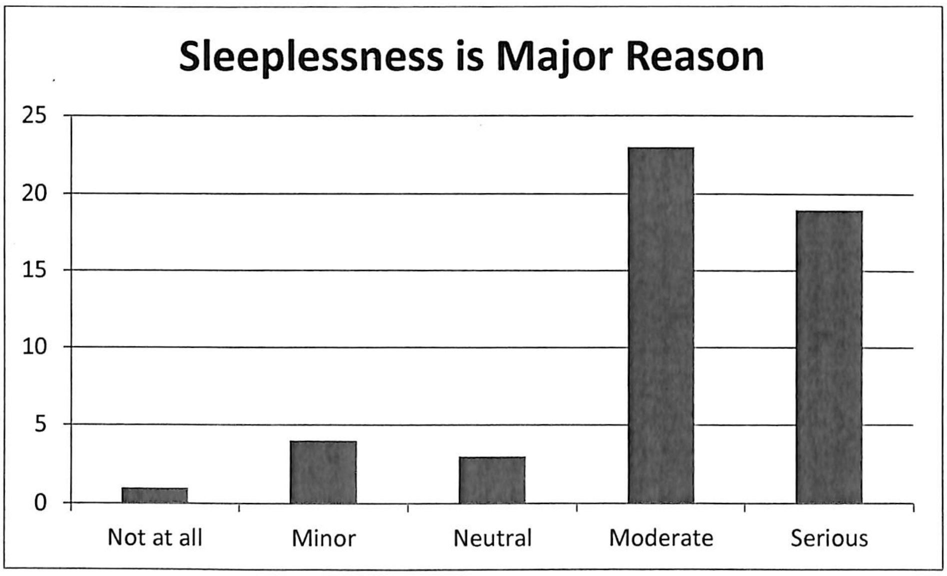
6% of respondents say No, while 94% of respondents say Yes; crew sleeplessness is a common occurrence in long haul flight operation.

14. In your opinion, sleeplessness is one of the major reason which increases crew fatigue?

Table 5.14 Sleeplessness is Major Reason

Option	No of Respondents	% of Respondents
Not at all	1	2%
Minor	4	8%
Neutral	3	6%
Moderate	23	46%
Serious	19	38%
Total	50	100%

Chart 5.14 Sleeplessness is Major Reason



Interpretation

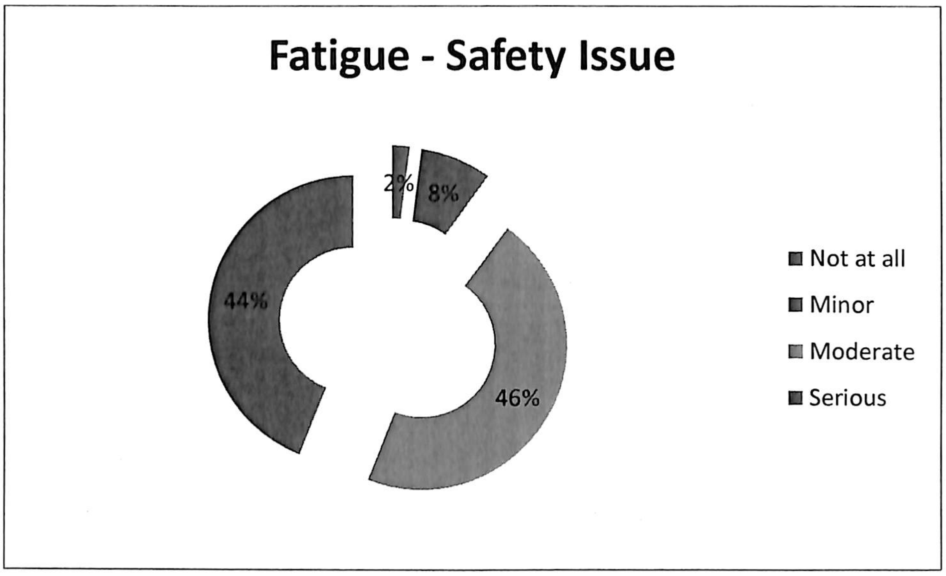
2% of respondents say Not at all, 8% of respondents say Minor, 6% of respondents are Neutral, 46% of respondents say Moderate, while 38% of respondents say Serious for sleeplessness is one of the major reason which increases crew fatigue.

