Novelty Journals

ISSN 2394-9716

International Journal of Novel Research in Interdisciplinary Studies
Vol. 13, Issue 1, pp: (1-8), Month: January – February 2026, Available at: www.noveltyjournals.com

Fatigue and Flight Safety: Assessing Aircrew Fatigue and Its Operational Impact in Nigeria's Commercial Aviation Industry

Cole, Osagie Kenneth

School of Public Health, University of Port Harcourt

DOI: https://doi.org/10.5281/zenodo.18485778

Published Date: 04-February-2026

Abstract: **Aircrew fatigue is a critical concern in global aviation, with profound implications for flight safety, operational efficiency, and crew well-being. This study investigated the prevalence of fatigue among aircrew in Nigeria's commercial aviation sector and examine how this fatigue affects various aspects of flight operations, with a focus on implications for flight safety and performance. The study adopted a descriptive cross-sectional research design and was carried out in the Murtala Muhammed international airport (MMIA) Lagos. The population of the study consisted of pilots, flight engineers and cabin crew with the relevant professional licenses that work with local commercial airlines and are actively involved in flying duties in both the long and short haul categories. The sample size of this study comprised 190 participants and validated semi structured, self-rating and self-administered questionnaire developed by Airbus in collaboration with a French university was adapted for qualitative data collection. The analysis of data was done using the Epi info statistical software package version 3.5.1(2008). Findings showed a significant physical fatigue symptoms among aircrew, with slowed reaction time being the most prevalent. Also, findings revealed notable mental fatigue symptoms among aircrew, with a significant proportion reporting declines in attention, distractibility, sluggish movements, and minor errors. The study concluded that fatigue both physical and mental is a widespread and critical issue among aircrew, affecting operational performance and safety. Physical symptoms such as slowed reaction time, lethargy, and impaired mood were highly prevalent, alongside signs of reduced alertness and physical strain. Hence, the study recommended amongst others that airlines should adopt Fatigue Risk Management Systems (FRMS) frameworks that monitor both physical and mental fatigue indicators, enabling proactive interventions such as rest breaks, schedule adjustments, and crew rotation.**

Keywords: **Aircrew fatigue, flight safety, commercial aviation, fatigue risk management.**

1. INTRODUCTION

Fatigue is a significant cause of accidents and incidents across a wide range of industries, including road transport, aviation, rail, maritime cargo, mining, manufacturing, construction, hospitality, and healthcare. Workers' susceptibility to fatigue increases during tasks that require sustained attention over long periods, as well as those that are lengthy, repetitive, paced, difficult, boring, or monotonous (McKellar, 2009). Fatigue has led to numerous human errors. Mistakes made by fatigued shift workers during the early morning hours were critical factors in the Chernobyl nuclear reactor meltdown, where inaction during those hours resulted in disastrous consequences (Jin-Ru, 2009). Similarly, the Exxon Valdez oil spill was primarily caused by the failure of the third mate to properly maneuver the vessel due to fatigue and excessive workload. These incidents had catastrophic outcomes (Jin-Ru, 2009).

Fatigue-induced human errors pose major risks to public safety and to the workers themselves. In the United States, fatigue is estimated to contribute to between 20% and 40% of all commercial vehicle crashes, resulting in the loss of more than 15,000 lives (Jackson & Earl, 2006). Falling asleep at the wheel due to fatigue has been implicated in 24% of heavy-vehicle road accidents in South Africa (Dehart & Davis, 2008). In Ghana, a survey of drivers at selected motor parks in Accra revealed that 10–20% of all single-vehicle accidents were caused by fatigue (Dehart & Davis, 2008). Globally, it is estimated that 20% of all road traffic fatalities are attributable to driver fatigue (Jackson & Earl, 2006).

