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Article

Psychosocial risks and occupational health: Fatigue and sleep disturbances among aviation professionals

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Abstract: This study investigates the relationship between exposure to psychosocial risk factors at work, fatigue, and sleep quality among civil aviation professionals. Psychosocial risk factors such as excessive workload, lack of control over tasks, job insecurity, and inadequate social support are prevalent in high-demand environments like civil aviation, where constant vigilance and rapid decision-making are crucial. The research involved 200 participants, including pilots and flight attendants, who completed questionnaires measuring psychosocial stressors, sleepiness, and fatigue. Results indicated significant associations between role conflict and ambiguity, lack of social support, work/family conflict, and the pressure of responsibility with increased fatigue and sleep disturbances. Gender differences were noted, with women experiencing higher levels of work/family conflict. The study emphasizes the need for organizational strategies to mitigate these psychosocial stressors by enhancing role clarity, providing social support, fostering work-life balance, and managing job responsibilities to improve health outcomes and operational safety in aviation. Future research should consider longitudinal and diverse studies to explore these dynamics further and test intervention efficacy.

Keywords: psychosocial risk factors; fatigue; sleep quality; aviation professionals; occupational health

1. Introduction

Psychosocial risk factors in the workplace refer to organizational, relational, and contextual aspects that can influence the mental and physical health of workers. These factors include, among others, excessive workload, lack of control over tasks, pressure to meet deadlines, job insecurity, and inadequate social support (Rodrigues et al., 2020). In high-demand environments, such as civil aviation, these risks are amplified due to the nature of the work, which requires constant vigilance, rapid and precise decision-making, and a high level of responsibility for the safety of numerous lives (Areosa and Fabres, 2018; Cullen et al., 2021; Hunter and Martinussen, 2017; Marqueze et al., 2023; Melo and Neto, 2013).

Working conditions in the domestic civil aviation sector are characterized by physical and material challenges, involving long shifts and exposure to inherent risks in the operational environment (Areosa and Fabres, 2018). Professionals such as pilots and flight attendants face long working hours, constant atmospheric pressure variations, exposure to cosmic radiation, and the effects of jet lag due to frequent time zone changes (Arseven and Yurdakul, 2024). The work environment in airports and aircraft requires constant adherence to safety regulations, sometimes with limited resources, directly impacting the physical and psychological well-being of workers

(Hunter and Martinussen, 2017; Marqueze et al., 2023). While on the one hand, pilots and co-pilots are directly subjected to stressors from the operation of aircraft (Görlich and Stadelmann, 2020; Zhao et al., 2023), on the other, flight attendants need to deal with passenger demands and control situations that may endanger the safety of the crew and passengers (Griffiths and Powell, 2012; McNeely et al., 2018).

Such working conditions can lead to the development of chronic stress, emotional exhaustion, and eventually severe fatigue, compromising both the professional's health and operational safety (Arseven and Yurdakul, 2024; Feijó et al., 2014; Folke and Melin, 2022; Wingelaar-Jagt et al., 2021). The domestic civil aviation sector has also been deeply affected by recent crises, particularly the COVID-19 pandemic, which led to a significant drop in demand, resulting in mass layoffs, salary reductions, and business restructuring (Valdés et al., 2022). The sector's economic instability was further exacerbated by mergers and acquisitions aimed at business survival, negatively impacting employment levels and working conditions (Görlich and Stadelmann, 2020).

Fatigue is a state of physical and mental exhaustion that reduces performance capacity and increases the likelihood of errors, being particularly dangerous in critical occupations such as aviation (Hacioglu and Özel, 2021; Pina et al., 2022; Wingelaar-Jagt et al., 2021). Moreover, prolonged exposure to psychosocial risk factors can negatively affect workers' sleep quality, further aggravating the effects of fatigue (Bendak and Rashid, 2020; Caldwell, 2012; Tamakloe et al., 2022; Zhao et al., 2023). Understanding how these factors interact is essential for developing interventions that can mitigate their adverse impacts and promote a healthier and safer work environment (Cullen et al., 2021; Morris et al., 2023; Tamakloe et al., 2022). Therefore, this study aims to investigate the relationship between exposure to psychosocial risk factors at work, fatigue, and sleep quality among civil aviation professionals.

