UNIVERSIDADE CATÓLICA PORTUGUESA

UNDERSTANDING FACTORS AFFECTING SLEEP, FATIGUE, SOCIAL SUPPORT AND THE MODERATING ROLE OF JOB SATISFACTION AMONG SHIFT WORKERS

Dissertation submitted to Universidade Católica Portuguesa to obtain a Master's Degree in Psychology in Business and Economics

By

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Abstract

In today's 24/7 economy, shift work has become increasingly common across industries, posing significant challenges to workers' health, well-being, and performance. Disrupted circadian rhythms, sleep disturbances, and chronic fatigue are well-documented consequences of irregular work schedules. However, less is known about the psychosocial factors—such as social support and job satisfaction—that may help mitigate these negative effects. Drawing on Affective Events Theory and the Job Demands-Resources model, this study aimed to deepen understanding of these dynamics in shift-working populations. The study had three main objectives: (1) to examine the relationships between sleep disturbances, chronic fatigue, and social support; (2) to explore whether job satisfaction moderates the relationship between chronic fatigue and sleep disturbances; and (3) to generate insights that could inform workplace interventions to support sleep health and well-being in shift work settings. A cross-sectional, quantitative survey design was employed, collecting data from 74 shift workers—including aircrew (pilots and cabin crew) and non-aircrew personnel (ground staff and office-based workers)—using validated questionnaires measuring sleep disturbances, chronic fatigue, social support (focused on family cohesion and intimacy), and job satisfaction. Data were analyzed using correlation, regression, and moderation analyses with bootstrapping to strengthen reliability.

The findings supported the first hypothesis, revealing a significant positive relationship between sleep disturbances and chronic fatigue, with sleep disturbance explaining approximately 33% of the variance in fatigue. The second hypothesis was also supported: higher levels of social support were associated with fewer sleep disturbances, explaining approximately 38% of the variance. Partial support was found for the third hypothesis: job satisfaction moderated the relationship between chronic fatigue and sleep disturbances, but this effect was significant only at lower levels of job satisfaction. At higher levels of job satisfaction, the link between fatigue and sleep disturbance was no longer statistically significant.

These findings suggest that social support and job satisfaction can act as protective factors in reducing sleep disturbances and fatigue in shift work environments. While the moderation effect of job satisfaction was only partially supported and limited by measurement constraints, the results align with existing theoretical models that emphasize the role of emotional and social resources in coping with occupational stressors. The results also highlight the potential for workplace interventions aimed at enhancing social support and job satisfaction to improve sleep quality and reduce fatigue.

In conclusion, this study provides preliminary but meaningful insights into the complex interplay between shift work, sleep, fatigue, and psychosocial factors. Further research with larger and more diverse samples will be essential to validate these findings and support the development of targeted interventions to promote the well-being of shift-working populations.

Keywords: sleep, fatigue, social support, job satisfaction, shift workers, aircrew members

Resumo

Na economia atual, que funciona 24 horas por dia, 7 dias por semana, o trabalho por turnos tornou-se cada vez mais comum em diversos setores, colocando desafios significativos à saúde, bem-estar e desempenho dos trabalhadores. Ritmos circadianos desregulados, perturbações do sono e fadiga crónica são consequências bem documentadas de horários de trabalho irregulares. No entanto, sabe-se menos sobre os fatores psicossociais — como o apoio social e a satisfação profissional — que podem ajudar a atenuar estes efeitos negativos. Com base na Teoria dos Eventos Afetivos e no modelo de Exigências e Recursos do Trabalho, este estudo procurou aprofundar a compreensão destas dinâmicas em populações que trabalham por turnos.

O estudo teve três objetivos principais: (1) examinar as relações entre perturbações do sono, fadiga crónica e apoio social; (2) explorar se a satisfação profissional modera a relação entre fadiga crónica e perturbações do sono; e (3) gerar conhecimentos que possam informar intervenções no local de trabalho para promover a saúde do sono e o bem-estar em contextos de trabalho por turnos. Foi utilizado um desenho de estudo transversal e quantitativo, com a recolha de dados de 74 trabalhadores por turnos — incluindo tripulantes de voo (pilotos e assistentes de bordo) e pessoal não aeronáutico (funcionários de terra e trabalhadores administrativos) — através de questionários validados que avaliaram perturbações do sono, fadiga crónica, apoio social (com foco na coesão e intimidade familiar) e satisfação profissional. Os dados foram analisados através de análises de correlação, regressão e moderação, com recurso a bootstrapping para reforçar a fiabilidade dos resultados.

Os resultados confirmaram a primeira hipótese, revelando uma relação positiva e significativa entre perturbações do sono e fadiga crónica, sendo que as perturbações do sono explicaram aproximadamente 33% da variância na fadiga. A segunda hipótese também foi confirmada: níveis mais elevados de apoio social estiveram associados a menos perturbações do sono, explicando cerca de 38% da variância. A terceira hipótese foi parcialmente confirmada: a satisfação profissional moderou a relação entre fadiga crónica e perturbações do sono, mas este efeito só foi

estatisticamente significativo em níveis baixos de satisfação profissional. Em níveis mais elevados de satisfação, a ligação entre fadiga e perturbações do sono deixou de ser significativa.

Estes resultados sugerem que o apoio social e a satisfação profissional podem funcionar como fatores de proteção na redução das perturbações do sono e da fadiga em contextos de trabalho por turnos. Embora o efeito moderador da satisfação profissional tenha sido apenas parcialmente confirmado e limitado por constrangimentos de medição, os resultados estão em linha com modelos teóricos existentes que destacam o papel dos recursos emocionais e sociais na gestão do stress ocupacional. Os resultados sublinham também o potencial de intervenções no local de trabalho que visem reforçar o apoio social e a satisfação profissional para melhorar a qualidade do sono e reduzir a fadiga.

Em conclusão, este estudo oferece contributos preliminares mas relevantes sobre a complexa interação entre trabalho por turnos, sono, fadiga e fatores psicossociais. São necessários estudos futuros com amostras maiores e mais diversificadas, para validar estes achados e apoiar o desenvolvimento de intervenções específicas que promovam o bem-estar das populações que trabalham por turnos.

Palavras-chave: sono, fadiga, apoio social, satisfação profissional, trabalhadores por turnos, tripulantes de voo

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Chapter 1: Introduction

This chapter will focus on the grounded theories that explain the interplay between sleep, fatigue, and social support among aircrew members and shift workers who are non-aircrew members. Air travel is one of the most widely used modes of transportation globally. In this sector, aircrew have a special type of shift that are the rosters, where the working schedules are irregular. Therefore, it is crucial to understand the variations and nuances of working in this specific type of shift, as well as the possible associated risks for safety concerns and the well-being of these employees. The main goal of the literature review is to analyze and summarize the theoretical findings, research outcomes, and possible empirical gaps related to sleep, fatigue, and social support among shift workers.

The International Labor Office described shift work as a method of labor organization where workers succeed one another at the workplace, allowing the enterprise to operate beyond the regular daytime working hours, covering the 24-hour period of the day (International Labour Organization, 1990a).

However, the concept of shift work has existed since the very early stages of humanity, when the work schedule was mostly based on daylight and seasonal changes, establishing morning and daytime as a labor norm (Moore-Ede & Richardson, 1985).

As societies developed, the need for continuous attention and maintenance of certain tasks through the night hours emerged. The very primitive examples were mostly represented by the food distributors, military, and farming industries (Waterhouse et al., 2002). These types of labor could be considered the origins of shift work scheduling, later on resulting in more structured and demanding shift work patterns (Smet et al., 2020).

As history evolved, shift work was significantly transformed during the Industrial Revolution when mechanized production factories began to operate all around the clock to maximize output (Biriowu, 2023). During the 20th century, the necessity for operating in non-regular hours was widespread in different sectors such as healthcare, public safety, and transportation (Zoch et al., 2021). These trends became more prominent and significant with the outbreak of the Second World War which increased the demand for continuous production to support military operations and maintain safety (Glazner, 1991).

The further impact of globalization and digital technologies facilitated the increased demand for continuous operations all around the clock. According to research by Clark et al., nearly 12% to 13% of workers perform rotational shifts, and at least 10% - 30% of workers operate on night shifts at least once a month (Clark et al., 2023). According to Silva et al., approximately 15 million full-time wage and salary workers in the United States work on shifts that fall outside the traditional 9-to-5 schedule (Silva et al., 2020)

Due to the large demand, shift work has been extensively studied over the decades. The results revealed that shift work negatively affects workers' health, leading to chronic sleep deprivation, increased fatigue, and a higher risk of cardiovascular diseases, metabolic disorders, and mental health issues such as anxiety and depression (Glazner, 1991). Our study will discuss sleep displacement and fatigue, emerging from circadian misalignment, and evaluating the role of social support in mitigating the negative effects of shift work.

Chapter 2: Literature review

2.1. Correlation Between Shift Work Components and Sleep Disturbances

Studies demonstrated a negative correlation between shift work and sleep problems due to circadian misalignment that leads to sleep disturbances and results in negative health outcomes (Al-Hrinat et al., 2024; Boivin et al., 2021). American Psychiatric Association identified sleep disturbances as various impairments of quality, quantity and duration of sleep that results in insomnia, distortions of sleep wake cycles and poor sleep quality. Sleep disturbances can be transient or chronic depending on the number of factors such as work environment, lifestyles, medical conditions and psychological disorders (American Psychiatric Association, n.d.). The association between shift work and sleep disorders was mostly explained by shift types and shift cycles. Shifts can be organized in various ways but generally are presented by two main categories: fixed shifts and rotating shifts (Toupin et al., 2014).