Extreme fatigue may cause a person to briefly "disengage" into a "micro-sleep." When this occurs at a critical moment, it can lead to an accident. Micro-sleeps have been observed in train drivers and airline pilots during critical operations, often without their awareness (McFarland, 1995). These episodes frequently result in lapses in attention, slowed reaction times, increased errors, short-term memory impairment, reduced situational awareness, and impaired decision-making. Some studies have documented that the effects of sleep loss are comparable to those of alcohol consumption, often resulting in significant performance decrements (Dehart & Davis, 2008; McFarland, 1995).

A 2011 report by British researchers revealed that airline pilots in the United Kingdom were experiencing significant fatigue. The report showed that, among a sample of 492 pilots (two-thirds of whom were captains), 45% reported suffering from significant fatigue. Additionally, 40% indicated that they had to fly beyond regulated hours at least twice a month to manage flight volume (Fisher, 2006; Steptoe, 2011). In another study, 75% of short-haul commercial pilots were reported to be severely fatigued, with approximately 80% acknowledging that their judgment was impaired during flight operations (McFarland, 1995).

Pilot fatigue has steadily increased alongside growing concerns over air safety (McKellar, 2009). Accident statistics, pilot self-reports, and operational flight studies consistently show that fatigue is a mounting concern in aviation and remains the most identifiable and preventable cause of accidents in air transport operations (Jin-Ru, 2009).

The Nigerian aviation industry is beginning to experience heightened competitiveness due to visible growth, with more airlines entering the market and new domestic and international routes being established. This expansion, coupled with the pursuit of profitability by airlines, is likely to increase the workload for aircrew and inevitably lead to higher levels of fatigue. Elevated fatigue levels make pilots more prone to errors, thereby raising serious concerns about flight safety. This study aims to examine the prevalence of aircrew fatigue in Nigeria's rapidly evolving aviation sector and to propose viable solutions.

Aim and Objectives of the Study

This study aimed at evaluating the prevalence of fatigue among aircrew in Nigeria's commercial aviation sector and examine how this fatigue affects various aspects of flight operations, with a focus on implications for flight safety and performance. Specifically, the objectives of the study were:

1. To assess levels of fatigue among aircrew in the commercial aviation industry in Nigeria.

2. To measure the effect of fatigue on various aspects of flight operations among aircrew in the commercial aviation industry in Nigeria.

2. MATERIALS AND METHODS

Adopting a descriptive cross-sectional research design, this study was carried out in the Murtala Muhammed international airport (MMIA) Lagos. It involved local Airlines operating both domestic and international flights who also use MMIA as their hub. Murtala Muhammed International Airport (MMIA) is located in Ikeja, Lagos State, Nigeria, and is the major airport serving the city of Lagos, southwestern Nigeria and the entire nation. The population of the study consisted of individuals who are pilots, flight engineers and cabin crew with the relevant professional licenses that work with local commercial airlines and are actively involved in flying duties in both the long and short haul categories. There are over 250 registered aircrew in this category (NCAA, 2011). The inclusion criteria encompass aviation professionals actively engaged in the local industry. Eligible participants include licensed pilots who have been in active service within the past six months, expatriate pilots holding Nigerian licenses and working locally, and helicopter pilots employed by airlines offering helicopter charter services. Additionally, licensed cabin crew members and licensed flight engineers are also included. The exclusion criteria eliminate certain categories of aviation professionals from participation. These include military or combat pilots, expatriate pilots employed by foreign airlines that operate flights into Nigeria, and pilots serving in the presidential air fleet. Also excluded are pilots of privately owned small aircraft, Nigerian pilots working for airlines based outside the country, and those affiliated with local airlines that are not yet fully operational. The sample size of this study comprised 190 participants. In view of the high non response rates in self-administered questionnaire surveys and the relatively small size of the total study population, all consented subjects were studied. Consequently, no sampling will be carried out. A validated semi structured, self-rating and self-administered questionnaire developed by Airbus in collaboration with a French university was adapted for qualitative data collection (Lee, 1998; Bourgeois-bougrine, et al. 2003). The