2. Materials and methods

2.1. Participants

A total of 200 participants were obtained, of whom 26 (13.00%) work as pilots, while 174 (87.00%) are flight attendants. Among the pilot professionals, 24 (12.00%) are men, and 2 (1%) are women. Regarding flight attendants, 49 (24.50%) are men, while 125 (62.50%) are women. The average age of the participants is 32.40 years (SD = 9.78), while the average length of service in civil aviation is 8.90 years (SD = 5.56). Participants were invited to complete the questionnaire via invitations sent through social networks, such as Facebook, LinkedIn, and specific WhatsApp groups for civil aviation professional communities.

Data collection took place over approximately two months. Participants work in 4 private Brazilian civil aviation companies of passenger transport that together include 99.12% of the share in the Brazilian domestic aviation market (Agência Nacional de Aviação Civil, 2024). As an inclusion criterion, participants should present at least 12 months of work experience in civil aviation as a crew member on commercial flights.

In this study, pilots and flight attendants were combined in the same sample of civil aviation professionals. Although these two groups perform distinct roles within

the cabin, both are exposed to similar psychosocial risks, including long working hours, irregular shifts, frequent travel, and the high responsibility for passenger safety (Areosa and Fabres, 2018; Cullen et al., 2021). Moreover, both groups share the need for effective coordination and rapid decision-making in critical situations, factors that significantly contribute to psychosocial stress in their work routines.

Despite differences in their roles, emotional overload, the impact of fatigue, and pressures related to safety manifest similarly in both groups, thus justifying the combined analysis. Previous studies suggest that the aviation work environment as a whole involves similar stress risks, regardless of the specific role, making it relevant to combine these groups to assess the overall effects of psychosocial risk factors (Feijó et al., 2014; Wingelaar-Jagt et al., 2021).

2.2. Instruments

Sociodemographic Questionnaire-Participants answered demographic questions, including age, gender, and the region of the country in which they reside, as well as information about their position, role, and length of service in civil aviation. This questionnaire was used to collect basic information from the participants, allowing for the characterization of the sample and the analysis of possible sociodemographic influences on the study's variables of interest.

The Psychosocial Stressors at Work Scale was developed for the Brazilian context to assess workers' perceptions of different sources of stress in the work environment (Ferreira et al., 2015). The scale comprises seven factors: Role Conflict and Ambiguity ($\alpha = 0.77$), Role Overload ($\alpha = 0.71$), Interpersonal Difficulties ($\alpha = 0.77$), Career Insecurity ($\alpha = 0.62$), Lack of Autonomy ($\alpha = 0.71$), Work-Family Conflict ($\alpha = 0.75$), and Pressure Due to the Level of Responsibility ($\alpha = 0.77$). Higher scores in each dimension indicate a greater perception of stress related to that specific source.

The Brazilian version of the Epworth Sleepiness Scale (Bertolazi et al., 2009) is a self-administered questionnaire that measures the likelihood of an individual falling asleep in eight different everyday situations known to induce sleepiness. The total score of the scale ranges from 0 to 24, with higher scores indicating greater daytime sleepiness. The ESE-BR showed good internal consistency in adaptation studies ($\alpha = 0.83$).

Fatigue Assessment Scale, consisting of 10 items that assess the frequency with which participants experience symptoms of fatigue (e.g., "I feel bothered by fatigue," "I get tired very quickly"). Responses are given on a five-point scale ranging from 1 (Never) to 5 (Always), reflecting the participant's state in the past 30 days. The scale adapted for Brazil demonstrated factorial validity and a unidimensional structure with acceptable reliability ($\alpha > 0.70$) (Oliveira et al., 2010).

2.3. Data collection procedures

Data collection for this study was carried out through an electronic form, created using the Google Forms platform. The form included a sociodemographic questionnaire and three scales: the Psychosocial Stressors at Work Scale, the Epworth Sleepiness Scale, and the Fatigue Assessment Scale.

This study adhered to all ethical guidelines established for research involving human subjects and was approved by the Research Ethics Committee of the Authors' Institution (Protocol: 30336620.6.0000.8927). Participants were informed about the study's objectives, guarantees of anonymity, data confidentiality, and the right to withdraw at any time without any penalties. Free and informed consent was obtained electronically before participants could access the questionnaire.