Fixed shift workers perform duties daily on the same allocated time, while rotating shift workers are assigned to a specific shift that varies regularly during a given period of time. The most prevalent shift systems are represented by morning/afternoon and afternoon/evening working time and three shift systems where morning/ afternoon/evening, where the night period is also covered (Åkerstedt et al., 2022).

Shift cycles differ in terms of direction and speed of rotations. The direction can be clockwise also known as "phase delay" or "forward rotation," (morning/afternoon/night), or counterclockwise that is known as "phase advance" or "backward rotation," (afternoon/morning/night), with differing intervals between shifts. Speed of rotations represents the number of working days before changing shifts. Rotations can be fast (every 1, 2, or 3 days), intermediate (every week), or slow (every 15, 20, or 30 days). This factor significantly affects the number of consecutive night shifts and rest periods (Hung, 1997).

These two components of the shift system significantly impair sleep-wake cycles (De Roeck et al., 1990). Sleep and wake cycles are regulated by the endogenous biological clock – circadian rhythms that drive for increased alertness during the day hours and decreased alertness and propensity to fall asleep during the night hours. These rhythms are synchronized by the light/dark cycle. The sleep pressure, also designated by the homeostatic pressure for sleep, accumulates during the wake time (Latta & Van Cauter, 2003).

Poor sleep quality was primarily associated with working nights because of circadian misalignment and homeostatic sleep debt (Lim et al., 2020; Boivin et al., 2021b). Numerous studies have shown that sleep deprivation alone can negatively impact performance and alertness in night shift workers (Ganesan et al., 2019a, Vidaček et al., 1986). This impairment was comparable to the effects of consuming 0.19 % alcohol (Elmenhorst et al., 2018).

However, some studies have shown that a permanent night shift may be more advantageous due to better adjustment of circadian rhythms (Folkard, 2008). However, there is not enough evidence supporting this finding (Härmä et al., 1994; Nabe-Nielsen et al., 2024). A study conducted among nurses indicated that sleep issues tend to increase with the number of consecutive night shifts. The findings indicated that nurses who worked more than 10 nights reported poorer and shorter sleep quality compared to those working less than 10 nights in a month (Chaiard et al., 2019).

On the other hand, shift workers performing early morning shifts experienced similar sleep disturbances to workers performing night shifts and greater sleep deprivation than workers on day shifts. This can be explained by the fact that workers need to wake up

before 5 am and be active during the nadir of circadian alertness - the lowest alertness point across the day (Zitting et al., 2023). Multiple studies confirm that early morning and night shifts disrupt the sleep-wake cycles more than afternoon shifts, causing excessive sleepiness and insomnia (Y. Peng et al., 2024b; Zitting et al., 2023b). Tilley's study reported that early-morning workers had 1h less sleep compared to afternoon workers (Tilley et al., 1982). Another study indicated that night workers experienced the highest levels of sleepiness as opposed to afternoon workers (Arifah et al., 2019; Da Silva et al., 2017). In a study conducted with aircrew members, both Short-Haul (SH) and Long- Haul (LH) Flight Duty Periods (FDP's) covering the entire night (from 12 to 6 AM at home base) were consistently associated with reduced sleep-wake ratio and subjective alertness. So, performing duties during the early morning and night shifts means that a worker should be awake when alertness is decreased and sleep when alertness is high. This opposes the natural biological clock and leads to short sleep durations and poorer sleep quality (Sallinen et al., 2017).

However, not only type of shifts can influence sleep, but also the regularity of the shifts, namely fixed or rotational shifts (Chang & Peng, 2021). Despite several studies conducted on fixed and rotational shifts, there is no significant evidence to conclude which one can impair sleep more. However, it is assumed that rotating shifts pose more challenges for shift workers due to the speed and direction of rotations (Ganesan et al., 2019b). Rapid shift rotations within a week were found to reduce sleep durations in contrast to slow speed rotations, for example at least two weeks for one shift. Furthermore, forward rotation is considered more beneficial because it better aligns with the biological clock (Postnova et al., 2014).

According to Di Muzio et al findings revealed that workers on forward rotating shifts slept more on morning shift days compared to workers on backward rotations (Di Muzio et al., 2021). Shon's study explored the effects of speed direction change by switching the experimental group of workers from forward rotation to backward rotation. The results showed that the experimental group experienced problems with waking up and troubles with falling asleep. In contrast, the control group did not report any changes. Moreover, the sleep problems experienced by the experimental group were associated only with evening shifts which confirmed that the direction of shift rotation might be less important than the presence of quick returns (Shon et al., 2016).

Another study confirms the above-mentioned results by stating that nurses working on backward rotational shifts showed more symptoms of sleep deprivation and excessive sleepiness than those on forward rotating shifts (Albakri et al., 2024). These results showed that sleep is not only affected by the direction of rotations but also by the speed of rotations. Several studies reported that fast rotations are more beneficial for physical health showing a constant improvement in sleep and fatigue levels (Botzum & Lucas, 1981; Hakola & Härmä, 2001). However, there is evidence suggesting that shift types do not have a significant effect on sleep patterns (Lecca et al., 2021).

2.2. The Role of Social Support

The specific shift arrangement factors such as hours, shift length, flight duration were the key constraints that were approached through work hours limitations that served as the first methodology of fatigue management. One of the limitations of this system was that being fatigued or impaired were solely associated with working time schedules as rule of thumb disregarding psychological and mental fatigue (Chang et al., 2019). As a result, this system has a very poor considerability in terms of predicting impairment with respect to safety concerns (Greubel et al., 2010).

These limitations facilitated several studies on psychological factors that influenced fatigue levels and sleep disturbances in the shift work context including sleep management, lifestyle choices, cognitive behavioral techniques and workplace interventions. However, a pioneer but often overlooked factor of fatigue mitigating techniques is the role of social support (Jason et al., 2003).

Social support, particularly in the form of family experience, which includes emotional and practical assistance emerges as a crucial factor for sleep disturbances and fatigue because it helps individuals to cope with the effects of fatigue (Acoba, 2024b). While studies have shown correlations between social support, sleep quality, and fatigue, the extent to which social support directly affects fatigue is subject to ongoing research among nurses (Ruisoto et al., 2021). Specifically, it was found that social support contributes to a positive work environment and better mental well-being in a workplace context (King et al., 2012). This phenomenon is especially important for shift workers due to unpredictability of their work schedule where balancing work, personal life, and family responsibilities plays a

crucial role in their mental and physical health (Barnett & Gareis, 2007; Estryn-Béhar & Van Der Heijden, 2012).

The unique role of social support as a predictor of sleep disturbances can be explained by the disengagement with family circles and closed ones as a result of operational demands (Nordin et al., 2005). According to the study conducted by Cooper and Sloan: when investigating the mental health or psychological well-being of shift workers, it becomes evident that a combination of factors related to work, personal life, and family life significantly contribute to one's overall health. Poor mental health is not solely linked to factors such as fatigue and a lack of job responsibility, but also to the absence of opportunities for relaxation and social support from friends, family, and colleagues. (Cooper & Sloan, 1985b; Zhu et al., 2023).

Coherently, study suggests that inadequate social support negatively affects sleep patterns (Hale, 2010). Runeson et al found that pilots reporting low levels of workplace support are more likely to experience sleep problems, emphasizing the potential impact of relationships and support mechanisms on the sleep quality (Runeson et al., 2011). Additionally, Drury, Ferguson, and Thomas's study on restricted sleep and negative affective states in commercial pilots during short-haul operations underlines the potential impact of inadequate sleep on pilots' emotional well-being (Drury et al., 2012).

Another study reported that a supportive home environment can reduce sleep disturbances for shift workers (Newey & Hood, 2004). This finding supports the results of previous research studies revealing that social support at work and home helps to cope with stress and mitigate fatigue levels which can potentially improve the sleep quality and duration as discussed above (Boumans & Landeweerd, 1992; Gray-Toft & Anderson, 1983). Sinokki et al also stated that inadequate social support leads to poor sleep quality and fatigue (Sinokki et al., 2010).

Therefore, the lack of social engagement and poor assistance of family and colleagues lead to sleep disturbances that result in chronic fatigue. However, the role of social support in shift work context has remained relatively uncharted territory due to the lack of studies especially in the context of aviation. The existing literature on sleep complaints and fatigue among airline pilots underscores the critical importance of

investigating the relationship between these factors and social support within the aircrew community (Reis, 2016). We believe that social support has a far-reaching consequence for shift workers and fatigue management as a consequence of irregular schedules, situational pressure, family separation, and different lifestyles of shift workers (Wadsworth & Owens, 2007). Therefore, it is essential to consider different aspects of social support while designing and implementing interventions to decrease sleep disturbances for shift workers. While there is evidence that sleep disturbances are a strong predictor of fatigue and social support can potentially decrease the sleep disturbances, the impact of these factors is not obvious for different individuals in a shift work environment due to personal psychological attributes.