questionnaire measures for responses to 10 items related to Physical fatigue and 10 items for mental fatigue thus allowing for a rating of fatigue levels among aircrew (Lee, 1998; Bourgeois-bougrine, et al. 2003). In addition, key informant interviews were conducted and the chief operations officers of the various airlines were interviewed with a view to acquiring better insight into demands of duty and rest scheduling for aircrew. The head of the NCAA responsible for ensuring compliance with regulations and standards in the industry was also interviewed to ascertain levels of compliance by the airlines and enforcement efforts by the agency. The entire study was carried out over a six-month period with data collection spanning over 4 months. The instrument was pretested on 15 military transport pilots of the Nigerian Air Force Mobility command's 201 Heavy Airlift Group, Lagos. The pretest was carried out to assess the readability, ease of understanding and to assess the completion time of the questionnaire. Adjustments were made accordingly to improve ease of understanding for aspects of the questionnaire that required corrections. The questionnaires were administered in the privacy of the crew rooms of the various airlines within the vicinity of both the local and international airports. Aircrew passing through the crew rooms before and after flights as well as those coming to their airline offices to attend to various administrative concerns were approached to fill the questionnaire. One in-house administrative staff in each of the airlines was recruited to assist with questionnaire administration and collection. (Access for research assistants from outside the industry could not be guaranteed by the airlines in view of the prevailing security challenges in the country). The questionnaires were unmarked and returned in sealed unmarked envelopes. They were retrieved immediately they were filled. For willing participants who are unable to answer the questionnaire immediately, marked boxes with slit holes were provided in the crew rooms for their convenience. The boxes were be emptied daily by the in-house research assistants over the duration of the study. Where necessary, the research assistants followed up on aircrew in their airlines to enhance the collection of filled instruments.

Interviews were conducted with eight key stakeholders in the aviation industry, including the Director General of the NCAA, the Director of Licensing, the General Manager of Aero Medical Standards, Chief Pilots of registered airlines, and aircrew representatives from each airline. Two tailored interview protocols were developed to address the distinct roles of aircrew and regulatory personnel, ensuring consistency and enhancing the reliability of the findings. Prior to each interview, participants were thoroughly briefed on the purpose, their selection rationale, and the expected duration. Written informed consent was obtained, along with permission to take notes and use a tape recorder. All participants were assured of confidentiality, with no names or organizational identifiers used during data transcription and review. The analysis of data obtained from this survey was done using the Epi info statistical software package version 3.5.1(2008). The data generated from the study was be presented in form of tables, pie charts, and bar charts. The comparism of the variables was done using chi-square (X2) test and fischers exact test. Level of significance was taken at $p < 0.05$. In the analysis of the results of the in-depth interviews, the information collected from the various participants was compared. Common themes and patterns were established from the report and used as the basis for discussing the results. Where necessary, quotes from the respondents were included to give credence to the results. On grounds of confidentiality, efforts were made to ensure that respondents were not identifiable from their quotes. The interview records were transcribed within 24hours of the conduct of an interview. Ethical approval was obtained from the Ethical and Research Committee of the Lagos University Teaching Hospital. The NCAA and FAAN were informed of the study as well as the chief operating officers of the various registered airlines. The respondents were assured of the highest level of confidentiality on information given and individual names or names of their respective airlines would not be required. Respondents were informed of their right to opt out of the study at any point they choose to if they so desired.

3. RESULTS AND FINDINGS

Table 1: Physical Fatigue Level of Respondents

	Fatigue level					
Fatigue Experienced	**None (%)**	**Slight (%)**	**Moderate (%)**	**High (%)**	**Very High (%)**	**Total**
Physical						
Smarting eyes/Irritation	64(33.7)	18(19.5)	54(28.4)	48(25.3)	6(3.2)	190(100)
Yawning	30(16.4)	35(18.6)	28(14.9)	55(29.3)	40(21.3)	188(100)
Headache	38(20.0)	31(16.3)	50(26.3)	57(30.0)	14(4.7)	190(100)

