THE EFFECT OF WORK POSTURE, WORK LOAD, AND PSYCHOSOCIAL FACTORS ON WORK FATIGUE IN FORKLIFT DRIVERS IN THE WAREHOUSE DEPARTMENT OF PT Y

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Abstract

This study aims to evaluate the extent to which work posture, workload intensity, and psychosocial aspects affect fatigue levels in forklift operators at PT Y's warehouse. The background of this study is the high incidence of property damage involving forklifts and changes in storage systems that increase operator workload. This study uses a quantitative approach with PLS-SEM-based regression analysis. The results of the analysis show that all three factors—work posture, workload, and psychosocial conditions—have a significant and positive effect on work fatigue, with regression coefficients of 0.358; 0.367; and 0.333, respectively. The T-statistic value of all three exceeds 1.96 and the P-value <0.05, indicating that all three are statistically significant. These findings indicate that non-ergonomic work positions, heavy workloads, and unfavorable psychosocial conditions can increase the risk of work fatigue. This study recommends the need for in-depth ergonomic evaluations, reorganization of operational rhythms, and strengthening social interactions in the workplace to reduce fatigue levels and prevent potential work accidents.

Keywords: Work Posture, Workload, Psychosocial, Fatigue

INTRODUCTION

Occupational Safety and Health (OHS) is an integral part of operational activities in the industrial sector. Work-related fatigue is a risk factor that is often overlooked, despite its significant impact on worker safety and productivity. According to data from the International Labor Organization (ILO, 2018), fatigue is a major contributor to more than two million work-related deaths globally each year. Fatigue can reduce alertness, slow response times, increase the likelihood of errors, and increase the risk of workplace accidents, both minor and fatal (National Safety Council, 2018a).

In the context of the manufacturing industry, high physical and mental workloads, shift work systems, and monotonous and stressful work environments are factors that can accelerate the onset of fatigue (Guo et al., 2017; Widanarko & Modjo, 2017). One area of work with high activity intensity is the warehouse division, especially the forklift operator position, whose job is to transport, organize, and move goods to and from various storage locations within the warehouse area. The use of heavy equipment, such as forklifts, does make work easier, but it also creates the potential for fatigue due to static work positions, repetitive body movements, and the pressure to complete tasks quickly and accurately (Grandjean, 1979; McAtamney & Corlett, 1993).

PT Y is a manufacturing company that produces nutrition for infants, children, and pregnant women. To meet high and sustainable market demand, the company operates a 24-hour shift system. In PT Y's warehouse area, two types of forklifts are used—Reach Trucks and Counterbalance Trucks—operated by more than 80 drivers in a three-shift, four-team rotation system. According to an internal HIRADC report from 2024, forklift driving is categorized as high-risk due to its high frequency, suboptimal ergonomics, and exposure to potential accidents.

Although PT Y has made various efforts to create a safe and ergonomic work environment, such as routine forklift maintenance, regular training, implementation of safe routes, and provision of personal protective equipment and health facilities, incidents related to work fatigue still frequently occur. Data warehouses show that approximately 80% of property damage cases in the warehouse area throughout 2024 were related to forklift operation. Furthermore, an internal survey of 205 employees showed that 95% of forklift drivers considered their workload high, and 67% stated they were reluctant to work overtime to maintain their health.

Various literature shows that work fatigue is the result of the interaction of several factors, including non-ergonomic work postures, high workloads, and psychosocial pressure and stress (Tarwaka et al., 2004; Hobfoll, 1989; Barker et al., 2009). Inappropriate work postures cause disorders of the musculoskeletal system, such as neck, shoulder, and lower back pain. Excessive workloads, both physical and mental, can drain energy and reduce endurance, while psychosocial stress, such as lack of support from superiors or colleagues, and feelings of dissatisfaction at work, can reduce enthusiasm and motivation, thus accelerating the onset of fatigue (Wu et al., 2020; Rahman et al., 2016).