2.3. The Role of Job Satisfaction

Research suggests that sleep disturbances, specifically insomnia, is linked with affective states and can be represented as emotion due to the association with a range of negative emotional experiences (Ekman & Davidson, 1994). Despite numerous studies on emotions, researchers still have difficulty defining the exact definition. Although, the majority agree that any emotion is the reaction to a certain state (Frijda, 1994; Watson, 2000). In this sense, affective states are the combination of mood and emotion experiences by an individual caused by specific events (Weiss & Cropanzano,1996). This correlation leads to the question of how sleep disturbances influence the affective states.

Kamphuis and Lancel found that reduced sleep quality negatively affects one's well-being leading to feelings of anger and fatigue. Scientific research also confirms that sleep loss negatively affects cognitive functions namely decision-making ability and ability to control emotions (Kamphuis & Lancel, 2015). Furthermore, Zohar et al revealed that sleep loss leads to decreased motivation due to negative emotional reactions that results in difficulties in completing tasks (Zohar et al., 2005). This idea is supported by neuropsychological studies showing that the prefrontal cortex responsible for reactions and attention span is the most affected area by the sleep disturbances. These assertions imply that individuals will have difficulties in completing tasks and lose their motivation that leads to increased fatigue and results in decreased performance (Petiau et al., 1998). Consequently, there is a link between negative emotions, sleep disturbances and job satisfaction (Scott & Judge, 2006b).

Affective Event Theory suggests, emotions in the workplace are shaped by certain events, such as sleep loss or fatigue, and these emotional states, in turn, impact the job satisfaction levels (Williams et al., 2023). Studies have indicated that people who suffer from sleep deprivation are prone to make errors, and have lower levels of concentration. Consequently, their overall productivity is likely to diminish (Van Dongen et al., 2003b). This decline in performance may lead to feelings of frustration and dissatisfaction with one's job. These negative emotions subsequently intensify feelings of fatigue (Reiner & Krupinski, 2011). Based on this evidence, it is believed that job satisfaction may act as a buffer between sleep disturbances and fatigue (Scott & Judge, 2006c; Ye et al., 2023a).

Therefore, it is important to understand how job satisfaction relates to chronic fatigue and sleep disturbances in the workplace. Job satisfaction could be defined as the emotional reaction an individual has toward their work that is influenced by several factors, including the nature of the job, working conditions, and personal experiences (Tripathi & Chaturvedi, 2023). Another study revealed that employees experiencing high levels of job satisfaction are more likely to perceive workplace challenges, such as chronic fatigue, as manageable. Consequently, this perception, on the other hand, could mitigate the negative effects of sleep disturbances that relate to fatigue (Theofilou et al., 2022). Scott and Judge found that job satisfaction significantly moderates the relationship between sleep quality and fatigue (Scott & Judge, 2006b). Similarly, research by Omar et al has shown that job satisfaction can help employees to recover from sleep deprivation and fatigue faster (Omar et al., 2020).

These findings are consistent with the Job Demands-Resources (JD-R) model which states that job satisfaction can help to reduce the effects of work demands such as long hours or shift work, unpredictability of rosters and rotational shift schedule (Scholze & Hecker, 2024). It was found that individuals experience difficulties in overcoming sleep debt given that chronic fatigue is closely linked with sleep disturbances which in turn amplifies feelings of exhaustion and emotional distress (Gotts et al., 2015; Jou & Pace-Schott, 2024). Conservation of Resources Theory (COR) supports this idea by showing that job satisfaction can be seen as the physiological resource that helps shift workers to overcome fatigue (Bon & Shire, 2022; “Conservation of Resources Theory,” 2022).

Another study found that job satisfaction is negatively correlated with fatigue and sleep disturbances (Barnes et al., 2013). According to Pebriasanty et al., job satisfaction functions as a psychological buffer by decreasing the emotional pressure of stressors such as fatigue and sleep disturbances for employees (Pebriasanty et al., 2024). Therefore, they can demonstrate greater resilience in the face of work-related stressors which is essential to consider for shift workers as they are particularly vulnerable to sleep disturbances and fatigue.

2.4. Aims and Objectives of this Dissertation

While extensive research has been dedicated to exploring the determinants of sleep and fatigue among shift workers, a notable research gap persists concerning the mitigating strategies (Swaminathan et al., 2024). While studies have shown correlations between social support, sleep quality, and fatigue, the extent to which social support directly affects fatigue is subject to ongoing research (Abolhassani, 2024). Job satisfaction was found to be linked with sleep disturbances and fatigue and can't be overlooked while designing the interventions for shift workers (Chae & Ryu, 2023).

The goal of the present study was to identify the relationships between sleep, fatigue, social support and the moderating role of job satisfaction. The research aims to identify factors contributing to fatigue and sleep disturbances as well mitigating strategies for shift workers. The study may reveal variations in the impact of social support and job satisfaction on sleep quality and fatigue. Findings will contribute to a deeper understanding of the complexities affecting shift workers well-being. The current study will explore the following hypotheses.

H1: There is a statistically significant positive relationship between Chronic Fatigue and Sleep Disturbance.

H2: There is a statistically significant negative relationship between Social Support and Sleep Disturbance.

H3: Job Satisfaction Moderates the Relationship Between Chronic Fatigue and Sleep Disturbances

Chapter 3: Methods

3.1. Participants

All participants were approached via a link to an online questionnaire in the Qualtrics platform. The responses were collected from 15.03.2024 to 25.07.2024. Before assessing the questionnaire, the participants were informed about the goals of the study and were given the right to withdraw. The participation was anonymous and voluntary, there was only one item that was mandatory – confirmation that the participant is older than 18 years and that it was their free willing to participate in the study. The study was reviewed and approved by the Ethics Committee for Technology, Social Sciences and Humanities (CETCH) of Catholic University of Portugal (18.01.2024).

3.2. Data Handling and Statistical Approach

This section includes results for descriptive and then inferential analysis for the main study hypotheses. The first section includes information regarding missing data handling and calculation of the required sample size. The software used for analysis was Jamovi Version 2.4.(The Jamovi Project, 2023). Furthermore, the power analysis was performed by G*Power 3.1.9.7. (Faul et al., 2007).

The second part includes descriptive statistics of demographic variables such as Age, Social Status, Gender, Sex, Employment Status, Hours Worked per Week, Total Tenure and 4 single item questions on frequency of self-perceived problems sleep problems, social life, domestic and family life and lastly frequency of receiving a lack of social support from colleagues at work.

After demographics, the section includes univariate descriptive statistics for the main study variables including reliability and construct validity analysis. Confirmatory factor analysis is used for the latter. The interpretation of model fit indices is based on Hu and Bentler (1999) as follows: a good fit when Chi^2 >0.05, NFI/TLI >0.95, CFI >.96, RMSEA<.08.

A priori power analysis was performed (Faul, Erdfelder, Lang, & Buchner, 2007). For moderation analysis, we needed 107 observations to achieve a statistical power of 95%

at alpha rate 5% (moderate effect size with 2 single and 3 total predictors). For bivariate regressions (H1 and H2) with 1 predictor, medium effect size and power of 95%, the required sample size reached 134. The final sample included 74 observations, thus post-hoc power calculation revealed that the actual observed power achieved in the study with 74 cases equals to β=0.76 for H1 and H2 while β=0.84 at Alpha error prob .05, 2 predictors and 3 overall variables for moderation analysis (H3).

For the purposes of this thesis, 74 participants' data were considered in the analysis. Originally, 88 participants voluntarily agreed to participate in research and started to fill in the questionnaire. However, only 74 (84%) completed assessment on at least one current study's constructs of interest – job satisfaction, social support, sleep disturbance and chronic fatigue. Final dataset was screened for missing values (for details see Table 1) and it was decided that these missing values are nonignorable. The dataset revealed a clear pattern as follows: 14 participants provided responses only to the first part of the questionnaire (demographics) and decided to withdraw. For analysis for patterns of missing values see Appendix (Table 1, 2 and Figure 1, 2).

As such, no data was recorded for measurement of the main variables of this study (response to Age, Social Status, Measurement of Social Support). No imputation method for missing values in this scenario is recommended for entries with this observable trend (Alison, 2001). As a result, the row entries numbered 12, 17, 35, 38, 42, 43, 44, 45, 49, 75, 76, 81, 83 and 84 were deleted from further analysis.

Deletion of input from 14 respondents resulted in 74 participants considered for description of demographics and main analysis. As the sample size was relatively small and in order to avoid increased measurement error due to imputation of missing data arbitrarily, the main analysis was relying on bootstrapped methods to maximize truthfulness of actual reality as represented by data entries of 74 participants. All participants were included on descriptive measures of Age. The youngest participant was 19 years old, while the oldest was 65 years old. The range was 46 indicating a quite large variability (*SD*=11.7). The majority 48 (65%) were married or living with the partner, followed by being single (22%), only 3 participants were either widowed, divorced or live separated. The sample was overrepresented (n=44) by males relative to females (n=28) and there were 2 participants selecting the option to not reveal the gender or other. Out of 74 participants, more than third

indicated having only one full time employment whereas 7 participants had more than one full time employment. The majority 54 (77%) of 74 participants revealed to work a maximum of 40 hours per week, while 16 participants indicated to work between 40 to 60 hours per week. The sample included respondents working in the company from a few months (0 years) to 36 years. Seventy-five percent of the sample respondents have stayed in the company 20 years or less years. For details see Section of Sample Descriptive Statistics in the Results section.

3.3. Design

This is a quantitative, non-experimental correlational research study with a convenient sampling method and cross-sectional design.

