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Identification of risk factors associated with occupational fatigue among employees at PT. XYZ

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ABSTRACT

This study aimed to identify factors associated with fatigue among employees of PT. XYZ in Medan, a futures brokerage firm where preliminary observations indicated a high prevalence of exhaustion and decreased alertness among employees. This study aimed to identify factors associated with fatigue. A descriptive analytic study with a cross-sectional design was conducted using a total population sample of 45 employees. Data were collected on workload (measured as %CVL), work duration, work environment (assessed through a questionnaire), and occupational fatigue (measured using the IFRC questionnaire). Univariate, bivariate (Chi-square), and multivariate statistical analyses were performed. The results showed that 33.3% of participants experienced fatigue. Bivariate analysis demonstrated statistically significant associations between fatigue and workload (p=0.015), work duration (p=0.001), and work environment (p=0.006). Multivariate analysis further quantified these relationships, identifying the work environment as the most dominant risk factor (OR=3.18), followed by work duration (OR=2.4) and heavy workload (OR=2.4). In conclusion, an unsafe work environment, long work duration, and heavy workload are significant and quantifiable risk factors for occupational fatigue, with the work environment serving as the strongest predictor.

Keywords: occupational fatigue, work environment, workload

INTRODUCTION

Occupational fatigue is a central concern in the field of Occupational Health and Safety (OHS). It is defined as a protective physiological mechanism that prevents the body from sustaining further harm and facilitates the recovery process that follows rest (Cunningham et al., 2022; Dahlan and Widanarko, 2022). Despite its protective function, the term “fatigue” primarily denotes a condition characterized by decreased efficiency, reduced work capacity, and diminished overall physical endurance (Evans and Lambert, 2007; Tornero-Aguilera et al., 2022). Symptomatically, occupational fatigue often presents as subjective complaints such as reduced alertness and a profound sense of exhaustion (Billones et al., 2021).

The significance of occupational fatigue is considerable due to its widespread implications for the global workforce. Surveys from developed countries report that between 10% and 50% of workers experience work-related fatigue (Dawson et al., 2012; Wang et al., 2025; Yoon et al.,

2023). The consequences are detrimental to both individuals and organizations. Cunningham et al. (2022) noted that work fatigue can directly impair productivity. Moreover, Suma'mur (2014) emphasized that fatigue reduces vigilance, concentration, and precision. The combination of delayed perception, cognitive impairment, and decreased motivation increases the likelihood of occupational accidents.

The present study specifically focuses on the context of employees at the PT. XYZ. This firm operates as a business entity within the futures brokerage industry, specializing in Alternative Trading System (ATS) transactions on the Jakarta Futures Exchange. As an active brokerage, PT. XYZ participates in financial product transactions and facilitates trade in primary commodity products. The work environment within the financial services and futures trading sectors is often characterized by high work demands, which are potential sources of significant stress and fatigue for employees.

The selection of PT. XYZ as the research site was based on preliminary observations and interviews with several employees. Workers frequently reported symptoms of physical exhaustion and lack of focus, particularly during peak transaction hours. Additionally, initial observations of the workplace highlighted potential environmental hazards and irregular working hours, necessitating a comprehensive investigation into these risk factors. The finding that one-third of employees experience fatigue, together with evidence that almost half work in unsafe conditions and a majority endure moderate workloads and long hours, highlights the need for further investigation. Based on this background, the primary objective of this study is to identify the factors influencing occupational fatigue among employees at PT. XYZ.

METHOD

This study employed a descriptive analytic design with a cross-sectional approach. This design was selected to enable observation and measurement of variables at a single point in time, with the aim of identifying and quantifying variables and assessing the influence of specific factors on occupational fatigue without researcher intervention. The study was conducted at PT. XYZ in Medan City, from October 2024 to January 2025. The study population included all employees of PT. XYZ. A total sampling technique was used, in which the entire population was included as the research sample, consisting of 45 participants.

Primary data were collected directly using the Industrial Fatigue Research Committee (IFRC) questionnaire. Secondary data on the total number of employees were obtained from PT. XYZ.