Based on this background, this study was conducted to comprehensively analyze the influence of three main factors—work posture, workload, and psychosocial conditions—on the level of work fatigue of forklift drivers in the warehouse section of PT Y. This study is expected to provide a real contribution in efforts to improve occupational safety and health, especially in designing ergonomic interventions, managing operational rhythms, and strengthening social support in the manufacturing industry work environment.

REVIEW OF LITERATURE

Work Fatigue

Occupational fatigue is a condition characterized by decreased physical and mental capacity caused by excessive workloads, unergonomic working positions, or psychosocial stress. The ILO (2018) defines fatigue as decreased alertness and performance due to physical or mental stress. Fatigue can lead to reduced concentration, increased reaction time, and work errors, ultimately impacting productivity and workplace safety (National Safety Council, 2018a).

Grandjean (1979) defined fatigue as a loss of work efficiency and a decreased desire to perform activities. Fatigue can be physical, mental, or emotional. All three can occur simultaneously and exacerbate each other (WorkSafe Victoria, 2020).

Work Posture

Unergonomic work postures can cause muscle tension, musculoskeletal disorders, and prolonged fatigue. Tarwaka et al. (2004) stated that static body postures that do not comply with ergonomic principles, such as prolonged sitting without proper back support, are at high risk of causing neck, back, and shoulder pain. Research by McAtamney & Corlett (1993) showed that poor work postures increase the risk of disorders of the muscular and skeletal systems.

Research by Umiyati et al. (2020) in the power generation industry shows that work fatigue is significantly influenced by non-ergonomic work postures and inadequate work facilities. Posture measurement methods such as RULA (Rapid Upper Limb Assessment) and REBA (Rapid Entire Body Assessment) are widely used to evaluate ergonomic risk levels (Hignett & McAtamney, 2000).

Workload

Workload is the number of tasks or responsibilities a person must complete within a given time. Sanders and McCormick (1993) divide workload into two: physical and mental. Physical workload relates to muscle use, while mental workload relates to cognitive and emotional demands.

According to Hart & Staveland (1988), mental workload can be measured using the NASA-TLX (Task Load Index), which measures an individual's perception of various aspects of workload, such as time demands, mental stress, and effort level. Excessive workload can lead to stress, burnout, and even chronic fatigue (Frone & Blais, 2019).

Psychosocial Factors

Psychosocial factors include psychological and social elements in the work environment, such as job stress, job satisfaction, social support, and general working conditions. Karasek (1979), through the Job Demand-Control Model, explains that stress and fatigue increase when job demands are high but workers lack control over their work.

According to Sarafino (2017), social support from coworkers and superiors can mitigate the negative effects of work stress. Barker et al. (2009) in their Fatigue in Healthcare Workers model also stated that fatigue results from the interaction between individual characteristics, workload, and psychosocial factors. Research by Wu et al. (2020) shows that good social support and high self-efficacy can reduce the risk of mental and emotional exhaustion in the workforce.

Theoretical Framework and Previous Research

Previous research by Widanarko & Modjo (2017) showed that sitting for more than 4 hours and strenuous physical activity significantly correlated with muscle fatigue. Research by Rahman et al. (2016) demonstrated that psychosocial factors such as work conflict and lack of recognition can be key predictors of work fatigue. Meanwhile, research by Pratiwi (2023) found that mental workload, stress, and sleep quality significantly influence fatigue among heavy equipment operators in the logistics industry.

Overall, the literature indicates that occupational fatigue is multidimensional and influenced by a combination of ergonomic factors, workload, and psychosocial conditions. Therefore, a comprehensive approach is needed to prevent and control occupational fatigue in industrial settings.