Effort to maintain wakefulness	37(19.5)	35(18.4)	39(20.5)	53(27.9)	26(13.7)	190(100)
Decreased verbal communication	39(20.9)	39(20.5)	49(25.8)	53(27.9)	10(5.3)	190(100)
Feeling of Lethargy	48(25.3)	28(14.7)	42(22.1)	63(33.2)	9(4.7)	190(100)
Difficulty evaluating time	48(25.3)	32(16.8)	45(23.7)	53(27.9)	12(6.3)	190(100)
Nodding off or becoming fixated	48(25.3)	18(9.5)	28(14.7)	53(27.9)	43(22.6)	190(100)
Slowed reaction time	48(25.3)	22(11.6)	38(20.0)	66.(34.7)	16(8.4)	190(100)
Impaired mood	47(24.7)	35(18.4)	29(15.3)	59(31.1)	20(10.5)	190(100)

Table 1 examines the physical fatigue parameters among respondents and experienced at various levels of severity. 22.6% of aircrew experienced "very high" levels of nodding off /being fixated while 21.3% complained of yawning. Efforts to maintain wakefulness was experienced at very high levels in 13.7% of the respondents. Slowed reaction time was found to be the most significant in the experiences recorded with a high outcome at 34.7%. Others in this category are feeling of lethargy, (33.2%) and impaired mood (31.3%). In the moderate category, the experience that occurred the most was smarting eyes/irritation (28.4%) followed closely by headache (26.3%) and decreased verbal communication (25.8%).

Table 2: Mental Fatigue Level of Respondents

	Fatigue level					
Fatigue Experienced	**None (%)**	**Slight (%)**	**Moderate (%)**	**High (%)**	**Very High (%)**	**Total**
Mental						
Redundancy of some actions	45(23.7)	38(20.0)	52(27.4)	47(24.7)	8(4.2)	190(100)
Difficulty in making decisions	44(23.2)	31(16.3)	48(25.3)	55(28.9)	12(6.3)	190(100)
Slips, lapses, minor errors	38(20.0)	37(19.5)	37(19.5)	65(34.2)	13(6.8)	190(100)
Lack of coherence or reasoning	46(24.2)	36(18.9)	56(29.5)	44(23.2)	8(4.2)	190(100)
Tendency to delay decision making	42(22.1)	29(15.3)	45(23.7)	57(30.0)	17(8.9)	190(100)
Difficulty in oral expression	43(22.6)	41(21.6)	55(28.9)	44(23.2)	7(3.7)	190(100)
Slow understanding	36(18.9)	35(18.4)	50(26.3)	60(31.6)	9(14.7)	190(100)
Easily distracted	37(19.5)	32(16.8)	30(15.8)	68(35.8)	23(12.1)	190(100)
Decline in attention	36(18.9)	32(16.8)	23(12.1)	74(38.9)	25(13.2)	190(100)
Sluggish actions and movements	36(18.9)	31(16.3)	36(18.9)	68(35.8)	19(10.0)	190(100)

Table 2 shows the various mental fatigue parameters often experienced by air crew. It was found that in the very high category,13.2% of the respondents experienced decline in attention while 12.1% were easily distracted. Another 10% experienced sluggish movements while 6.8% admitted to slips, lapses and minor error. 6.3% also experienced difficulty in making decisions. In the high category, 38.9% had a decline in attention while 35.8% were easily distracted. Another 35.8% felt their actions and movements became sluggish. Also worthy of note is that 34.2% admitted to have experienced slips and minor errors.

Table 3: Fatigue Level of Respondents

Variable	**Frequency (n=188)**	**Percent**
Mild	101	53.7
Moderate	49	26.1
Severe	38	20.2

In table 3 above, fatigue level of respondents is shown. Based on their last experience of fatigue, 53.7% were found to be mildly fatigued, 26.1% were moderately fatigued while the remaining 20.2 % were severely fatigued.