2.4. Data analysis

The collected data were analyzed using the statistical software R. Initially, descriptive analyses were conducted to characterize the sample and check the normality of the variable distributions. Subsequently, Confirmatory Factor Analysis (CFA) was performed for each of the instruments to verify construct validity and model adequacy. To assess the internal consistency of the scales, Cronbach's alpha and Guttman's lambda-2 coefficients were calculated.

After the psychometric validation of the instruments, multiple regressions were conducted to examine the relationships between psychosocial stressors in the work context and health outcomes, such as Fatigue and Sleep Disturbances. Separate multiple regression models were created for each health outcome (dependent variable), using the factors of the Psychosocial Stressors at Work Scale as independent variables. Regression coefficients (β), 95% confidence intervals, and *p*-values were reported for each independent variable.

3. Results

The instruments used in the study demonstrated satisfactory psychometric adequacy, as evidenced by the fit indices obtained in the confirmatory factor analyses and the internal consistency coefficients (**Table 1**).

Table 1. Fit indices and internal consistency of the instruments used.

Instrument	χ^2 (*p*-value)	CFI	TLI	RMSEA	SRMR	α	λ_2
Psychosocial Stressors at Work Scale	112.34 (p = 0.08)	0.95	0.94	0.05	0.04	0.89	0.87
Epworth Sleepiness Scale	45.67 (p = 0.12)	0.96	0.95	0.04	0.03	0.91	0.90
Fatigue Assessment Scal	38.92 (p = 0.10)	0.97	0.96	0.03	0.02	0.92	0.91

Note: χ^2 = chi-square; CFI = Comparative Fit Index; TLI = Tucker-Lewis Index; RMSEA = Root Mean Square Error of Approximation; SRMR = Standardized Root Mean Square Residual; α = Cronbach's Alpha; λ_2 = Guttmann"s lambda-2.

The distribution of participants across these levels of sleepiness was analyzed based on their professional roles (pilots and flight attendants) and gender (male and female). Among the pilots, most men exhibited average to abnormal levels of sleepiness, while the few women in this role predominantly showed normal sleep or average sleepiness. Among flight attendants, both men and women displayed a more balanced distribution across the three levels, with a slight predominance of women showing abnormal sleepiness (**Figure 1**). However, they did not identify a statistically significant difference between the gender groups or the professional groups regarding the levels of sleepiness in the analyzed sample.

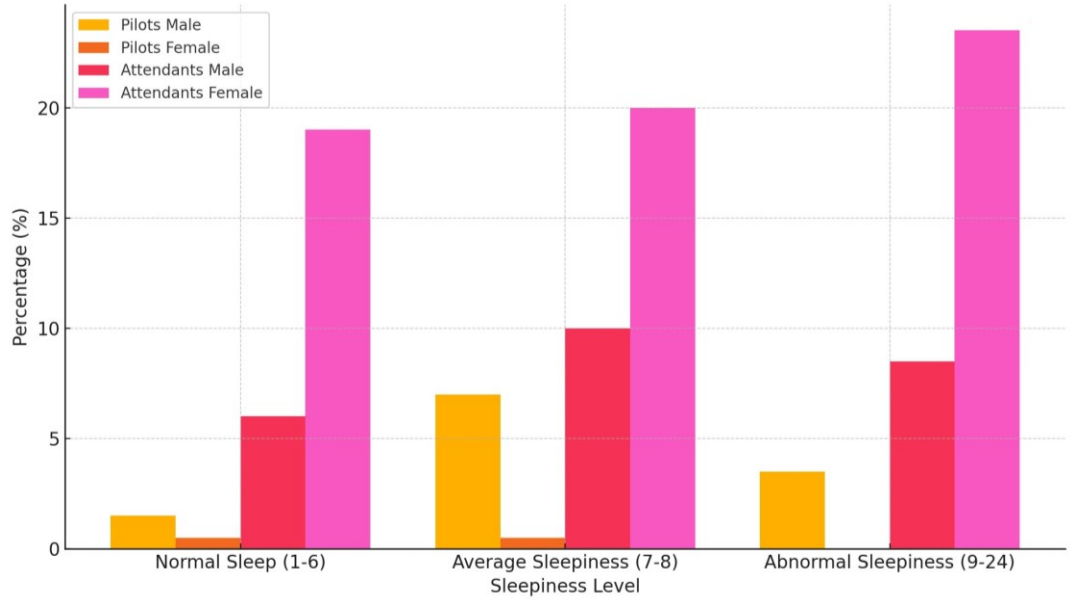

Figure 1. Distribution of participants by sleepiness level, gender, and profession.