Framework Theory

In general, the theoretical basis of this research refers to the framework model related to fatigue factors proposed by ILO (2018), Barker et al. (2009), and Sadeghniiat-Haghighi & Yazdi (2015). Based on this model, factors influencing fatigue are generally divided into two categories: work-related and non-work-related. However, the focus of this study is on work-related factors, such as posture during work, workload, and psychosocial aspects. A conceptual representation of these factors is shown in the following figure:

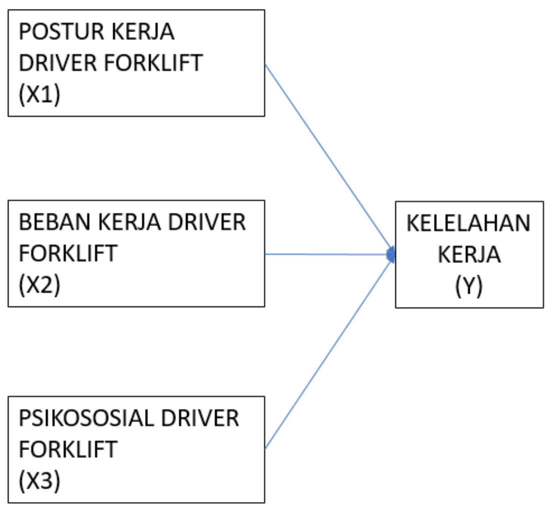

Figure 1. Framework

RESEARCH METHOD

This study uses a quantitative approach with a cross-sectional study design to analyze the effect of work posture, workload, and psychosocial factors on work fatigue in warehouse forklift operators at PT Y. The study was conducted from May to June 2025 at the PT Y warehouse location located in Klaten Regency, Central Java.

The data used consisted of primary and secondary data. Primary data was obtained through a closed-ended questionnaire distributed to all respondents who were active forklift operators. In addition, direct observations of working conditions and brief interviews with warehouse management and supervisors were conducted. Secondary data were obtained from internal company documentation such as work incident reports, HIRADC, work schedule data, and occupational health and safety policy documents.

The population in this study was all 82 forklift operators in the warehouse of PT Y. Because the population size was relatively small and could not be fully reached, the sampling technique used a census approach. This aimed to increase the internal validity of the research results (Kurniawan & Puspitaningtyas, 2016).

The questionnaire was developed based on indicators validated in previous studies. The independent variables in this study include:

- **Working posture (X_1)**: measured from sitting comfort, muscle pain, frequency of position changes, and ergonomic suitability.
- **Workload (X_2)**: includes levels of physical fatigue, time demands, concentration, and work pressure.
- **Psychosocial factors (X_3)**: consists of stress levels, social support from superiors and coworkers, job satisfaction, and the impact of shifts on psychological well-being.

The dependent variable (Y) is work fatigue, which is assessed through the frequency of fatigue, muscle pain, impaired concentration, drowsiness while working, and post-work recovery duration. All statements are measured using a 5-point Likert scale (1 = strongly disagree to 5 = strongly agree).

The collected data were analyzed using the Partial Least Squares Structural Equation Modeling (PLS-SEM) approach using SmartPLS 4 software. PLS-SEM analysis was chosen because it is able to evaluate complex relationships between latent variables and does not require the assumption of a normal distribution. Furthermore, PLS-SEM is suitable for small to medium sample sizes.

Model evaluation is carried out in two stages, namely:

1. **Outer Model**– to assess the validity and reliability of indicators, through loading factor values, AVE, composite reliability, and Cronbach's Alpha.
2. **Inner Model**– to assess the structural relationship between variables, through path coefficients, T-statistics, and P-values. Hypothesis testing was conducted using the bootstrapping method with significant criteria if the T-statistic > 1.96 and P-value < 0.05 (Hair et al., 2019).

Multicollinearity Testalso carried out using the Variance Inflation Factor (VIF) to ensure that there is no high correlation between independent variables.

RESULTS AND DISCUSSION

Measurement Model Analysis (Outer Model)

1) Validity Test

Convergent and discriminant validity are part of validity measurement. To assess convergent validity, indicators such as factor loading values and AVE (Average Variance Extracted) are used.

a) Convergent Validity

Convergent validity is used to assess the strength of the relationship between an indicator and the construct it represents. This assessment is conducted through the loading factor values between the latent variable and its indicator. An indicator is considered valid if it has a loading factor above 0.7 and an Average Variance Extracted (AVE) value above 0.5 (Hair et al., 2019). Details of the values are presented in the following table.