Novelty Journals

ISSN 2394-9716

International Journal of Novel Research in Interdisciplinary Studies
Vol. 13, Issue 1, pp: (1-8), Month: January – February 2026, Available at: www.noveltyjournals.com

Table 4: Effect of Fatigue on Respondents' Flight Operations

	Effect of Fatigue on Operations			
Operation/Tasks	**Not at all (%)**	**Moderately (%)**	**A Great deal (%)**	**Total**
Flight path monitoring	99(71.2)	39(28.1)	1(0.7)	139(100)
Manual flying	89(64.0)	47(33.8)	3(2.2)	139(100)
Utilization of aircraft automation	96(69.1)	38(27.3)	5(3.6)	139(100)
Communication	85(61.2)	52(37.4)	2(1.4)	139(100)
Crew resources management	89(64.0)	49(35.3)	1(0.7)	149(100)
Use of Check-list	91(65.5)	46(33.1)	2(1.4)	139(100)
Selecting and entering data	79(56.8)	57(41.0)	3(2.2)	139(100)
Take off	92(66.2)	46(33.1)	1(0.7)	139(100)
Landing	80(58.0)	53(38.4)	5(3.6)	138(100)

Table 4 looks at the effect of fatigue on various aspects of flight operations. In terms of the aspects of flight affected a great deal, landing and utilization of aircraft automation were affected the most with 5% of the respondents each. The process of selection and entry of data was moderately affected in 41% of respondents while the landing was also moderately affected in 38.4% of respondents. Crew resource management (35.3%), take off (33.1%), use of check list (33.1%) and communication (37.4%) were also moderately affected by fatigue.

Table 5: Association Between Respondents' Occupation Characteristics and Fatigue Level

Variable	**Fatigue Level**				**X2**	**P value**
	Mild	**Moderate**	**Severe**	Total		
Current Function					3.2	0.787
Captain	42(50.0)	25(29.8)	17(20.0)	84(100)		
Copilot	30(60.0)	10(20.0)	10(20.0)	50(100)		
Flight engineer	1(50.0)	0.(0.0)	1(50.0)	2(100)		
Cabin crew	28(53.3)	14(26.9)	10(19.2)	52(100)		
Total						
Mean No. of yr in current position (SD)	7.8(8.7)	9.7(10.4)	8.1(7.3)		0.76*	0.468
No. of Years in current position						
<10	76(55.9)	35(25.7)	25(18.4)	136(100)	6.5	0.163
10-20	13(41.9)	7(22.6)	11(35.5)	31(100)		
>20	12(57.1)	7(33.3)	2(9.5)	21(100)		
Total	101(53.7)	49(26.1)	38(20.2)	188(100)		
Nature of flying duty						
Short haul	74(56.5)	32(24.4)	25(19.1)	131(100)	1.3	0.514
Long haul	27(47.4)	17(29.8)	13(22.8)	57(100)		
Total	101(53.7)	49(26.1)	38(20.2)	188(100)		
Mean No. of Hr flown in the last month (SD)	73.2(108.9)	640(35.8)	61.2(35.5)		0.4	0.687

No. of Hr needed to commute from home to work (hr)						
<1	78(57.8)	30(22.2)	27(20.0)	135(100)	7.0	0.136
1-2	19(42.2)	15(33.3)	11(24.4)	45(100)		
>2	4(50.0)	4(50.0)	0(0.0)	8(100)		
Total	101(53.7)	49(26.1)	38(20.2)	188(100)		

***F test**

Table 5 compares for association between respondents' occupational characteristics and fatigue levels. Captains, copilots and cabin crew appear to have similar percentages of severe fatigue. Respondents who have spent 10-20 years in their current positions experienced the highest percentage of severe fatigue (35.5%) followed by those who have spent less than 10 years (18.4%). 25% of aircrew in the short haul category are severely fatigued as compared to 13% in the short haul category. There is no statistically significant association between occupational characteristics and levels of fatigue. (p>0.05)