15. When crew fatigue occurs, how significant a safety issue is it?

Table 5.15 safety issue

Option	No of Respondents	% of Respondents
Not at all	1	2%
Minor	4	8%
Moderate	23	46%
Serious	22	38%
Total	50	100%

Chart 5.15 safety issue



Interpretation

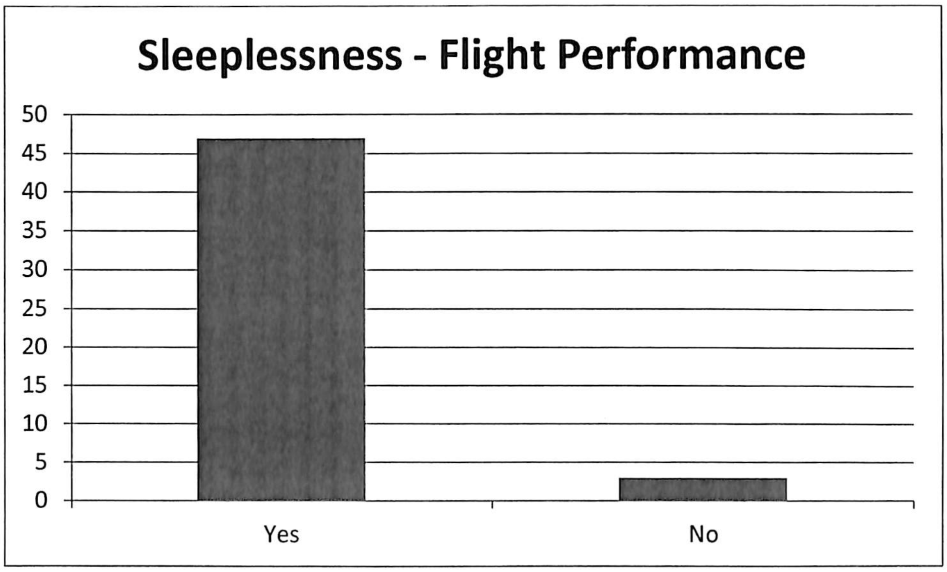
2% of respondents say Not at all, 8% of respondents say Minor, 46% of respondents say Moderate, while 38% of respondents say Serious for crew fatigue is a significant a safety issue.

16. Does sleeplessness affect your flight performance?

Table 5.16 flight performance

Option	No of Respondents	% of Respondents
Yes	47	94%
No	3	6%
Total	50	100%

Chart 5.16 flight performance



Interpretation

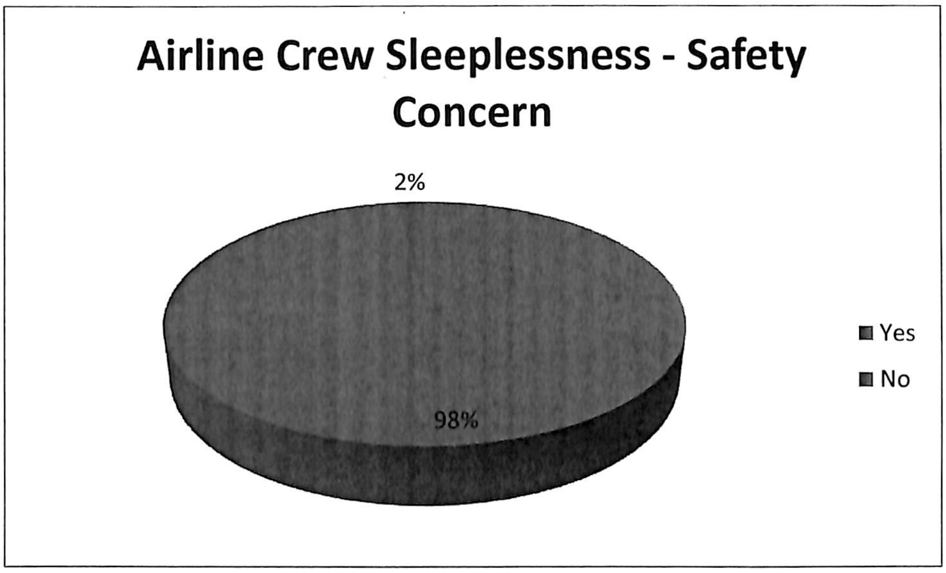
6% of respondents say No, while 94% of respondents say Yes, sleeplessness affect their flight performance.