Indicator	**(X1) Forklift Driver Working Posture**	**(X2) Forklift Driver Workload**	**(X3) Psychosocial Forklift Drivers**	**(Y) Work Fatigue**
X1. 1	0. 831			
X1. 2	0. 852			
X1. 3	0. 857			
X1. 4	0. 872			
X1. 5	0. 877			
X2. 1		0. 804		
X2. 2		0. 806		
X2. 3		0. 840		
X2. 4		0. 833		
X2.5		0. 821		
X3. 1			0. 844	
X3. 2			0. 846	
X3. 3			0. 833	
X3. 4			0. 872	
X3. 5			0. 858	
Y1. 1				0. 772
Y1. 2				0.787
Y1. 3				0. 763
Y1. 4				0. 783
Y1. 5				0.764

Table 1. Values of Loading Factor

Looking at the table above, all indicators in this study meet the validity criteria because each has a loading factor value according to the requirements above 0.7. Table 4.5 shows that all indicators in the four constructs have loading factor values above 0.7, which means that convergent validity is met; each indicator consistently and strongly represents the construct it measures, although indicator Y1.1 has the lowest value of 0.772, but still meets the criteria, so no indicators need to be eliminated based on the loading factor criteria. Meanwhile, the image below shows the results of the loading factor test carried out through the Smart PLS application. Indicator X1.5 in the work posture variable has the highest Outer Loadings value of 0.877, and the lowest Outer Loadings value is in the Fatigue variable in indicator Y1.3 at 0.763. All constructs have indicators with loading factors > 0.7, which means that convergent validity is met, so that the measurement model can be considered reliable and representative.