Table 6: Association Between Respondents' Fatigue Level and Smoking

	Smoking			**X2**	**P value**
Fatigue level	**Yes**	**No**	**Total**	**2.0**	**0.362**
Mild	10(9.9)	91(90.1)	101(100)		
Moderate	7(14.6)	41(85.4)	48(100)		
Severe	2(5.3)	36(94.7)	38(100)		
Total	19(10.2)	168(89.8)	187(100)		

This table looks at association between smoking and fatigue levels. Of those who are severely fatigued,5.3% of them are smokers. 14.6 % of those with moderate fatigue are smokers as well while 9.9 % of those who are mildly fatigued also smoke. There is no statistically significant association between smoking and fatigue levels. (p>0.05)

Table 7: Association Between Respondents' Fatigue Level Alcohol Use

	Alcohol			**X2**	**P value**
Fatigue level	**Yes**	**No**	**Total**	**4.5**	**0.103**
Mild	43(42.6)	58(57.4)	101(100)		
Moderate	29(59.2)	20(40.8)	49(100)		
Severe	15(39.5)	23(60.5)	39(100)		
Total	87(46.3)	101(53.7)	188(100)		

In table 7, the association between fatigue levels and alcohol use was examined. While 39.5% of those with severe fatigue consumed alcohol, 59% of those who with moderate fatigue levels drank alcohol. 42.6% of those with mild fatigue also consume alcohol. There is no statistically significant association between alcohol and fatigue levels. (p>0.05)

4. DISCUSSION OF FINDINGS

The findings from the tables addressing research question one highlighted significant physical fatigue symptoms among aircrew, with slowed reaction time being the most prevalent at 34.7%, followed by lethargy (33.2%) and impaired mood (31.3%). These symptoms suggested a serious impact on operational performance and safety, consistent with research by Meng Yu (2025), who identified delayed reaction time and mood disturbances as key indicators of fatigue resulting from circadian disruption and sleep deprivation. Additionally, 22.6% of respondents reported very high levels of nodding off or being fixated, while 21.3% experienced frequent yawning, indicating reduced alertness symptoms also emphasized in the study of Kebeng and Gano (2024), which linked such manifestations to impaired situational awareness and burnout. Efforts to stay awake were notable at 13.7%, reflecting compensatory behaviors often observed in fatigued crew members. Moderate symptoms included smarting or irritated eyes (28.4%), headaches (26.3%), and decreased verbal communication

(25.8%), pointing to the physical strain and cognitive fatigue experienced during flight operations. These results align with findings from Åkerstedt et al. (2021), which documented the cumulative effects of long duty hours and irregular schedules on aircrew, leading to both physical discomfort and diminished interpersonal coordination. Overall, the data reinforces the need for fatigue risk management strategies to safeguard crew health and flight safety.

Tables addressing research question two revealed notable mental fatigue symptoms among aircrew, with a significant proportion reporting declines in attention, distractibility, sluggish movements, and minor errors. In the very high severity category, 13.2% of respondents experienced a decline in attention, 12.1% were easily distracted, and 10% reported sluggish movements. Additionally, 6.8% admitted to slips, lapses, and minor errors, while 6.3% struggled with decision-making. These symptoms reflect deteriorating cognitive performance and executive function, which are critical for safe flight operations. In the high severity category, the prevalence of these symptoms was even more pronounced: 38.9% experienced attention decline, 35.8% were easily distracted, and another 35.8% reported sluggishness in actions and movements. Furthermore, 34.2% acknowledged experiencing slips and minor errors. These findings are consistent with empirical studies by Kebeng and Gano (2024), which link mental fatigue to impaired attention, judgment, and error management. Sieberichs, Corrigan and McDonald (2024) also highlighted distractibility and decision-making difficulties as common outcomes of fatigue in aircrew, while research from (Dickens, Champion & Schenke, 2024) confirmed that mental fatigue undermines cognitive reflection and increases operational errors. Collectively, these results underscored the need for proactive fatigue management strategies to preserve cognitive performance and flight safety.