17. Do you think, airline crew member sleeplessness is one of the major safety concerns?

Table 5.17 Airline Crew Sleeplessness

Option	No of Respondents	% of Respondents
Yes	49	98%
No	1	2%
Total	50	100%

Chart 5.17 Airline Crew Sleeplessness



Interpretation

2% of respondents say No, while 98% of respondents say Yes they think, the airline crew members sleeplessness is one of the major safety concerns.

CHAPTER 6 FINDINGS

Findings of the Study

- 38% of respondents are Female while 62% of respondents are Male which is participated in this survey.
- 18% of respondents are Below 30 years, 30% of respondents are 30 - 40, and 38% of respondents are 40 - 50 while 14% of respondents are fell in Above 50 year's age groups.
- 20% of respondents say Captain, 28% of respondents say Co-pilot, 26% of respondents say Flight Engineer while 26% of respondents say other is their current function as a crew member
- 14% of respondents say Yes while 86% of respondents say No, they are working as airline crew member, and they have any other activity other than airline crew.
- 8% of respondents say Very Low, 14% of respondents say Low, 18% of respondents are Neutral, and 38% of respondents say High, while 22% of respondents say Very High for mentally demand workload during the flight.
- 4% of respondents say Very Low, 8% of respondents say Low, 6% of respondents are Neutral, and 58% of respondents say High, while 24% of respondents say Very High for physically demand workload during the flight.
- 4% of respondents say Above 7 hours, 26% of respondents say 3 to 5, and 16% of respondents say Below 3 hours while 54% of respondents say 5 to 7 hours of last long consolidated sleep period.
- 4% of respondents say No, while 96% of respondents say Yes, their sleep was interrupted during long-haul flight.
- 2% of respondents say Zero, 52% of respondents say One, 36% of respondents say Two and 5% of respondents say Three time zones crossed in single flight.
- 84% of respondents say the slower is better, 4% of respondents are Neutral and 12% of respondents say the faster the better, if more than one time zone crossed in single flight.
- 2% of respondents say Very Low, 6% of respondents say Low, 16% of respondents are Neutral, and 58% of respondents say High, while 18% of respondents say Very High workload during flight operation.

- 2% of respondents say Very Low, 8% of respondents say Low, 6% of respondents are Neutral, and 46% of respondents say High, while 38% of respondents say Very High in their opinion, to sleeplessness is a concern in-flight operation.
- 6% of respondents say No, while 94% of respondents say Yes, crew sleeplessness is a common occurrence in long haul flight operation.
- 2% of respondents say Not at all, 8% of respondents say Minor, 6% of respondents are Neutral, 46% of respondents say Moderate, while 38% of respondents say Serious for sleeplessness is one of the major reason which increases crew fatigue.
- 2% of respondents say Not at all, 8% of respondents say Minor, 46% of respondents say Moderate, while 38% of respondents say Serious for crew fatigue is a significant a safety issue.
- 6% of respondents say No, while 94% of respondents say Yes, sleeplessness affect their flight performance.
- 2% of respondents say No, while 98% of respondents say Yes they think, the airline crew members sleeplessness is one of the major safety concerns.

CHAPTER 7 CONCLUSION

Conclusion

The study results highlight the need to implement preventive actions related to the organization of work, aiming at improving working conditions and health, especially in aspects related to the sleep of Airline flight crew members in UAE. Aircraft flight team member should be aware of the signs of sleeplessness which include a reduction in alertness what's more, consideration, absence of focus, expanded reaction times, little slip-ups, a decrease of social communications, and poor comprehension. Airline Flight Crew Members can use simple strategies such as developing a good sleep routine, only using the bedroom for sleep, not ingesting alcohol or caffeine before going to sleep to improve sleep and reduce fatigue.

Sleep and circadian factors are the primary underpinnings of human fatigue, and aviation schedules exert a powerful influence on both. Unfortunately, the regulations designed to manage fatigue in operational environments have not sufficiently emphasized these factors. Thanks to technological advances such as computerized fatigue models and sleep-tracking autography, we are now able to better consider the impact of scheduling factors on aircrews. These advances, when used in combination with behavioural counter-fatigue strategies, can significantly mitigate fatigue and improve operational safety.