The dependent variable in this study was occupational fatigue, while the independent variables included workload, work duration, and work environment. Workload was measured using the percentage of cardiovascular load (%CVL) method, in which pulse rate was manually measured with a stopwatch. Work duration was defined as the time elapsed from the start to the completion of the workday. It was categorized into 'Long' (>8 hours/day) and 'Not Long' (≤8 hours/day) based on national labor standards. Occupational fatigue was assessed based on workers' self-reported symptoms collected through the IFRC questionnaire.

Data analysis was conducted using three methods. First, univariate analysis was performed to describe the frequency distribution and percentages of each variable, with results presented in frequency tables. Second, bivariate analysis was conducted to examine the association between the independent variables (workload, work duration, and work environment) and the dependent variable (occupational fatigue). Hypotheses were tested using the chi-square test, with statistical significance set at a 95 percent confidence level ($\alpha = 0.05$). Third, multivariate analysis was applied to evaluate the relationships among multiple variables potentially exerting mutual influence.

RESULTS

Table 1 presents the results of the univariate analysis for a total sample of 45 participants, focusing on four key variables: workload, work duration, work environment, and work fatigue. Regarding workload, the responses were concentrated in two main categories. The largest group, consisting of 21 participants (46.70%), reported a moderate workload, followed closely by 20 participants (44.40%) who described their workload as heavy. A smaller portion of the sample, four participants (8.90%), reported a light workload.

For work duration, a majority of participants (27 or 60.00%) reported that their work duration was not long, while the remaining 18 participants (40.00%) considered their work duration long. Perceptions of the work environment were almost evenly divided. A slight majority of 23 participants (51.10%) perceived their environment as safe, whereas 22 participants (48.90%) classified it as unsafe.

Finally, the results for work fatigue showed that most respondents were not fatigued. Thirty participants (66.70%) reported no fatigue, while the remaining 15 (33.30%) reported experiencing fatigue.

Table 1. Univariate Analysis Results

Variable	Frequency (n=45)	Percentage (%)
Workload		
Moderate	21	46.70%
Light	4	8.90%
Heavy	20	44.40%
Work Duration		
Not Long	27	60.00%
Long	18	40.00%
Work Environment		
Safe	23	51.10%
Unsafe	22	48.90%
Work Fatigue		
Not Fatigued	30	66.70%
Fatigued	15	33.30%

Table 2 summarizes the results of the two-stage analysis conducted to identify factors associated with work fatigue. In the initial bivariate (Chi-square) analysis, three variables were tested for their association with fatigue. All three were statistically significant. Work duration showed the strongest association (p=0.001), followed by work environment (p=0.006) and workload (p=0.015).

Table 2. Bivariate, multivariate, and risk factor analysis results for work fatigue

Variable / Factor	Chi-Square	Multivariate / Risk Factor	Remarks
Workload	p=0.015	p=0.022 (Heavy workload) OR=2.4	Significant risk factor. Approximately 2.4 times higher risk.
Work Duration	p=0.001	OR=2.4	Significant risk factor. Consistent risk magnitude with workload.
Work Environment	p=0.006	OR=3.18	Most influential variable. Highest risk probability (3.18 times).

The subsequent multivariate analysis quantified the strength of each risk factor using the Odds Ratio (OR). The work environment emerged as the strongest predictor of work fatigue, indicating that individuals in poor environments were 3.18 times more likely to experience fatigue (OR=3.18). Both work duration and workload also demonstrated significant associations, each with an OR of 2.4. The elevated risk for workload was specifically linked to the heavy workload category, which remained statistically significant (p=0.022).

The remarks column of Table 2 notes that work environment and work duration are significant risk factors. It also identifies workload as the most influential variable, with an approximate threefold increase in risk, reflecting a rounded interpretation of its 2.4 Odds Ratio.