3.4. Measurements and Instruments

The questionnaire was used to assess main study variables and collect data on demographics. The full version of the questionnaire included 39 questions. For demographics, the respondents were asked to indicate Age, Social Status, Number of years worked with the company, type of crew (ground, air) and frequency of problems related to sleep, social life, occupational and family life and lack of support received from colleagues at work to address life issues. The frequency of problems was addressed via a single item using a 5-point Likert type scale (never, always). Higher numbers indicate higher frequency of problems in specific areas.

The construct of social support was assessed via standardized questionnaire: 4EverFamilyQuestionnaire (Costa-Ramalho & Rebelo-Pinto, 2022). This questionnaire assesses family cohesion and intimacy. For all other measures, we used the Standard Shiftwork (Barton et al., 2007). The questionnaire followed guidelines for measurement of job satisfaction, sleep disturbances, chronic fatigue. The final version of the questionnaire is organized into 4 distinct parts.

(i) General Biographical Information: consisting of 16 questions that access general bibliographic information (age, gender, household situation, social status, experience with shift work, specific role, types of flights and most challenging areas of life due to shifts). The majority of the questions are represented by multiple choice and open questions options,

for example: *"What type of flight/work do you do? "How does your partner feel about your working shifts?".*

(ii) Shift details consisting of 7 questions: time and duration of the shifts, preferred schedule, regularity and frequency of shifts, expected workload and assessment of the general satisfaction. The individual measurements include such questions as: *"Rate your workload in comparison to the average workload of other people performing a similar job in other parts of your organization, "Are required to change your roster/shift schedule at short notice"* accessed by a 5 Likert-type scale.

(iii) Sleep and fatigue measures are organized in 13 questions relating to timing and duration of sleep and naps between successive early morning shifts, morning shifts, afternoon shifts, night shifts, days off; quality of sleep, difficulties associated with irregularities of circadian rhythms, physical health questions referring and fatigue assessment.

(iv) Job satisfaction was measured using the General Job Satisfaction Scale from the Job Diagnostic Survey (Hackman & Oldham, 1975). The scale consists of five items designed to assess the degree to which employees are satisfied and happy with their job overall. Respondents rated their agreement with each item on a 7-point Likert scale ranging from 1 (*disagree strongly*) to 7 (*agree strongly*), with a mean score computed. Items B and E were reverse-coded before calculating the total score, in accordance with the standard scoring procedure. The scale has demonstrated good internal consistency in prior research, with reliability coefficients ranging from $\alpha = 0.76$ to 0.77 (Hackman & Oldham, 1975). In this study, the scale also showed strong internal consistency (Cronbach's $\alpha = 0.82$).

3.5. Procedure

In March 2023, the survey was distributed via anonymous link among airline associations and public corporate company employees. The survey included the measurements of all necessary instruments (see instruments section). Respondents were informed that their answers were anonymous and that were going to be used solely for the purpose of the study with the deletion of data upon completion of the study. Participants were also informed that they could withdraw from the study at any time.

Participants were informed that the questionnaire was part of a master's thesis project conducted at the Portuguese Catholic University in the Lisbon campus, aiming to investigate the relationships between sleep, fatigue, social support and the mediating role of job satisfaction among shift workers. No particular goals of the study or hypotheses were disclosed. Participants had to give their consent to participate in the study.

The questionnaire was performed in the Qualtrics electronic platform and consisted of 39 questions divided into 5 blocks and the estimated time for complexion was approximately 30 minutes. Researchers also provided an email address in case of any questions related to the study.

Chapter 4: Results

4.1. Sample Descriptive Statistics

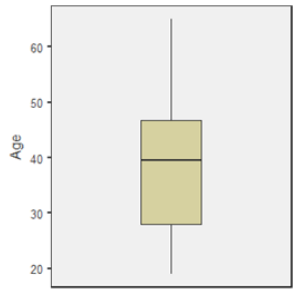
For details of the Measures of Age, Social Status, Sex, Employment Status, Hours Worked per Week, Total Tenure and 4 single item questions on frequency of self-perceived problems in sleep, social life, domestic and family life and lastly frequency of receiving social support from colleagues at work see Table 1 in addition to below sections.

Age

Overall, 74 participants were included on descriptive measures of Age from 19 to 65 years old. The range was 46 indicating a quite large variability (*SD*=11.7). The median score (*Mdn*=39.5) was slightly higher than the average (*M*=38.2, *SE*=1.36), however the distribution was following approximately normal distribution (Shapiro's Wilk, $p>0.05$) with small positive skew and <-1 platykurtic shape. Seventy-five percent of all study participants were 47 or younger, the sample was pretty homogeneous judging based on absence of outliers (See Table 1 and Figure 1).

Figure 1

Boxplot of Age, n=74

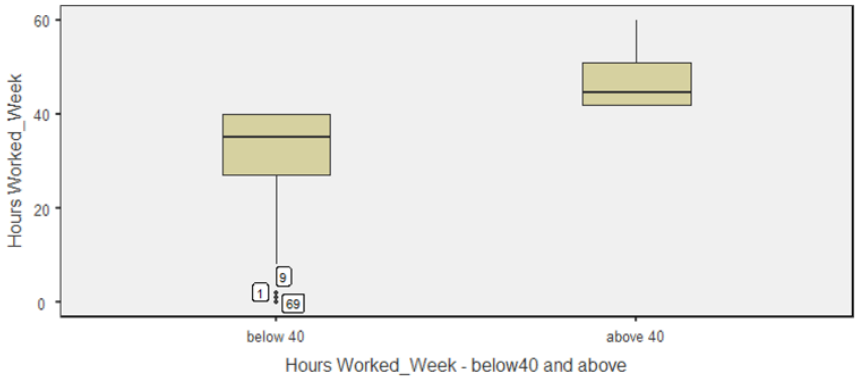


Hours Worked Per Week

The majority (54, 77%) of 74 participants revealed to work a maximum 40 hours per week, while 16 participants indicated to work between 40- 60 hours per week. Interestingly, 21 out of 74 claimed to work exactly 40 hours. Median split was performed on data recorded for the number of hours worked per week. In a group below 40 hours (n=54), the scores ranged from 0 up to 40, with median value of 35 and average of 31. The distribution was negatively skewed (skew=-1.51, SE_{skew}=.32) and leptokurtic (kurt= .32, SE_{kurt}=.64) with multiple modes. Data was normally distributed as assessed by Shapiro's Wilk test (p>.05).

Figure 2

Boxplots of 2 Categories Based on Number of Hours Worked Per Week



Note: Lower limit outliers for group blow 40 (cases 1, 9, 69 with the values 1, 2 and twice 0.

For the group with the number of hours above 40 (n=16), the average hours worked per week equals to a value of 47.9, slightly higher than the median (Mdn=44.5). We observed a lower range (min=42, max=60) compared to the first group, range of 38. The distribution was not normally distributed (Shapiro's Wilk test, $p<.05$) due to mainly low sample size with excessive negative skewness (-1.51) and moderate platykurtic shape (kurt= -.4) and multimodal. As such, any analysis based on type of crew would need to be performed via nonparametric statistical analysis instead of parametric.

Social Status

For the measure of social status, the respondents were prompted to select one of 5 options. The majority (48, 65%) were married or living with the partner, followed by being single (22%), only 3 participants were either widowed, divorced or live separated. The response distribution was not equal by categories suggesting that the sample was heavily biased in direction of participants who were married or living with the partner.

Employment Status

Out of 74 participants, more than third indicated having only one full time employment whereas 7 participants had more than one full time employment.

Tenure

Seventy participants provided data on measurement of tenure within the company. The respondents were asked to indicate the length of tenure with the company in years. The results showed that the sample included respondents working in the company from a few months (0 years) to 36 years. Seventy-five percent of sample respondents have stayed with the company 20 or less years. The most frequent tenure was up to 1 year (n=12) followed by tenure of 1 year (n=7). Half of all participants indicated working with the company equal or less than 7 years (Mdn=7). Top 5% of the sample (n=4) reported tenure between 34 and 36 years. Overall, 5 scores were detected with z value 1.89. The values varied a lot (SD=11.42).

Despite the high range, there were no outliers detected in the original scores (See Figure 3). The distribution was asymmetrical, with a skewness of .7 (SE = .29), and platykurtic, with a kurtosis of -.7 (SE = .56). This is further supported by the statistics: M=11.6M, Mdn=7 and Mode=0. The data did not follow a normal distribution, as assessed by the Shapiro-Wilk test ($p < .001$). However, given the sufficient sample size ($n > 30$), normality can be assumed based on the Central Limit Theorem.