When analysing daytime sleepiness, where the main cause is usually irregular work hours influencing the biological clock and the homeostatic regulation of sleep and wakefulness, variables that were associated were encouraging starts, fatigue and sleep protests, albeit just the last two had a predictive value for sleepiness. Once again, the role of sleepiness and fatigue were highlighted.

The sleeplessness reported by airline crew member's reflected the effects of their work schedules: night flights, jet lag, and successive early wake-ups. For long-haul flights, time pressure, number of legs per day, and consecutive days on duty contributed to increased sleeplessness with fatigue. There is strong need to consider chronobiology in the development of aircrew scheduling rules, as well as flight and duty time limitations to allow for the additional fatigue effects of multi-leg flights and work constraints in long-haul flights. At long last, pilots ought to be made mindful that the impacts of fatigue incorporate not only the self-reported reduction of alertness and attention, and lack of concentration, but also produces in them the signs that they observed in other crewmembers, including increased response times, small mistakes, a reduction of social communications, and bad air traffic control message reception.

The idea of airline head out inclines pilots to disturbed sleep schedules, however he calls attention to a few methodologies that can both anticipate a genuinely impaired pilot and moderate the results of an absence of sleep. There are some fatigue expectation models that can help decide the effect of work/lay schedules on pilot execution. Crew members ought to be instructed on sleep cleanliness so they can catch some remedial rest before obligation or during delays. On-board cockpit resting ought to be approved with the goal that pilots will have the option to make up for an absence of sleep. Also, new wearable sleep-following advances ought to be used to really quantify the pre-obligation and delay sleep of flight crews with the goal that they can all the more likely oversee and enhance their own sleep.

REFERENCE

- Akerstedt T, Wright KP Jr. Sleep loss and fatigue in shift work and shift work disorder. Sleep Med Clin. 2009; 4(2):257-71. https://doi.org/10.1016/j.jsmc.2009.03.001
- Caldwell JA. Fatigue in aviation. Travel Med Infect Dis. 2005; 3(2):85-96. https://doi.org/10.1016/j.tmaid.2004.07.008
- Goode JH. Are pilots at risk of accidents due to fatigue? J Safety Res. 2003; 34(3):309-13. https://doi.org/10.1016/S0022-4375(03)00033-1
- Ingre M, Van Leeuwen W, Klemets T, Ullvetter C, Hough S, Kecklund G, et al. Validating and extending the three process model of alertness in airline operations. PLoS One. 2014; 9(10):e108679. https://doi.org/10.1371/journal.pone.0108679
- Itani A. Saúde e gestão na aviação: a experiência de pilotos e controladores de tráfego aéreo. Psicol Soc. 2009; 21(2):203-12. https://doi.org/10.1590/S0102-71822009000200007
- Powell DMC, Spencer MB, Holland D, Broadbent E, Petrie KJ. Pilot fatigue in short-haul operations: effects of number of sectors, duty length, and time of day. Aviat Space Environ Med. 2007;78(7):698-701
- Banks S, Dinges DF. 2007. Behavioural and physiological consequences of sleep restriction. J Clin Med. 3:519–528
- Scott JPR, McNaughton LR, Polman RCJ. 2006. Effects of sleep deprivation and exercise on cognitive, motor performance and mood. Physiol Behav. 87:396–408
- Waters F, Bucks RS. 2011. Neuropsychological effects of sleep loss: implication for neuropsychologists. J Int Neuropsychol Soc. 17:571–586.
- Lieberman HR, Tharion WJ, Shukitt-Hale B, Speckman KL, Tulley R. 2002.Effects of caffeine, sleep loss, and stress on cognitive performance and mood during U.S. Navy SEAL training. Sea-air-land. Psychopharmacology. 164:250–261
- Harrison Y, Horne JA. 2000. The impact of sleep deprivation on decision making: A review. J Exp Psychol Appl. 6:236–249
- Gander PH, Mangie J, Van Den Berg MJ, Smith AAT, Mulrine HM, Signal TL. 2014. Crew fatigue safety performance indicators for fatigue risk management systems. Aviat Space Environ Med. 8:139–147.
- Akerstedt T. 2003. Shift work and disturbed sleep/wakefulness. Occup Med. 53:89–94.