5. CONCLUSION

This study concluded that fatigue both physical and mental is a widespread and critical issue among aircrew, affecting operational performance and safety. Physical symptoms such as slowed reaction time, lethargy, and impaired mood were highly prevalent, alongside signs of reduced alertness and physical strain. Mental fatigue was equally concerning, with many crew members reporting declines in attention, increased distractibility, sluggish movements, and frequent minor errors. These impairments reflect deteriorating cognitive function and decision-making capacity. The findings emphasize the need for comprehensive fatigue management strategies that address both physiological and psychological dimensions to ensure crew well-being and flight safety

6. RECOMMENDATIONS

Considering the findings and conclusion of this study, the following recommendations were made:

1. Airlines should adopt Fatigue Risk Management Systems (FRMS) frameworks that monitor both physical and mental fatigue indicators, enabling proactive interventions such as rest breaks, schedule adjustments, and crew rotation.

2. Flight rosters should be designed to reduce consecutive night shifts, long duty periods, and irregular start times, which are known to exacerbate fatigue and impair cognitive performance.

3. Regular training programs should educate aircrew on recognizing fatigue symptoms, managing alertness, and applying coping strategies to maintain performance during demanding operations.

4. Periodic assessments should be standardized across all occupational categories to ensure early detection and equitable support.

REFERENCES

[1] Åkerstedt, T., Klemets, T., Karlsson, D., Häbel, H., Widman, L., & Sallinen, M. (2021). Acute and cumulative effects of scheduling on aircrew fatigue in ultra-short-haul operations. *Journal of Sleep Research*, *30*(5), e13305.

[2] Dehart, L., & Davis, J. (2008). *Fundamentals of aerospace medicine* (4th ed., pp. 842–843). Philadelphia: Lippincott Williams & Wilkins.

[3] Dickens, A., Champion, A. J., & Schenke, K. C. (2024). Fatigue management: a systematic review of objective measurement techniques for cognitive fatigue. *Journal of Clinical and Experimental Neuropsychology*, *46*(8), 776-793.

[4] Fisher, E. (2006). *Flight safety foundation* (2nd ed., p. 36). London: Calderon Press.

[5] Jackson, C. A., & Earl, L. (2006). Prevalence of fatigue among commercial pilots. *Journal of Occupational Medicine*, *56*, 263–268. Retrieved from http://www.elsevier.com/locate/jom

[6] Jin-Ru, Y. A., Chiung-Chi, H. A., Hsuan, Y. A., & Hero, H. B. (2009). An investigation of fatigue issues on different flight operations. *Journal of Air Transport Management*, *19*(1), 236–240. Retrieved from http://www.elsevier.com/locate/jairtraman

[7] Kebeng, R. E., & Gano, C. B. (2024). Navigating Challenges for Disaster Resilience: Insights from Department of Public Works and Highways Personnel. *International Journal for Multidisciplinary Research (IJFMR), 6(*2), 1-15.

[8] McFarland, R. A. (1995). *Human factors in air transportation: Occupational health and safety* (5th ed., p. 131). New York: McGraw Hill.

[9] McKellar, G. (2009). Fatigue issues re-visited: A layman's look at legalese. *Interpilot: Journal of the International Federation of Airline Pilots*, *15*(3), 3–4.

[10] Meng Yu. (2025). *Aircrew Fatigue: Causes, Symptoms, and Mitigation Strategies.* Aviation Health and Safety Journal, 18(2), 45–59.

[11] Olaganathan, R., Holt, T. B., Luedtke, J., & Bowen, B. D. (2021). Fatigue and its management in the aviation industry, with special reference to pilots. *Journal of Aviation Technology and Engineering*, *10*(1), 45.

[12] Sieberichs, S., Corrigan, S., & McDonald, N. (2024). How pilot fatigue affects operational flight risk in scheduled commercial aviation. *Aviation Psychology and Applied Human Factors*.

[13] Steptoe, A. (2011). Pilot fatigue in the UK. *British Airline Pilots Association Aviation Newsletter*, *5*, 17–19. Retrieved from http://newsletter.balpa.org/unolilcs