Figure 3

Histogram of Tenure (n=70)

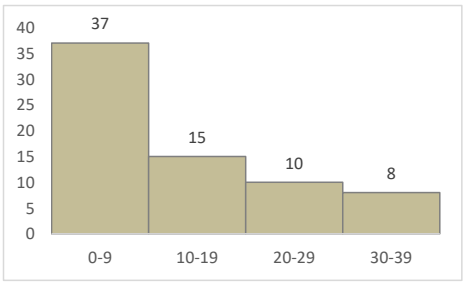
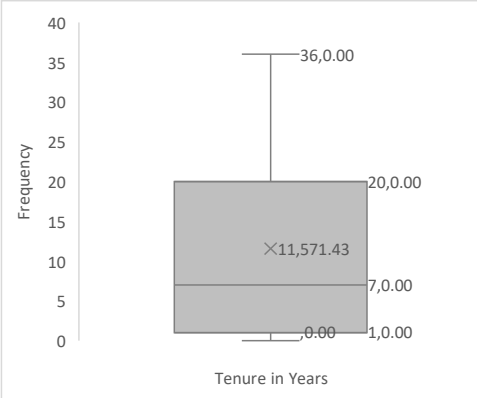


Figure 4

Boxplot of Tenure Without Outliers



Note: Group 1 (0-3 years inclusive) n=25, Group 2 (3 exclusive-16 inclusive) n=23, Group 3 (16 exclusive -36 inclusive), n=22, Cases 49 and 53 with value of 3.

Intrapersonal Perception of Problems Severity

Furthermore, the demographic part of the questionnaire included 4 self-evaluative questions on frequency of usual problems perceived in specific life areas: sleep, social life, support received from colleagues as a response to life challenges and problems with domestic/social life. Each of those questions were assessed on a 5-point Likert type scale (1- never, 5-always). A high score indicates higher severity of self-perceived problems. The responses for measure of frequency of social support received from colleagues at work on work-related issues was reverse scored.

The full sample univariate analysis revealed, that the respondents subjectively evaluated problems with sleep as the most severe for Sleep (*M*=3.46, *SD*=1.18) followed by Self-perceived lack of social support received from colleagues at work (*M*=2.95, *SD*=1.19), problems with social life (*M*=2.92, *SD*=1.16) and problems with domestic and family life (*M*=2.61, *SD*=1.18) following this order. The scores for 1-item assessment of each life area were averaged. The full sample average for measure of self-perceived frequency of intrapersonal problems equals to 2.98 (*SD*=.71), with moderately positively

skewed distribution with leptokurtic shape. The analysis of boxplots for each area did not reveal any outliers except problems with sleep which had 4 outliers. All data was kept in analysis despite Shapiro's Wilk's indication of non-normal distribution for four indicator scales and also computed average. The data was assumed to be normal based on Central Limit Theorem (n>30) (Chang et al., 2006). To conclude, the sample seems to experience problems with all aspects of life at least sometimes (M=3).

Table 1.

Demographics of Study Sample

Variable	*n final*	*F,t(df), d/χ^2(df)*	*M±SD*	*Mdn*	*Min*	*Max*	*Skew*	*Kurt*	*Shapiro's Wilk*
Crew Type	72								
Cabin Crew	50 (69%)	10.9** (1)							
Ground Crew	22 (31%)								
Age	74		38.2±11.7	39.2	19	65	.17	-.97	.96*
Social Status	74	115** (4)							
Married/Cohabitating	48 (65%)								
Single	22 (30%)								
Separated	2 (3%)								
Divorced	1 (1.5%)								
Widowed	1 (1.5%)								
Sex	74	36.4**(2)							
Male	44 (60%)								
Female	28 (38%)								
Other	2 (2%)								

Employment Status	74	48.6**(1)							
One FTE	67 (91%)								
Two or More FTE	7 (9%)								
Hours Worked Week	70	20.6**(1)	35.1±12.1	40	0	60	-.89	1.56	.91**
Below 40 hours/week	54 (77%)								
Above 40 hours/week	16 (23%)								
Tenure in Years	70		11.6±11.4	7	0	36	.76	-.64	.87**
Frequency of Problems Severity	74		2.98±0.71	3	1.5	5	.3	.0	.97
Problems With Sleep	74		3.46±1.18	3	1	5	-.3	-.8	.89*
Problems with Social Life	74		2.92±1.16	3	1	5	.1	-.7	.92*
Problems with Domestic and Family Life	74		2.61±1.18	3	1	5	.4	-.4	.89*
Lack of Social Support at Work	74		2.95±1.19	3	1	5	.3	-.9	.89*
Social Support	74		3.75±1.01	3.8	1	5	-.9	.5	.92**
Sleep Disturbance	40		3.19±0.47	3.1	2.2	4.4	.6	.8	.98
Job Satisfaction	53		4.39±1.44	4.2	1	7	.01	-.3	.97
Chronic Fatigue	42		2.84±0.94	2.9	1	4.8	-.01	-.4	.98

16%

Figure 4

Data Distribution of 74 responses to 4 Self-rated Items on Frequency of Perceived Problems

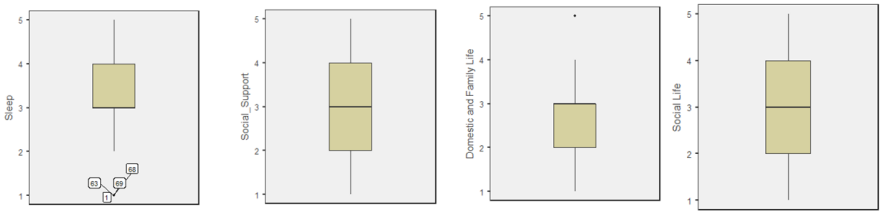


Figure 5

Distribution of Average Frequency of Perceived Problems

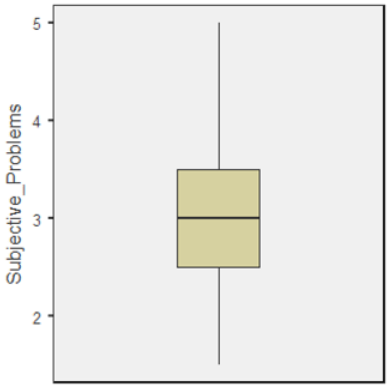


Table 2 displays intercorrelation between average sample perceptions of frequency of problems occurring in 4 life areas. Hierarchical multiple regression was run in order to find out what was the relative contribution of each life area to the overall score of perceived problems. Perception of problems in family explained 69% of overall problems, F (1, 72) =163, p<.001, addition of domestic and family life problems statistically significantly increased explanation by 8 %, F (1, 71) =24.1, p<.001; addition of problems with sleep by additional 10%, F (1, 70) =53.9, p<.001. As such, the remaining 13% was explained by

frequency of self-perceived social support at the workplace, $F(1,70) = 67.7$, $p < .001$. Nevertheless, the consistency of overall problems scale was not ideal (Cronbach's Alpha = .62) thus grouping 4 questions into one factor should not be considered as an overall measure of self-perceived severity of problems in 4 life areas. For intercorrelations between individual problems and overall mean total problem score see Table 2.

Table 2

Intercorrelations Of Four Aspects of Severity of Perceived Life Problems and Average

		Sleep	Social Life	Domestic and Family Life	Lack of Social Support	Subjective Problems
Sleep	Pearson's r	—				
	df	—				
	p-value	—				
	95% CI Upper	—				
	95% CI Lower	—				
Social Life	Pearson's r	.372 **	—			
	df	72	—			
	p-value	.001	—			
	95% CI Upper	.553	—			
	95% CI Lower	.157	—			
Domestic and Family Life	Pearson's r	.268 *	.687 ***	—		
	df	72	72	—		
	p-value	.021	< .001	—		
	95% CI Upper	.468	.791	—		
	95% CI Lower	.042	.543	—		
Lack of Social Support	Pearson's r	-.021	-.234 *	-.171	—	
	df	72	72	72	—	
	p-value	.859	.045	.145	—	
	95% CI Upper	.209	-.006	.060	—	
	95% CI Lower	-.248	-.439	-.385	—	
Subjective Problems	Pearson's r	.674 ***	.750 ***	.737 ***	.247 *	—

		Sleep	Social Life	Domestic and Family Life	Lack of Social Support	Subjective Problems
	df	72	72	72	72	—
	p-value	< .001	< .001	< .001	.034	—
	95% CI Upper	.782	.835	.826	.450	—
	95% CI Lower	.526	.629	.611	.020	—

Note. * $p < .05$, ** $p < .01$, *** $p < .001$

Social Support

The construct of Social Support (*n*=74) was measured by 4 Ever Family Questionnaire (Costa-Ramalho & Rebelo-Pinto, 2022) that recognizes 2 subscales: Intimacy and Cohesion. The internal structure for Cohesion subscale was stable (Cronbach's α=.914, *M*=3.7, *SD*=.9). For details see Table 3. Similarly, the subscale of Intimacy was internally consistent (Cronbach's α=.940, M=3.8, SD=1.1). The confirmatory factor analysis confirmed internal structure as expected – 2 subscales, data was an excellent fit to the model, CFI=.918, TLI=0.89, $\chi^2(53) = 123$, $p<.001$ (Hu and Bentler [FM2], 1999). In this case, Chi^2 test results are acceptable given that this statistic is sensitive to sample size. For details and item-factor loadings see Table 4. Table 3 displays the results of univariate descriptive statistics for total scale and two subscales.