- Horne JA, Reyner LA. 1995. Sleep related vehicle accidents. Br Med J. 310:565–567
- Reason J. 1990. Human error. Cambridge (England): Cambridge University Press.
- Moore-Ede M.2003. (Writer). Sleep, alertness, and fatigue among military personnel in Iraq. Lexington (MA):In I. Circadian Technologies (Producer)
- Dinges DF, Powell LW. 1985. Microcomputer analyses of performance on a portable, simple visual RT task during sustained operations. Behav Res Methods Instrum Comput. 17:625–655
- Lim J, Dinges DF. 2008. Sleep deprivation and vigilant attention. Ann N Y Acad Sci. 1129:305–322
- Dinges DF, Pack F, Williams K, Gillen KA, Powell JW, Ott G,E, Aptowicz C, Pack AI. 1997. Cumulative sleepiness, mood disturbance, and psychomotor vigilance performance Decrements during a week of sleep restricted to 4–5 hours per night. Sleep. 20:267–277
- Russo M, Sing H, Kendall A, Johnson D, Santiago S, Escolas S, Holland D, Thorne D, Hall S, Redmond D, et al. (2005). Visual perception, flight performance, and reaction time impairments in military pilots during 26 hours of continuous wake: implications for automated workload control systems as fatigue management tools. In Strategies to maintain combat readiness during extended deployments –a human systems approach (pp. 27–1,7–16). Meeting Proceedings RTO-MP-HFM-124, Paper 27.
- McNair DM, Lorr M, Droppleman LF. 1971. Profile of mood states manual. San Diego: Education and Industrial Testing Service
- Terry PC, Lane AM, Fogarty GJ. 2003. Construct validity of the POMS-A for use with adults. Psychol Sport Exerc. 4:76–92.
- Previc FH, Lopez N, Ercoline WR, DaLuz CM, Workman AJ, Evans RH, Dillon NA. 2009. The effects of sleep deprivation on flight performance, instrument scanning and physiological arousal in United States air force pilots. Int J Aviat Psychol. 19:326–346
- Harrington JM. Health effects of shift work and extended hours of work. Occup Environ Med 2001;58(1):68-72
- Costa G. Shift work and occupational medicine: an overview. Occup Med 2003; 53(2):83-8.
- Figueiro MG, White RD. Health consequences of shift work and implications for structural design. J Perinatol 2013; 33:S17-S23.
- Arendt J. Shift work: coping with the biological clock. Occup Med 2010; 60(1):10-20.

- Haus E, Smolensky M. Biological clocks and shift work: circadian dysregulation and potential long-term effects. Cancer Causes Control 2006; 17(4):489-500.
- Zee PC, Goldstein CA. Treatment of shift work disorder and jet lag. Curr Treat Options Neurol 2010; 12(5):396-411.
- Åkerstedt T. Shift work and disturbed sleep/wakefulness. Occup Med 2003; 53(2):89-94.
- Sallinen M, Kecklund G. Shift work, sleep, and sleepiness-differences between shift schedules and systems. Scand J Work Environ Health 2010; 36(2):121-33.
- van Dongen HPA, Maislin G, Mullington JM, Dinges DF. The cumulative cost of additional wakefulness: dose-response effects on neurobehavioral functions and sleep physiology from chronic sleep restriction and total sleep deprivation. Sleep 2003; 26(2):117-29.
- Folkard S, Lombardi DA, Tucker PT. Shiftwork: safety, sleepiness and sleep. Ind Health 2005; 43(1):20-3.
- Achermann, P. (2004). The two-process model of sleep regulation revisited. Aviation, Space, and Environmental Medicine, 75(Suppl. 3), A37–A43.
- Caldwell, J. A., & Caldwell, J. L. (2003). Fatigue in aviation: A guide to staying awake at the stick. Burlington, VT: Ashgate Publishing Company.
- Caldwell, J. A., Caldwell, J. L., Brown, D. L., & Smith, J. K. (2004). The effects of 37 hours without sleep on the performance of F-117 pilots. Military Psychology, 16, 163–181.
- Caldwell, J. A., Caldwell, J. L., & Schmidt, R. M. (2008). Alertness management strategies for operational contexts. Sleep Medicine Reviews, 12, 257–273.
- Caldwell, J. A., Mallis, M. M., Caldwell, J. L., Paul, M. A., Miller, J. C., & Neri, D. F. (2009). Fatigue countermeasures in aviation. Aviation, Space, and Environmental Medicine, 80, 29–59.
- Caldwell, J. A., Mu, Q., Smith, J. K., Mishory, A., George, M., Caldwell, J. L., Brown, D. L. (2005). Are individual differences in fatigue vulnerability related to baseline differences in cortical activation? Behavioural Neuroscience, 119, 694–707.
- Command Flight Surgeon. (2005). Fatigue in naval aviation. Retrieved from https://www.netc.navy.mil/nascweb/sas/files/fatigue_in_naval_aviation.pdf
- Committee on Military Nutrition Research. (2001). Caffeine for the sustainment of mental task performance: Formulations for military operations. Washington, DC: National Academies Press.