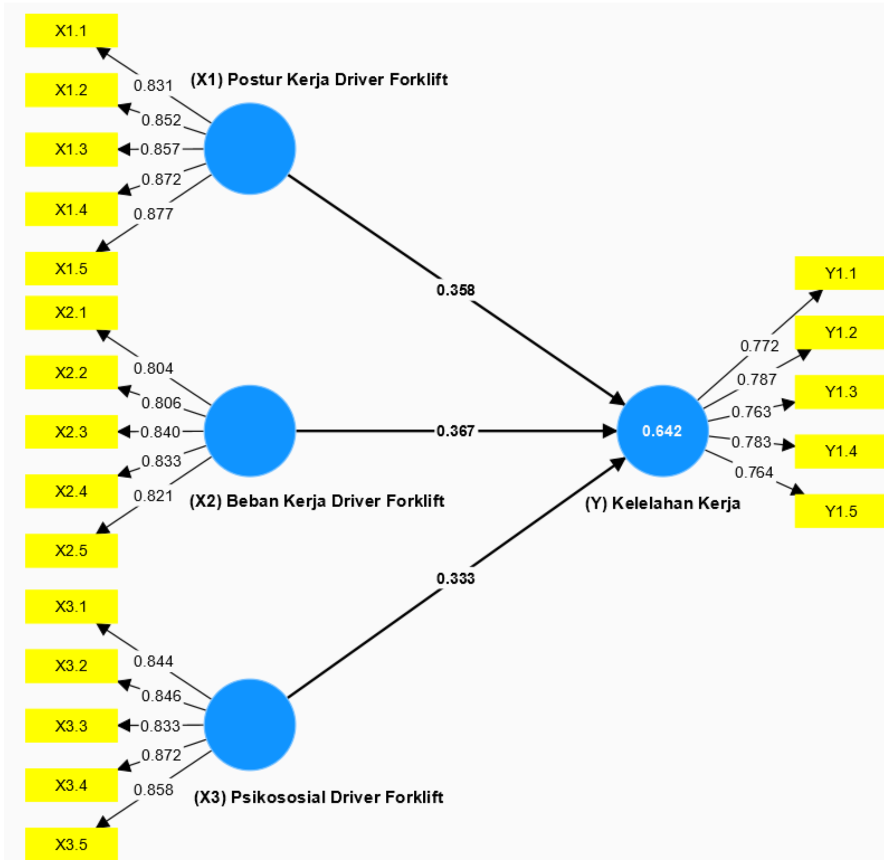

Figure 2. Loading Factor Test Results

In this study, the measurement model consisted of two types: reflective and formative. Variables such as work posture, workload, and psychosocial factors were measured reflectively, while work fatigue was measured using a formative approach. According to Hair et al.'s (2021) guidelines, the assessment of the reflective model was carried out by considering a loading factor value above 0.70, a composite reliability above 0.70, and discriminant validity evaluated using the Fornell-Larcker criteria and the HTMT ratio, which should be less than 0.90.

In addition, construct validity is measured through the AVE (Average Variance Extracted) value, which ideally exceeds 0.50. From the table presented below, it is known that the Forklift Driver Work Posture variable has the highest AVE value of 0.736, while the Work Fatigue variable shows the lowest AVE value, namely 0.599.

Variables	**Average variance extracted (AVE)**
(X1) Forklift Driver Working Posture	0.736
(X2) Forklift Driver Workload	0.674
(X3) Psychosocial Forklift Drivers	0.724
(Y) Work Fatigue	0.599

Table 2. Average Variance Extracted (AVE) Value

Referring to the table above, all variables have an AVE value above 0.5. The work posture construct shows the highest AVE value of 0.736, which indicates that 73.6% of the indicator variance can be explained by the construct, followed by the psychosocial construct (0.724) and workload (0.674), although the work fatigue construct has the lowest AVE value but still meets the criteria (0.599). Thus, both the loading factor and AVE values have met the criteria to declare convergent validity.

b) Discriminant Validity

.**Cross loadings**

Indicator	(X1) Forklift Driver Working Posture	(X2) Forklift Driver Workload	(X3) Psychosocial Forklift Drivers	(Y) Work Fatigue
X1. 1	0. 831	0. 318	0. 364	0. 478
X1. 2	0. 852	0. 252	0. 304	0. 482
X1. 3	0. 857	0. 286	0. 259	0. 501
X1. 4	0. 872	0. 282	0. 304	0. 541
X1. 5	0. 877	0. 303	0. 362	0. 582
X2. 1	0. 233	0. 804	0. 388	0. 528
X2. 2	0. 296	0. 806	0. 224	0. 441
X2. 3	0. 318	0. 840	0. 290	0. 533
X2. 4	0. 346	0. 833	0. 292	0. 568
X2.5	0. 156	0. 821	0. 331	0. 403
X3. 1	0. 232	0. 309	0. 844	0. 498
X3. 2	0. 368	0. 318	0. 846	0. 556
X3. 3	0. 300	0. 282	0. 833	0. 453
X3. 4	0. 318	0. 302	0. 872	0. 517
X3. 5	0. 355	0. 371	0. 858	0. 531
Y1. 1	0. 495	0. 460	0. 482	0. 772
Y1. 2	0. 460	0. 506	0. 504	0.787
Y1. 3	0. 413	0. 520	0. 375	0. 763
Y1. 4	0. 458	0. 463	0. 528	0. 783
Y1. 5	0. 513	0. 421	0. 437	0.764

Table 3. Values of Cross Loading

Based on the table above, all variables show cross-loading factor values exceeding 0.7, which indicates that each variable has met the requirements set out in this study.

2) Reliability Test

a) Composite Reliability

Composite reliability is used to assess the reliability of a variable's indicators. A variable is considered to meet the criteria if its composite reliability value exceeds 0.70, indicating acceptable construct reliability. The related data are shown below.