The results of the multiple regression analyses indicated significant associations between several predictor variables and the dependent variables related to the work context of civil aviation professionals (**Figure 2**). Role Conflict and Ambiguity was identified as a significant predictor of Fatigue ($\beta = 0.35$, 95% CI [0.20–0.48], $p < 0.01$). This result suggests that an increase in uncertainty and ambiguity regarding job responsibilities is associated with an increase in fatigue.

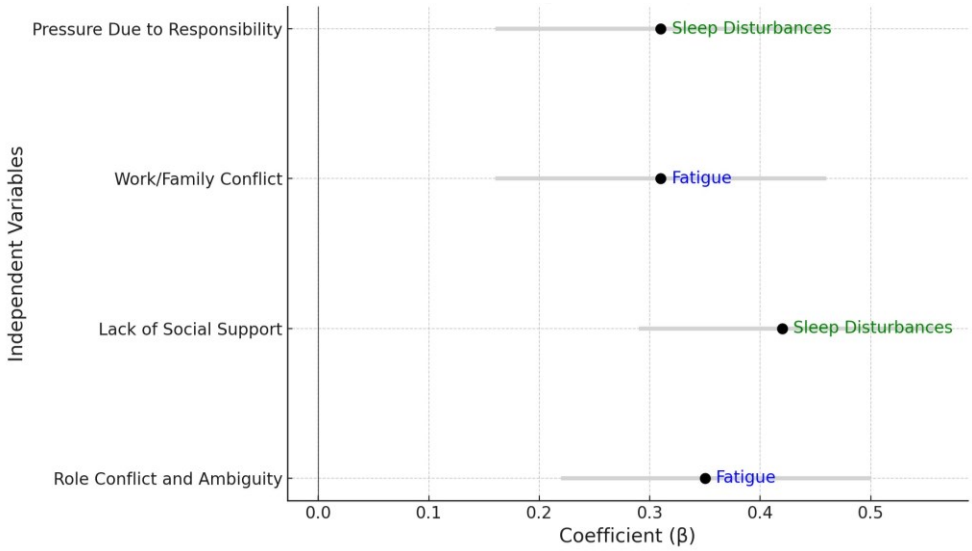

Figure 2. Predictive factors for fatigue and sleep disturbances with 95% CI.

Additionally, Lack of Social Support was also a significant predictor of Sleep Disturbances (β = 0.42\beta = 0.42β = 0.42, 95% CI [0.28, 0.55], $p < 0.05$). These results suggest that the absence of adequate social support contributes to sleep problems, possibly due to social isolation and increased stress. Similarly, Work/Family Conflict emerged as a significant predictor of Fatigue ($\beta = 0.31$, 95% CI

[0.16, 0.46], $p < 0.05$), indicating that an increase in conflict between professional and family demands is associated with higher levels of fatigue.

Another relevant finding was the identification of Pressure Due to Level of Responsibility as a significant predictor of Sleep Disturbances ($\beta = 0.31$, 95% CI [0.16–0.46], $p < 0.05$). This finding suggests that the pressure associated with a high degree of responsibility affects sleep, contributing to elevated levels of stress and sleep disorders.

In addition to these regression analyses, a comparison of means analysis indicated a statistically significant difference in fatigue levels between pilots and other aviation professionals (t (198) = 2.45, $p < 0.05$), with pilots showing higher levels of fatigue. A significant gender difference was also found concerning Work/Family Conflict (t (198) = 3.18, $p < 0.05$), suggesting that women face a higher level of conflict between professional and family responsibilities compared to men.

The effect of participants' age on the dependent variables was examined but found to be non-significant. Specifically, age did not significantly predict either fatigue or sleep disturbances in the regression analysis ($\beta = 0.08$, 95% CI [−0.05—0.21], $p = 0.32$). This suggests that age does not have a meaningful impact on these outcomes within this sample.

4. Discussion

The findings of this study underscore the critical importance of various psychosocial and organizational factors associated with fatigue and sleep patterns among civil aviation professionals (Arseven and Yurdakul, 2024; Feijó et al., 2014). The significant positive relationship between Role Conflict and Ambiguity and Fatigue suggests that work environments characterized by uncertainties and ambiguities regarding job responsibilities are linked to higher levels of fatigue. This result aligns with existing literature, which discusses the potential impact of role ambiguity on workers' well-being, particularly in sectors where safety is paramount, such as aviation (Feijó et al., 2014; Rodrigues et al., 2020). In these settings, the lack of clarity about roles and expectations may contribute to heightened stress and cognitive overload, ultimately resulting in physical and emotional exhaustion (Arseven and Yurdakul, 2024; Itani, 2009).