Table 3

Results of Item Reliability Analysis: Cohesion and Intimacy Subscale

				If item dropped	
	Mean	**SD**	**Item-rest correlation**	**Cronbach's α**	**McDonald's ω**
Coh_1	3.39	1.06	.605	.918	.920
Coh_2	3.69	1.15	.796	.894	.897
Coh_3	3.84	1.18	.722	.904	.907
Coh_4	3.76	1.16	.846	.887	.889
Coh_5	3.86	1.29	.840	.887	.889
Coh_6	3.69	1.28	.750	.900	.902
Int_1	3.36	1.29	.781	.934	.936
Int_2	4.16	1.17	.851	.925	.928
Int_3	4.14	1.10	.754	.937	.939
Int_4	3.80	1.25	.882	.921	.924
Int_5	3.46	1.22	.888	.920	.924
Int_6	3.85	1.37	.780	.935	.937

Table 4

Factor loadings: Cohesion and Intimacy subscales: Social Support

Factor	Indicator	Estimate	SE	Z	p	Stand. Estimate
Cohesion	Coh_1	.654	.112	5.83	< .001	.623
	Coh_2	.926	.110	8.42	< .001	.814
	Coh_3	.914	.116	7.86	< .001	.778
	Coh_4	.998	.107	9.31	< .001	.869
	Coh_5	1.153	.116	9.96	< .001	.903
	Coh_6	1.044	.123	8.52	< .001	.820
Intimacy	Int_1	1.060	.122	8.67	< .001	.829
	Int_2	1.027	.107	9.62	< .001	.883
	Int_3	.870	.107	8.16	< .001	.795
	Int_4	1.130	.111	10.14	< .001	.911
	Int_5	1.101	.109	10.13	< .001	.910
	Int_6	1.094	.132	8.28	< .001	.803

Table 5

Summary Descriptive Statistics for Measure of Social Support (n=74)

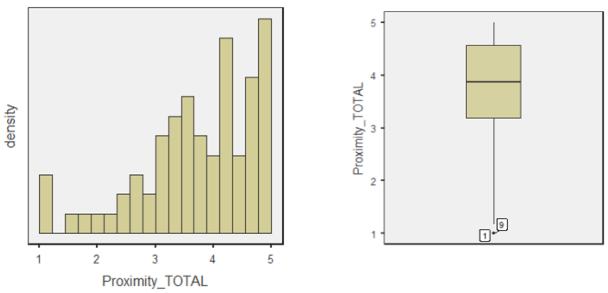
	Intimacy Subscale	Cohesion Subscale	Proximity
Mean	3.80	3.70	3.75
Std. error mean	.126	.115	.117
Median	4.00	3.83	3.88
Mode	5.00	3.83	3.33 [a]
Standard deviation	1.08	.993	1.01
IQR	1.50	1.12	1.38
Minimum	1.00	1.00	1.00
Maximum	5.00	5.00	5.00
Skewness	-.949	-.914	-.949
Std. error skewness	.279	.279	.279
Kurtosis	.249	.441	.475
Std. error kurtosis	.552	.552	.552
Shapiro-Wilk W	.899	.923	.917
Shapiro-Wilk p	< .001	< .001	< .001

	Intimacy Subscale	Cohesion Subscale	Proximity
25th percentile	3.17	3.33	3.19
50th percentile	4.00	3.83	3.88
75th percentile	4.67	4.46	4.56

[a] More than one mode exists, only the first is reported

Figure 6

Boxplot and Histogram of Total Proximity



Note: Two Lower limit Outliers were kept in an analysis as with sufficient sample size (n>30) these did not impose risk to normality of data distribution.

Chronic Fatigue

The construct of chronic fatigue was measured by 12 items from Standard Shift Worker Scale (section 2.12). The scale was internally consistent (Cronbach's α=.901, *M*=2.84, *SD*=0.94). For details of item-reliability analysis see Table 6. The confirmatory factor analysis did not support the original unidimensional nature of the scale. Particularly problematic were items "f- "*I usually feel rather lethargic*" and "j"- "*I feel weary much of the time*". Both items could be loosely understood by the respondents who were not English speakers. As such, no modification was done to the scale. For details of internal structure and item-factor loadings see Table 7. The model had a poor fit to the data, CFI=.52, TLI=.38, SRMR=.242, $\chi^2(35) = 236$, p<.001.

Descriptive statistics of the scale revealed that the respondents scored between 1 and 3.8 with the average score of 2.8 (SD=.9), similar to the Mdn-2.9. The distribution of scores was approximately normal (Skew, Kurt <±1, Shapiro's Wilk test >.05) with no outliers. See Table 1 and Figure 7.

Table 6

Item Reliability Statistics: Chronic Fatigue

				If item dropped	
	Mean	**SD**	**Item-rest correlation**	**Cronbach's α**	**McDonald's ω**
Fat_a	3.10	1.12	.693	.889	.892
Fat_b	2.60	1.33	.719	.887	.893
Fat_c	3.12	1.35	.713	.887	.890
Fat_d	2.60	1.43	.688	.889	.895
Fat_e	3.50	1.23	.713	.887	.891
Fat_f	2.19	1.21	.525	.899	.904
Fat_g	3.10	1.36	.483	.902	.903
Fat_h	2.71	1.38	.745	.885	.891
Fat_i	3.00	1.29	.716	.887	.890
Fat_j	2.50	1.23	.542	.898	.903

Table 7

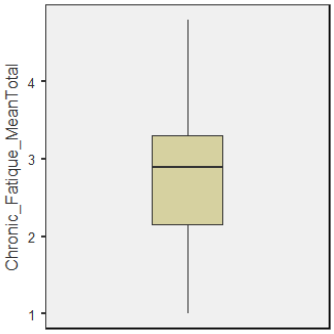
Item-Factor Loadings for Chronic Fatigue

Factor	Indicator	Estimate	SE	Z	p	Stand. Estimate
Chronic Fatigue	Fat_a	.974	.136	7.17	< .001	.878
	Fat_b	.603	.196	3.07	.002	.460
	Fat_c	1.192	.161	7.40	< .001	.895
	Fat_d	.581	.215	2.70	.007	.410
	Fat_e	1.133	.144	7.89	< .001	.929
	Fat_f	.285	.188	1.51	.130	.238
	Fat_g	1.009	.179	5.65	< .001	.752
	Fat_h	.709	.202	3.51	< .001	.518
	Fat_i	1.154	.152	7.58	< .001	.907

Factor	Indicator	Estimate	SE	Z	p	Stand. Estimate
	Fat_j	.283	.192	1.48	.140	.232

Figure 7

Boxplot of Chronic Fatigue (n=42)



Sleep Disturbance

The construct of Sleep Disturbance was conceptualized as a composite measure of Waking early morning, Falling Asleep, Quality of Sleep, Feeling Rested and Amount of Sleep scales defined in Standard Manual Shiftwork Index (Questions 2.4-2.11). The summary results of Descriptive analysis are provided in Table 1 and Figure 8. The scores ranged from 2.19 to 4.36, with the average score of 3.19 (*SD*=.47). The distribution was moderately positively skewed of leptokurtic shape and normal indices for distribution to be evaluated as approximately normal (Shapiro's Wilk test, p >.05). Reliability analysis revealed that the scale was internally consistent (Cronbach's α=.736, *M*=3.19, *SD*=.47) For details see item-reliability statistics (Table 8).

Table 8

Item Reliability Statistics – Overall Sleep Disturbance

				If item dropped	
	Mean	**SD**	**Item-rest correlation**	**Cronbach's α**	**McDonald's ω**
AmountofSleep	3.18	.692	.661	.622	.686
FeelingRested	3.04	.832	.619	.639	.694
QualityofSleep	3.17	.844	.800	.540	.614
FallingAsleep	3.25	.359	.356	.742	.774
WakingUpEarlyMorning	3.32	.510	.121	.795	.808

Confirmatory Factor Analysis confirmed a poor fit of theoretical unidimensional structure of sleep disturbance measure with the data, $\chi^2(5) = 17.8$, $p = .003$, CFI =.824, TLI= 0.649, RMSEA=.247. Particularly problematic items were Waking Up Early Morning Subscale and Falling Asleep with standardized estimates below 0.6. The composite mean total score has not been adjusted and the analysis was performed as per recommendations from the authors of the measure. The insufficient loadings could be most likely attributed to small sample size, n=40 and apparent fatigue of respondents. This construct has received the least number of responses out of all study measures. For details see Table 9.

Table 9

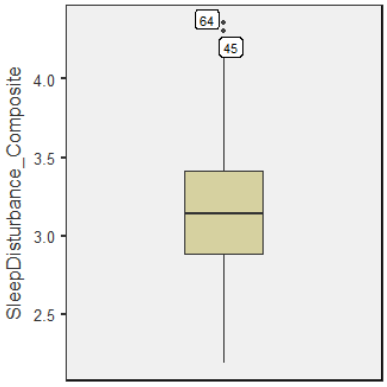
Factor Loadings – Sleep Disturbance

Factor	**Indicator**	**Estimate**	**SE**	**Z**	**p**	**Stand. Estimate**
Sleep Disturbance	AmountofSleep	.5314	.0947	5.612	< .001	.787
	FeelingRested	.6194	.1145	5.408	< .001	.763
	QualityofSleep	.7522	.1093	6.879	< .001	.923
	FallingAsleep	.1014	.0568	1.784	.074	.287
	WakingUpEarlyMorning	.0602	.0853	.706	.480	.120

Factor	Indicator	Estimate	SE	Z	p	Stand. Estimate

Figure 8

Score Distribution Sleep Disturbance



Note: Two upper limit outliers with values of 4.35 were kept in analysis – no leverage values affecting distribution.

Job Satisfaction

Overall, 53 responses were collected for the measure of general job satisfaction. The scale ranged from 1 to 7, with the average score of 4.4 (SD=1.44) and slightly lower median score of 4.2. The distribution was symmetrical and platykurtic and considered approximately normal (Shapiro's Wilk test, $p>.05$). The scale was highly internally consistent, Cronbach's $\alpha=.82$. For item reliability statistics see Table 10, for summary Descriptive statistics see Table 1 and Figure 9.