Variables	Composite reliability (rho_a)	Cronbach's alpha
(X1) Forklift Driver Working Posture	0.915	0. 910
(X2) Forklift Driver Workload	0.887	0. 879
(X3) Psychosocial Forklift Drivers	0.907	0. 905
(Y) Work Fatigue	0.834	0. 833

Table 4. Values of Composite Reliability

All variables in this study demonstrated composite reliability values above 0.7, with a range of 0.834 to 0.915, as shown in the table. Therefore, it can be concluded that all variables have met the reliability criteria, allowing the analysis to proceed to the inner model testing stage. The consistency of the results between Composite Reliability and Cronbach's Alpha confirms that all constructs have excellent reliability and that the research instrument can produce stable and consistent results.

1. **Structural Model Analysis (Inner Model)**

1) **Goodness of Fit Test**

a. R-Square

Variables	R-square
(Y) Work Fatigue	0.642

Table 5. Values of R-Square

The table above shows that the R-Square value for the Job Fatigue variable is 0.642. This means that the Work Posture, Workload, and Psychosocial variables in Forklift Drivers contribute 64.2% to Job Fatigue, while the remaining 35.8% is influenced by factors other than these variables.

b. F-Square

According to Ghozali (2021:73-74), effect size (f^2) is used as a measure to determine the inverse of the model. The f^2 value consists of 0.02 (weak), 0.15 (moderate), and 0.35 (strong).

Variables	(Y) Work Fatigue
(X1) Forklift Driver Working Posture	0.292
(X2) Forklift Driver Workload	0.307
(X3) Psychosocial Forklift Drivers	0.246

Table 6. Values of F-Square

Referring to the table above, the variable of Forklift Driver Work Posture has a moderate influence of 0.292 on Job Fatigue. Forklift Driver Workload contributes 0.307, and Forklift Driver Psychosocial Factors contribute 0.246, both of which also show a moderate influence on Job Fatigue.

2. **Hypothesis Testing**

Variables	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values
(X1) Forklift Driver Working Posture -> (Y) Work Fatigue	0. 358	0. 359	0.076	4. 738	0. 000
(X2) Forklift Driver Workload -> (Y) Job Fatigue	0. 367	0. 370	0. 080	4. 590	0. 000
(X3) Psychosocial Impact of Forklift Drivers -> (Y) Work Fatigue	0. 333	0. 334	0. 073	4. 590	0. 000

Table 7. Hypothesis Test Results

The hypothesis is accepted if the T-Statistic value exceeds 1.96 and the P-Value value is less than 0.05. In this condition, the alternative hypothesis (Ha) is declared accepted, while the null hypothesis (Ho) is rejected.

Discussion

The results of this study indicate that all independent variables—work posture, workload, and psychosocial factors—have a significant and positive influence on the level of work fatigue in forklift operators in the warehouse section of PT Y. These three variables simultaneously explain 64.2% of the variation in work fatigue ($R^2 = 0.642$), with the highest contribution coming from the workload variable, followed by work posture and psychosocial factors.

1. The Effect of Work Posture on Work Fatigue

Working posture showed a significant effect on work fatigue (coefficient = 0.358; T-statistic = 4.738; P-value < 0.001). This indicates that body position when driving a forklift directly affects the level of perceived fatigue. Most forklift operators at PT Y use a sideways sitting position (for Reach Truck) or facing forward (for Counterbalance), which causes repeated stress on the neck, shoulders, and lower back.

Movements such as looking up to see the height of shelves, turning sideways during maneuvers, and sitting for long periods without optimal back support contribute to muscle fatigue and decreased work concentration. These findings are consistent with studies by Grandjean (1979), McAtamney & Corlett (1993), and Hignett & McAtamney (2000), which state that non-ergonomic postures cause increased biomechanical loads and local muscle fatigue.

Research by Amalia et al. (2022) also confirmed that forklift operators who sit for extended periods and perform repetitive movements are prone to low back pain (LBP). Therefore, implementing ergonomic principles in forklift cabin design and training in proper working posture are crucial steps in reducing posture-related fatigue.

2. The Effect of Workload on Work Fatigue

Workload had the highest influence coefficient in this research model (coefficient = 0.367; T-statistic = 4.590; P-value < 0.001). The workload experienced by forklift operators includes physical load (frequency and duration of heavy equipment operation) and mental load (time demands, high concentration, and responsibility for the safety of goods).