The significant associations found between role ambiguity, fatigue, and sleep disturbances among aviation professionals may reflect the impact of long shifts, exposure to operational risks, and the demanding physical environment described (Caldwell, 2012; Marqueze et al., 2023). These environmental stressors, combined with the need for adherence to strict safety regulations under sometimes limited resources, could intensify the role ambiguity and workload pressures experienced by aviation workers, contributing to emotional exhaustion and compromised well-being (Çaki, 2023; Feijó et al., 2014; Görlich and Stadelmann, 2020).

Furthermore, the findings related to work/family conflict and lack of social support resonate with the broader context of instability within the aviation sector, particularly following crises such as the COVID-19 pandemic. Economic instability, mass layoffs, and salary reductions have likely worsened the stress levels of aviation professionals, adding to the burden of maintaining a work-life balance in an already

high-stress occupation (Görlich and Stadelmann, 2020; Valdés et al., 2022). The heightened levels of fatigue observed in the study may also stem from the sector's financial uncertainties and the need for professionals to constantly adapt to rapidly changing conditions, such as fuel price volatility and market fluctuations.

The significant association between Lack of Social Support and Sleep Disturbances highlights the essential role of social support in the workplace. The absence of adequate social support may exacerbate stress and contribute to sleep disturbances, particularly in a demanding and irregular work environment like civil aviation (Folke and Melin, 2022; Tamakloe et al., 2022). Social support is often seen as a buffer against stress, providing emotional comfort and practical assistance that can mitigate the adverse effects of workplace stressors. Without this support, employees may experience feelings of isolation and overwhelm, which could negatively affect their sleep quality and overall health (Caldwell, 2012; Areosa and Fabres, 2018).

Furthermore, the significant relationship between Work/Family Conflict and Fatigue underscores the central role of work-life balance in occupational health. Higher levels of work/family conflict are associated with increased fatigue, potentially compromising both operational safety and the general well-being of aviation workers (Cullen et al., 2021; Zhao et al., 2023). Balancing professional and personal life can be particularly challenging in high-stress professions like aviation, where irregular hours and demanding schedules may disrupt family life and personal time, contributing to chronic fatigue and burnout. These findings suggest that interventions aimed at promoting work-life balance may help reduce fatigue and enhance worker satisfaction and safety.

Similarly, the pressure associated with a high degree of responsibility was identified as a significant factor related to sleep disturbances. This pressure can elevate stress levels and affect sleep, especially in professions where safety relies on quick and precise decision-making (Caldwell, 2012; Feijó et al., 2014; Martinussen and Hunter, 2017). In aviation, the continuous demand for vigilance and accuracy may create a state of ongoing alertness, which could disrupt normal sleep patterns and compound the risk of fatigue, with potential consequences for performance and safety (Areosa and Fabres, 2018; Folke and Melin, 2022; Griffiths and Powell, 2012; McNeely et al., 2018).

The study also revealed significant gender differences, particularly concerning Work/Family Conflict, with women experiencing higher levels of conflict between professional and family responsibilities compared to men ($t(198) = 3.18$, $p < 0.05$). This finding suggests that female aviation professionals may face additional stressors related to balancing work and family life, which could increase fatigue and other negative health outcomes (Stevenson et al., 2021).

The disproportionate impact of work/family conflict on women may stem from societal expectations and traditional gender roles, which often place a greater burden on women to manage family responsibilities, even when they hold demanding professional roles (Douglas and Pittenger, 2020; Nussrat, 2024). This imbalance may contribute to heightened stress and reduced recovery time, further exacerbating fatigue and potentially affecting job performance and safety. Addressing these gender disparities may require targeted organizational policies, such as flexible scheduling,

childcare support, and resources specifically designed to alleviate the dual burden faced by women in the aviation sector (Casebolt, 1990; Stevenson et al., 2021).