DISCUSSION

The initial descriptive analysis revealed a workforce under considerable strain. The vast majority of respondents described their workload as “moderate” or “heavy,” while very few classified it as “light,” indicating that high demand is nearly universal among this group. The workforce was also almost evenly divided in its assessment of the work environment, with nearly half perceiving it as “unsafe.” This split perception of safety, combined with high workload demands, provides important context for the finding that one-third of participants reported experiencing work fatigue. These results are consistent with previous research, particularly in high-demand healthcare settings. For example, Nemati-Vakilabad et al. (2025) found that increased nursing workloads were significantly associated with higher levels of both acute and chronic fatigue. Similarly, Alrabae et al. (2021) reported that intensive care unit nurses experienced high physical and mental workloads that negatively influenced their perceptions of patient safety, mirroring this study’s link between heavy workload and perceived environmental unsafety. Collectively, the evidence indicates that high-demand work environments are consistently correlated with increased fatigue and diminished safety perceptions across various occupational contexts.

The subsequent risk analysis confirmed that work fatigue in this cohort is a multifactorial issue, with the work environment, work duration, and workload emerging as significant determinants. This finding aligns with the established understanding that work fatigue is a complex, multifactorial phenomenon driven by interrelated workplace factors. Multiple studies substantiate this complexity. For instance, the Maastricht Cohort Study identified both subjective and objective work-related factors contributing to fatigue (Jansen et al., 2007). Similarly, a systematic review by Ghaisani & Susilowati (2025) found that workload, work

stress, and work climate were key contributors, while Techera et al. (2016) linked work environment characteristics such as noise, vibration, and temperature to fatigue risk. These findings emphasize that occupational fatigue arises from interacting factors that jointly shape worker well-being and performance.

In this study, the work environment emerged as the strongest risk factor, suggesting that perceived safety is a powerful predictor of fatigue. This is supported by extensive evidence identifying workplace conditions as principal drivers of fatigue and as variables closely associated with fatigue levels (Barker and Nussbaum, 2011; Techera et al., 2016). The psychological mechanism is well documented: an environment perceived as "unsafe"—a subjective judgment shown to influence worker attitudes and behavior (McLain, 1995)—provokes both physical strain and psychological stress. This condition fosters hypervigilance and anxiety, generating a persistent cognitive and emotional burden that depletes mental resources and precipitates physical and psychological exhaustion. Given that nearly half of participants reported feeling unsafe, this factor represents a critical focus for intervention and a major occupational health concern requiring strategies that reduce psychological stress.

Heavy workload and extended work duration were also identified as major contributors to fatigue, showing comparably strong associations. This finding is consistent with established occupational health models and prior research demonstrating that both factors are key drivers of progressive fatigue. For example, Fan & Smith (2017) found that increased workload directly elevates fatigue, while Cropley et al. (2020) reported that chronic high workload is strongly linked to both psychological (OR = 7.24) and physical (OR = 4.23) fatigue. Similarly, Nemati-Vakilabad et al. (2025) confirmed significant associations between increased workload and both acute and chronic fatigue ($p < 0.001$). These results support the conceptual model of fatigue as a cumulative process. The descriptive data from the present study, showing that heavy workloads are the norm within this cohort, reinforce this interpretation. Across studies, the consistent pattern suggests that fatigue arises not from any single factor, but from the persistent combination of high demands and prolonged work duration that gradually exhausts the workforce (Techera et al., 2016).

The practical implications are clear. As the strongest predictor, the work environment should be prioritized for intervention. Efforts should focus on identifying and addressing the root causes of perceived unsafety, which may include revising safety protocols, upgrading equipment, and improving organizational communication. In addition, the widespread

prevalence and high-risk nature of heavy workloads require a systemic organizational response. Potential measures include reassessing staffing levels, optimizing work schedules, and implementing task rotations to better distribute physical and cognitive demands.

While these findings are important, they must be interpreted in light of the study's limitations. The primary limitation is the relatively small sample size, which restricts the generalizability of the results. Furthermore, the cross-sectional design captures associations but does not establish causality. For example, although a heavy workload likely contributes to fatigue, it is also possible that fatigued individuals perceive their workload as heavier. Future research should aim to replicate these findings in a larger sample and employ longitudinal designs to explore the causal relationships between workload, work environment factors, and fatigue development over time.

CONCLUSION

In conclusion, this study identified an unsafe work environment, heavy workload, and long working hours as significant predictors of occupational fatigue, with the work environment emerging as the strongest determinant. These findings indicate that effective interventions should adopt a multifactorial approach that prioritizes improving perceived workplace safety and managing excessive workloads to safeguard worker well-being.

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