Field observations and management interviews revealed that each forklift operator performs an average of over 70 pick-ups or put-aways per day, with a work shift lasting eight hours. Over the long term, this can lead to decreased endurance and concentration, and potentially dangerous microsleep (Safe Work Australia, 2013).

Hart & Staveland's (1988) research using the NASA-TLX method showed that high workload pressure, particularly in the temporal dimensions of demand and effort, correlates with an increased risk of fatigue. Pratiwi (2023) in her study of RTG crane operators in the logistics sector also found that mental workload was a major predictor of job fatigue.

Workloads that are not balanced with rest time management, fair rotation systems, and the use of supporting technology will increase psychophysical stress on workers. Therefore, companies need to conduct regular workload reviews and consider implementing workload leveling and task redesign systems.

3. The Influence of Psychosocial Factors on Work Fatigue

Psychosocial factors also significantly influence work fatigue (coefficient = 0.333; T-statistic = 4.590; P-value < 0.001). Factors such as work stress, support from superiors and coworkers, and satisfaction with working conditions have a direct impact on employee psychological well-being.

As many as 67% of operators in an internal survey stated they were unwilling to work overtime for health reasons. This indicates that perceptions of work pressure have reached a saturation point, affecting mental readiness and work motivation. According to the Job Demand-Control model (Karasek, 1979), an imbalance between high work demands and low job control or autonomy can lead to chronic stress and emotional exhaustion.

Barker et al. (2009) stated that fatigue is multidimensional—physical, mental, and psychological—and is influenced by a combination of personal and work environment factors. Research by Wu et al. (2020) showed that social support from superiors and colleagues plays a protective role against fatigue, even under demanding work conditions.

The questionnaire results revealed that despite relatively good social support from superiors, some respondents reported feeling less socially connected to their coworkers. This suggests that social interaction in the workplace is not yet a fully effective buffer in reducing perceived mental and emotional stress.

Therefore, efforts are needed to improve relations between workers through team building programs, servant leadership training for superiors, and the provision of informal discussion spaces to create a psychologically supportive work environment.

4. Practical Implications

The findings of this study provide an empirical basis for suggesting that a holistic approach to preventing work fatigue should be implemented, not just limited to technical improvements such as forklift seat design or work equipment, but also encompassing work rhythm management and work culture in the warehouse environment. Integrative interventions such as regular ergonomic evaluations, daily workload mapping, and psychosocial development based on collaborative leadership can be a long-term strategy for preventing chronic fatigue.

CONCLUSION

This study shows that work posture, workload, and psychosocial factors have a positive and significant effect on the level of work fatigue in forklift operators in the warehouse section of PT Y. Among the three variables, workload has the most dominant influence on fatigue, followed by work posture and psychosocial factors. These results indicate that work fatigue is multidimensional, where physical conditions, task load, and psychological and social aspects influence each other.

Unergonomic work postures cause muscle tension and recurring pain, particularly in the neck and back. High workloads—both physical and mental—put ongoing pressure on concentration and endurance. Meanwhile, psychosocial pressures such as stress, lack of social support, and job dissatisfaction exacerbate mental and emotional fatigue.

In general, this research model can explain 64.2% of the variation in forklift operator work fatigue, which shows that the three variables studied are crucial factors in understanding and managing work fatigue in the manufacturing industry sector.

Based on the results of this study, it is recommended that companies conduct a comprehensive evaluation of work ergonomics, particularly forklift operator posture, through improved chair design, more comfortable work positions, and proper posture training. Furthermore, more balanced workload management is needed through adjustments to the number of daily tasks, a fair rotation system, and sufficient rest periods to prevent physical fatigue. In terms of psychosocial aspects, companies need to increase social support through a supportive leadership approach, open two-way communication, and the provision of counseling services or informal discussion spaces as a form of attention to workers' mental well-being. With this integrated strategy, it is hoped that work fatigue can be minimized, thereby sustainably increasing productivity and safety in the warehouse area.

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