Additionally, in Brazilian civil aviation, flight attendant positions are predominantly occupied by women, while pilot and co-pilot roles remain male-dominated. By promoting a more equitable work environment, these measures could help reduce gender-related stressors and improve the overall well-being of aviation professionals (Casebolt, 2023; Nussrat, 2024).

The non-significant effect of age on fatigue and sleep disturbances is likely influenced by the relatively young average age of participants ($M = 32.40$ years, $SD = 9.78$) and the limited age variability in the sample. The narrow age range in the sample may be partially explained by the recruitment methods, particularly if social media was used to attract participants. Social media platforms often engage younger users, which could skew the sample towards individuals in their early careers. Additionally, the nature of the participants' professions, such as aviation or other specialized fields, may appeal more to younger individuals. This combination of recruitment through social media and the inherent characteristics of the profession may have limited the age diversity in the sample.

Overall, these findings emphasize the need for organizational strategies that address psychosocial stressors by enhancing role clarity, providing robust social support systems, fostering better work-life balance, and managing the pressures associated with high-responsibility roles (Marqueze et al., 2023; Tamakloe et al., 2022). Implementing such strategies may improve the health and performance of aviation professionals, contributing to both employee well-being and operational safety.

To address the psychosocial stressors faced by aviation professionals, organizational changes play a critical role in fostering a healthier and safer work environment (Tamakloe et al., 2022; Wingelaar-Jagt et al., 2021). Given the demanding nature of civil aviation, interventions must go beyond individual coping strategies and focus on systemic shifts within the workplace structure. This approach involves both policy reform and cultural transformation to mitigate fatigue, enhance work-life balance, and reduce stress, all of which are essential for improving the overall well-being and performance of aviation employees (Ćosić et al., 2024; Hunter and Martinussen, 2017; Wingelaar-Jagt et al., 2021). Below are key organizational strategies that can be implemented to achieve these goals:

- Organizational restructuring of work schedules to enforce clear limits on working hours and ensure adequate rest periods, reducing fatigue among aviation professionals.
- Implementation of flexible shift management policies to better accommodate work-life balance and reduce work-family conflicts, particularly benefiting female employees.
- Development of comprehensive social support systems within the organization, including peer networks and access to mental health resources, to mitigate workplace stress and isolation.
- Redesign of organizational roles and responsibilities to minimize role ambiguity, reducing stress related to unclear job expectations.

- Investment in health and wellness programs that integrate stress management techniques and education on sleep hygiene, nutrition, and physical well-being, tailored to the demands of aviation work.
- Organizational policy adjustments to foster a supportive environment for family life, including childcare services and flexible leave options, to alleviate work-family conflicts.
- Continuous monitoring of employee well-being through regular organizational assessments, enabling data-driven decisions to address psychosocial risk factors.
- Creation of a workplace culture that prioritizes mental health, where open communication about stress and fatigue is encouraged and supported by management.
- Enhancing operational safety by implementing organizational changes that directly address psychosocial stressors and fatigue, improving both employee well-being and performance.

While this study provides insights into the psychosocial risk factors affecting fatigue and sleep among civil aviation professionals, several limitations should be noted. First, the cross-sectional design limits the ability to infer causal relationships between the variables. Second, the reliance on self-reported measures may introduce bias, as participants could underreport or overreport their levels of fatigue, stress, or sleep disturbances due to social desirability or recall bias. Third, the study sample predominantly included flight attendants and pilots, which may limit the generalizability of the findings to other aviation professionals, such as maintenance staff or air traffic controllers, who may experience different stressors and health outcomes.

Future research should focus on:

- Conducting longitudinal studies to better understand the relationships between psychosocial risk factors and health outcomes such as fatigue and sleep disturbances.
- Incorporating objective measures, such as actigraphy for sleep assessment or physiological markers of stress, to provide a more comprehensive understanding of these variables
- Exploring the impact of specific organizational interventions, such as improving social support and implementing strategies for work-family balance.
- Including more diverse samples, particularly from other aviation roles like maintenance staff or air traffic controllers, to generalize the findings.
- Investigating potential gender-specific stressors and coping mechanisms within the civil aviation sector.

Additionally, research could investigate the effectiveness of specific organizational interventions aimed at reducing role conflict, enhancing social support, and promoting work-life balance to mitigate fatigue and improve overall well-being among aviation professionals. Experimental or intervention-based studies could provide stronger evidence on best practices for enhancing occupational health and safety in this high-stakes environment.

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