- Dijk, D. J., & Franken, P. (2005). Interaction of sleep homeostasis and circadian rhythmicity: Dependent or independent systems? In M. A.
- Kryger, T. Roth, & W. C. Dement (Eds.), Principles and practice of sleep medicine (pp. 418–434). Philadelphia, PA: Elsevier Saunders.
- Dinges, D. F. (1990). The nature of subtle fatigue effects in long-haul crews. Proceedings of the Flight Safety Foundation 43rd International Air Safety Seminar (pp. 258–267). Arlington, TX: Flight Safety Foundation.
- Folkard, S., & Åkerstedt, T. (1991). A three-process model of the regulation of alertness and sleepiness. In R. Ogilvie & R. Broughton (Eds.), Sleep, arousal and performance: Problems and promises (pp. 11–26). Boston, MA: Birkhauser
- Hursh, S. R., Raslear, T. G., Kaye, A. S., & Fanzone, J. F. (2006). Validation and calibration of a fatigue assessment tool for railroad work schedules, Summary Report (Technical Report No. DOT/FRA/ ORD-06/21). Washington, DC: U.S. Department of Transportation, Federal Railroad Administration, Office of Research and Development.
- Hursh, S. R., Redmond, D. P., Johnson, M. L., Thorne, D. R., Belenky, G., Balkin, T. J., Eddy, D. R. (2004). Fatigue models for applied research in warfighting. Aviation, Space, and Environmental Medicine, 75(Suppl. 3), A44–A53.
- Lyman, E. G., & Orlady, H. W. (1981). Fatigue and associated performance decrements in air transport operations (NASA Contractor Report No. 166167). Moffett Field, CA: NASA Ames Research Center.
- Monk, T. (1994). Shift work. In M. H. Kryger, T. Roth, & W. C. Dement (Eds.), Principles and practice of sleep medicine (pp. 471–476). Philadelphia, PA: Saunders.
- Morgenthaler, T., Alessi, C., Friedman, L., Owens, J., Kapur, V., Boehlecke, B., Swick, T. J. (2007). Practice parameters for the use of actigraphy in the assessment of sleep and sleep disorders: An update for 2007. Sleep, 30(4), 519–529.
- National Research Council. (2011). The effects of commuting on pilot fatigue. Washington, DC: National Academies Press. Retrieved from http://www.nap.edu/catalog.php?record_id=13201
- National Transportation Safety Board. (1994). A review of flight crew-involved, major accidents of U.S. air carriers, 1978 through 1990 (NTSB Safety Study No. SS-94–01). Washington, DC: Author.
- National Transportation Safety Board (2010). Aircraft accident report: Loss of control on approach, Colgan Air, Inc., operating as Continental Connection Flight 3407,

Bombardier DHC-8-400, N200WQ. (NTSB Report number NTSB/AAR-10/01, PB2010-910401). Washington, DC: Author.