Table 10

Item Reliability Statistics – General Job Satisfaction

				If item dropped	
	Mean	**SD**	**Item-rest correlation**	**Cronbach's α**	**McDonald's ω**
JobSat_1	4.51	1.76	.736	.751	.768
JobSat_2_R – Reversed	4.94	1.98	.561	.801	.839
JobSat_3	4.91	1.81	.601	.788	.801
Job_Sat_4	3.57	1.79	.771	.739	.781
Job_Sat_5_reversed	4.04	2.07	.441	.839	.861

There was a poor fit observed for data and unidimensional structure of the scale, CFI=.771, TLI=0.542, $\chi^2(5) = 41.4$, $p<.001$. Further analysis revealed that the responses to question 5 were not as expected – most likely the effect of "yeah saying" bias and long questionnaire. See details in Table 11.

Table 11

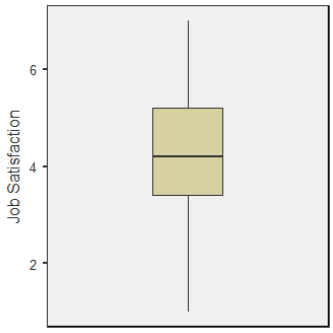
Factor Loadings: General Life Satisfaction Scale

Factor	**Indicator**	**Estimate**	**SE**	**Z**	**p**	**Stand. Estimate**
Factor 1	JobSat_1	1.725	.178	9.67	< .001	.989
	JobSat_2_R – Reversed	.918	.259	3.54	< .001	.467
	JobSat_3	1.566	.197	7.93	< .001	.873
	Job_Sat_4	1.291	.214	6.02	< .001	.727
	Job_Sat_5_reversed	.521	.285	1.83	.068	.255

The results of univariate Descriptive Analysis revealed that the average scores for two subscales and total scale level ranged from 3.7 to 3.8 with standard deviations between .9 and 1.08. The scores varied from 1 to 5 and the distributions were negatively skewed on total and subscale levels (skew -0.9) with leptokurtic distribution. As a result, the sample respondents tend to perceive high social support received from family. For details see Table 5 and Figure 6. None of the distribution was normally distributed as assessed by Shapiro's Wilk test ($p<.001$) however based on interpretation of skewness ($< \pm 1$) and moderate kurtosis and similar indices of Mdn and Mean in addition to sufficient sample size ($n>30$), data was assumed to be normal as per Central Limit Theorem (Hair et al., 2022).

Figure 9

Boxplot of General Job Satisfaction



4.2. Preliminary Analysis

As this is a regression study, all study variables were included in intercorrelation analysis. Due to issues with missing values and different number of observations per variable, bootstrap method with 1000 samples was used in computation of correlation coefficients with bias corrected and accelerated (Bca) confidence intervals type at 95% Confidence Level. Table 12 displays results of correlation analysis without application of bootstrapping and corrections. For comparison, Table 13 displays results after application of bootstrapping with 1000 samples to correct for possible biases due to methodological flaws (missing values and measurement error due to lack of replication of unidimensional nature

of measurement of sleep disturbance and general life satisfaction. The analysis is done at Alpha rate 0.05, two-directional.

4.3. Hypothesis Testing

4.3.1 Hypothesis 1: There is a statistically significant positive relationship between Chronic Fatigue and Sleep Disturbance.

The results showed that there was a large, positive and statistically significant, correlation between chronic fatigue and sleep disturbance, r (38) =.574, p<.001, 95%CI [.319, .751] two-tailed, [.365, 1] one-tailed; bias corrected 95%CI [.298, .758]. Coefficient of determination equals to .325 that translates to 33% of variability explained in one variable by the other.

4.3.2 Hypothesis 2: There is a statistically significant negative relationship between Social Support and Sleep Disturbance.

The results showed that there was a large, negative and statistically significant, correlation between social support and sleep disturbance, r (38) =-.618, p <.001, 95%CI [-.779, -.379] two-tailed, r (38) = -.618 [-1., -.423] one-tailed; bias corrected 95%CI [-.811, -.395]. Coefficient of determination is .382 that translates to 38.2% of scores of one variable explained by the other. For details of hypothesis 1 and 2 testing see Table 12 and 13. For assumptions check see Figures 10-11.

Figure 10

Scatterplot: Linear Relationship Chronic Fatigue and Sleep Disturbance

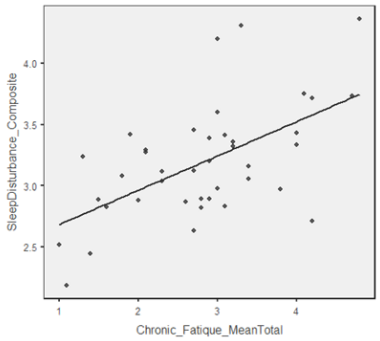


Figure 11

Linear Relationship: Social Support and Sleep

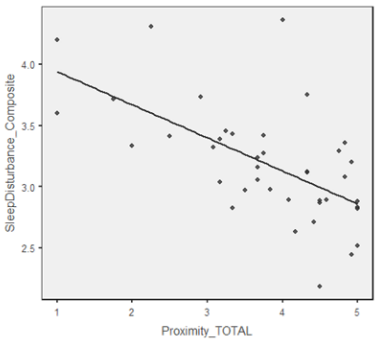


Table 12

Correlation Matrix for Main Study Variables

		Chronic_Fatique	Proximity	SleepDisturbance_Composite	Job Satisfaction
Chronic_Fatique	Pearson's r	—			
	df	—			
	p-value	—			
	95% CI Upper	—			
	95% CI Lower	—			
	N	—			
Proximity	Pearson's r	-.373 *	—		
	df	40	—		
	p-value	.015	—		
	95% CI Upper	-.078	—		
	95% CI Lower	-.608	—		
	N	42	—		
Sleep Disturbance	Pearson's r	.574 ***	-.618 ***	—	
	df	38	38	—	
	p-value	< .001	< .001	—	
	95% CI Upper	.751	-.379	—	
	95% CI Lower	.319	-.779	—	
	N	40	40	—	
Job Satisfaction	Pearson's r	-.486 **	.350 *	-.439 **	—
	df	38	51	38	—

		Chronic_Fatique	Proximity	SleepDisturbance_Composite	Job Satisfaction
	p-value	.001	.010	.005	—
	95% CI Upper	-.206	.567	-.148	—
	95% CI Lower	-.693	.089	-.660	—
	N	40	53	40	—

Note. * p < .05, ** p < .01, *** p < .001

Table 13

Results of The Correlational Analysis with Bootstrapping

				Proximity	Chronic Fatigue	Sleep Disturbance	JobSatisfaction
Proximity	Pearson Correlation			1	-.377*	-.618**	.322*
	Sig. (2-tailed)				.016	<.001	.043
	Bootstrap[c]	Bias		0	.000	-.001	-.003
		Std. Error		0	.113	.107	.130
		Bca 95% Confidence Interval	Lower	.	-.607	-.811	.064
			Upper	.	-.140	-.395	.561
Chronic_Fatique	Pearson Correlation			-.377*	1	.574**	-.486**
	Sig. (2-tailed)			.016		<.001	.001
	Bootstrap[c]	Bias		.000	0	-.015	.005
		Std. Error		.113	0	.126	.139
		Bca 95% Confidence Interval	Lower	-.607	.	.298	-.736
			Upper	-.140	.	.758	-.192

Sleep Disturbance	Pearson Correlation			-.618**	.574**	1	-.439**
	Sig. (2-tailed)			<.001	<.001		.005
	Bootstrap[c]	Bias		-.001	-.015	0	.011
		Std. Error		.107	.126	0	.152
		Bca 95% Confidence Interval	Lower	-.811	.298	.	-.713
			Upper	-.395	.758	.	-.092
JobSatisfaction	Pearson Correlation			.322*	-.486**	-.439**	1
	Sig. (2-tailed)			.043	.001	.005	
	Bootstrap[c]	Bias		-.003	.005	.011	0
		Std. Error		.130	.139	.152	0
		Bca 95% Confidence Interval	Lower	.064	-.736	-.713	.
			Upper	.561	-.192	-.092	.

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

c. Unless otherwise noted, bootstrap results are based on 1000 bootstrap samples

4.3.3 Hypothesis 3: Job Satisfaction Moderates the Relationship Between Chronic Fatigue and Sleep Disturbances

Finally, moderation analysis using "med mod ads" in Jamovi was used in order to see if the relationship between chronic fatigue and sleep disturbances could be different at high and low levels of job satisfaction. Based on internal validity and reliability analysis, the analysis is deemed to be preliminary as there is not sufficient evidence that the constructs have been measured as they purported to measure. As such the moderation was run with 1000 bootstrapped samples.

The results showed that chronic fatigue is positively associated with sleep disturbances, z=2.59, p=.009, however the job satisfaction was found to be a small negative, a statistically nonsignificant predictor of sleep disturbances, z=-1.30, p=.194. Importantly the interaction effect between chronic fatigue and job satisfaction was statistically significant, β=.06, SE=.04, Z=1.39, p=.027. As such simple slope analysis was used to interpret the nature of interaction effect.

Simple slopes were examined at three levels of job satisfaction: low (1 SD below the mean), mean, and high (1 SD above the mean). At low levels of job satisfaction, the relationship between chronic fatigue and sleep disturbances was significant, B =.288, SE = .109, Z=2.89, p =.004 At mean levels of job satisfaction, the relationship was also significant, B = .202, SE= .08, p = .012. However, at high levels of job satisfaction, the relationship was not significant, B = .115, SE =.098, p=.247. These results suggest that the positive effect of chronic fatigue and sleep disturbances is enhanced only at a lower level of job satisfaction. For details see Table 14, 15 and Figure 10.

Table 14

Moderation Estimates

			95% Confidence Interval			
	Estimate	**SE**	**Lower**	**Upper**	**Z**	**p**
Chronic_Fatique_MeanTotal	.2101	.0810	.0244	.3379	2.59	.009
Job Satisfaction	-.0788	.0607	-.2028	.0386	-1.30	.194
Chronic_Fatique_MeanTotal ✻ Job Satisfaction	.0600	.0431	-.1424	.0414	1.39	.027

Table 15

Simple Plot Estimates

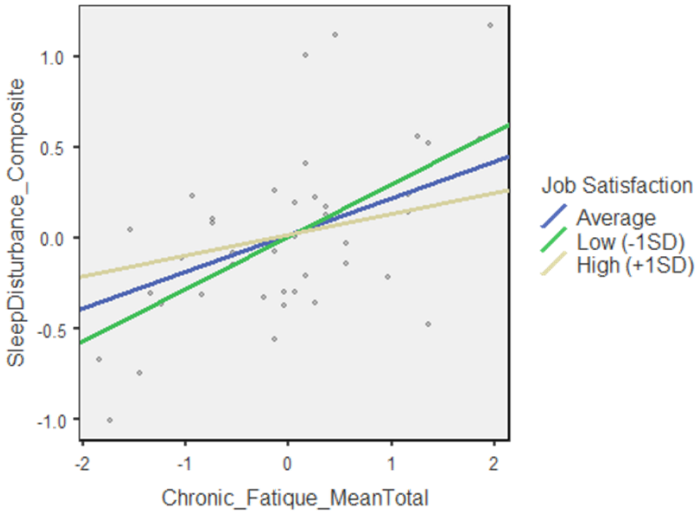
			95% Confidence Interval			
	Estimate	**SE**	**Lower**	**Upper**	**Z**	**p**
Average	.202	.0801	.0161	.329	2.52	.012
Low (-1SD)	.288	.1009	.0518	.459	2.86	.004
High (+1SD)	.115	.0989	-.1117	.282	1.16	.247

			95% Confidence Interval			
	Estimate	SE	Lower	Upper	Z	p

Note: shows the effect of the predictor (Chronic_Fatique_MeanTotal) on the dependent variable (SleepDisturbance_Composite) at different levels of the moderator (Job Satisfaction).

Figure 10

Simple Slope Plot



Chapter 5: Discussion

The goal of this dissertation was to examine the relationships between sleep, fatigue, social support and the moderating role of job satisfaction among a sample of shift workers. The results contribute to better understanding whether job satisfaction and social support can mitigate the negative outcomes of fatigue caused by sleep disturbances.

For the first hypothesis on the relationships between fatigue and sleep disturbances, the alternative hypothesis was supported indicating a statistically significant positive relationship between the variables ($p < 0.001$). Employees who experience more troubles with sleeping patterns tend to feel more fatigued. This implies that as sleep disturbances increase, the level of fatigue also tends to increase. This finding confirms the results of previous study by Claw indicating that sleep disturbances influence fatigue levels (Clauw, 2010). Another study also indicated a significant correlation between sleep problems and fatigue level (Sharpley et al., 1997b). The association between these two variables was also found significant in the study by Buchwald et al, reporting that the majority of chronic fatigue patients suffered from at least 1 sleep disorder (Buchwald et al., 1994). However, similar to our findings the study highlighted the complex nature of the relationships between sleep disturbances and fatigue (Sharpley et al., 1997a). The complexity of these relationships was also confirmed by the previous study indicating that fatigue and sleep disturbances can exist as separate constructs (Neu et al., 2010)

The results of the second hypothesis indicated that there is a statistically significant negative relationship between social support and sleep disturbances. The results revealed that 38.2 % of sleep disturbances can be explained by the lack of social support. This finding aligns with the previous research that lack of emotional support is linked with sleep disturbances. However, this study highlighted a statistically significant relationship between these constructs only for women (Nordin et al., 2005b). Previous study by Runeson partially supports our results as pilots who experienced lack of social support tend to have more sleep problems (Runeson et al., 2011). The role of social support as a mitigating factor was also observed in another study revealing that emotional support influences problems associated with sleep (Zhao et al., 2021). Nevertheless, the role of family experience in terms of sleep problems for shift workers is subject to ongoing research (Ruisoto et al., 2021).

The third hypothesis was also confirmed, reporting that job satisfaction moderated the relationships between fatigue and sleep disturbances but only at a lower levels of job satisfaction ($\beta = 0.274$, $p < 0.001$). The relationship between fatigue and job satisfaction was statistically significant ($p = 0.027$), indicating that the effect of sleep disturbances on fatigue levels might be altered by job satisfaction. The study by Scott & Judge also found a significant correlation between emotional states, job satisfaction and insomnia (Scott & Judge, 2006e).

Interestingly enough, the study by Ye et al also reported the negative relationships between sleep disturbances and job satisfaction. However, this study explored another protective factor - resilience as a mediator which was also found significant (Ye et al., 2023b). Nevertheless, the nature of this result is preliminary as we found out low reliability of the sample indicating that some participants did not understand the questions or suffered from "yea saying" bias. Therefore, we can't directly report that job satisfaction universally acts as a mitigating factor for all participants, buffering the impact of sleep disturbances on fatigue levels in the current study.

5.1. Limitations

The study has certain limitations. The designed self-reported questionnaire could lead to biased answers in responses such as social desirability and "yea saying" bias. While analyzing the data set, we encountered missing data that could be connected with the length and complexity of questions as well as personal reasons such as uncomfortable questions or misunderstanding of certain questions. Moreover, lack of responses provided by the participants can be also referred to increased frequency of surveys that resulted in cognitive and emotional overload and led to fatigue and rejection of participation in questionnaire based research studies. Future studies could refer to longitudinal approach and comparison between groups of shift workers in different sectors, shift cycles and types. We also recommend adopting a qualitative approach that will allow to understand the participants' perceptions better which might help mitigate the presence of "yea saying" bias.

The initial goal of the study was to compare two groups of participants (aircrew members (pilots and cabin crew and shift workers who are non-crew members) couldn't be fulfilled as we did not have sufficient data for non-air crew members to compare the differences between aforementioned groups. The lack of data can be attributed to the

difficulties in reaching air crew associations because of communication channels and demanding work schedules. Therefore, the small sample size of the study could limit the statistical power making it difficult to detect the significance of the relationship between variables. Moreover, the presence of any outlier could influence the results of the study. The data was also non normally distributed as indicated by skewness, kurtosis, and the results from the Shapiro-Wilk test. For instance, fatigue and proximity total, are skewed or have heavy tails in certain subgroups that could compromise the statistical analysis. Future studies can benefit from larger sample size that will enhance the statistical power and explore other factors that influence job satisfaction level. We will also advise to examine the relationships between neuroticism and sleep disturbances as well as fatigue and PHQ (physical health questionnaire) as the analysis observed the relationships between these variables.

While the sample of participants were diverse, the generalizability of the results could be limited to Portuguese context in terms of work implication and arrangements. In this sense we could also point out the possible sampling bias that could potentially occur while certain groups are underrepresented. For instance, the absence of data for some subgroups (like divorced males and non-binary individuals) limits its applicability to diverse real-world scenarios. Additionally, there may be an underrepresentation of older individuals. Follow – up studies can focus on gender attributes and chronotypes of shift workers across different shift cycles and types.

5.2. Organizational implications

Understanding that sleep disturbances affect fatigue levels and lead to decreased performance can help organizations to develop more complex wellness programs focusing fatigue mitigation strategies such as sleep education workshops and promoting work life balance. Organizations might also consider adjusting the schedules for shift workers based on their preference when applicable and trying to minimize the presence of rotational and night shifts. Moreover, management can introduce sleep education workshops for shift workers.

Organizations should also recognize the role of intimacy and cohesion that could affect employee's performance and abilities to cope with workload, physical and psychological consequences of shift work. Therefore, companies can consider implementing flexible work hours schedules or refer to hybrid work options as well as include special

family related benefits for employees that struggle to find balance between shift work and family responsibilities. In this sense, organizations can allow easier access to parental and family care leave. Undoubtedly, it will require special workshops for upper management employees who might find it difficult to understand the negative outcomes of shift work for employees with family needs. We would also recommend designing special programs for shift workers to reduce family work conflict and sleep related problems caused by family and parental responsibilities during unusual hours.

As mentioned above, preliminary results indicated that job satisfaction can act as a buffer between chronic fatigue and sleep disturbances but only at a lower level of job satisfaction. In this sense, management should consider designing a work support system ensuring that employees feel valued, can seek help from their supervisors and encourage career opportunities by referring to internal recruiting when possible. All these factors combined might reduce work-related stress and lead to a more positive work environment.

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