- Neri, D. F., Oyung, R. L., Colletti, L. M., Mallis, M. M., Tam, P. Y., & Dinges, D. F. (2002). Controlled activity as a fatigue counter measure on the flight deck. Aviation, Space, and Environmental Medicine, 73(7), 654–664.
- Åkerstedt, T., Fredlund, P., Gillberg, M., Jansson, B. (2002). A prospective study of fatal occupational accidents—Relationship to sleeping difficulties and occupational factors. Journal of Sleep Research, 11, 69-71. doi:10.1046/j.1365-2869.2002.00287.x
- Artazcoz, L., Borrell, C., Benach, J. (2001). Gender inequalities in health among workers: The relation with family demands. Journal of Epidemiology & Community Health, 55, 639-647. doi:10.1136/jech.55.9.639
- Aviation Safety Network. (1997). Retrieved from http://aviation-safety.net/database/record.php?id=19971219-0
- Aviation Safety Network. (1999). Retrieved from http://aviation-safety.net/database/record.php?id=19991031-0
- Baum, A., Newman, S., Weinman, J., West, R., McManus, C. (1997). Cambridge handbook of psychology, health & medicine. Cambridge, UK: Cambridge University Press.
- Belza, B. L. (1995). Comparison of self-reported fatigue in rheumatoid arthritis patients and controls. Journal of Rheumatology, 22, 639-643.
- Boisard, P., Gollac, M., Valeyre, A., Cartron, D. (2003). Time and work: Duration of work. Dublin, Ireland: European Foundation for the Improvement of Living and Working Conditions.
- Butcher, J. N. (2002). Assessing pilots with "the wrong stuff": A call for research on emotional health factors in commercial aviators. International Journal of Selection and Assessment, 10, 168-184. doi:10.1111/1468-2389.00204
- Danish Airline Pilots' Association. (2011). How do Danish pilots experience working under the current subpart-Q regulations contained in EU-OPS? Copenhagen, Denmark: JP/Politikens Hus.
- Dembe, A. E., Erickson, J. B., Delbos, R. G., Banks, S. M. (2005). The impact of overtime and long work hours on occupational injuries and illnesses: New evidence from the United States. Occupational & Environmental Medicine, 62, 588-597. doi:10.1136/oem.2004.016667

- Gjerdingen, D., McGovern, P., Bekker, M., Lundberg, U., Willemsen, T. (2001). Women's work roles and their impact on health, well-being, and career: Comparison between the United States, Sweden, and The Netherlands. Women & Health, 31(4), 1-20.
- Goode, J. H. (2003). Are pilots at risk of accidents due to fatigue? Journal of Safety Research, 34, 309-313. doi:10.1016/S0022-4375(03)00033-1
- Harrington, J. (2001). Health effects of shift work and extended hours of work. Occupational & Environmental Medicine, 58, 68-72. doi:10.1136/oem.58.1.68
- Health and Safety Executive. (2002). Occupational ill-health age statistics (Information Sheet 2/02/EMSU). Retrieved from www.hse.gov.uk/statistics
- Kim, Y. G., Yoon, D. Y., Kim, J. I., Chae, C. H., Hong, Y. S., Yang, . . . Kim, J. Y. (2002). Effects of health on shift-work: General and psychological health, sleep, stress, quality of life. Korean Journal of Occupational and Environmental Medicine, 14, 247-256.
- Maruyama, S., Morimoto, K. (1996). Effects of long workhours and life-style, stress and quality of life among intermediate Japanese managers. Scandinavian Journal of Work, Environment & Health, 22, 353-359. doi:10.5271/sjweh.153
- Matthews, S., Power, C. (2002). Socio-economic gradients in psychological distress: A focus on women, social roles and work-home characteristics. Social Science & Medicine, 54, 799-810. doi:10.1016/S0277-9536(01)00110-1
- Nolen-Hoeksema, S. (2001). Gender differences in depression. Current Directions in Psychological Science, 10, 173-176
- O'Hagan, A. D., Issartel, J., Fletcher, R., Warrington, G. (2016). Duty hours and incidents in flight among commercial airline pilots. International Journal of Occupational Safety and Ergonomics, 22, 165-172.
- Sirois, B., Trutschel, U., Edwards, D., Sommer, D., Golz, M. (2009, September). Predicting accident probability from frequency of micro sleep events. IFMBE Proceedings Volume 25/IV 11th International Congress of the IUPESM Medical, Physical and Biomedical Engineering World Congress 2009, Munich, Germany.
- Swedish Airline Pilots' Association . (2011). How do Swedish pilots experience working under the current subpart-Q regulations contained in EU-OPS? Stockholm, Sweden: Axand Consultancy Agency.
- Vandeputte, M., de Weerd, A. (2003). Sleep disorders and depressive feelings: A global survey with the Beck Depression Scale. Sleep Medicine, 4, 343–350.

- Virtanen, M., Ferrie, J. E., Singh-Manoux, A., Shipley, M. J., Stansfeld, S. A., Marmot, M. G., Kivimäki, M. (2011). Long working hours and symptoms of anxiety and depression: A 5-year follow-up of the Whitehall II study. Psychological Medicine, 41, 2485-2494. doi:10.1017/S0033291711000171