International Proceeding Conference on Psychology and Behavioral Sciences
Vol 4 No 1 (2025): 161-176
Copublisher: Collaboration CV. Doki Course and Training with
Institut Agama Islam Nadhlatul Ulama Sumatera Selatan
E-SSN: 2963-0886 / P-ISSN: 2986-5174
DOI: https://doi.org/10.61994/cpbs.v4i1.219

The Influence of Fatigue on the Performance of Machinist : The Moderating Role of Demographic Characteristics

Ully Krismanti[1], Nabila Puspita Ningrum[2], Nabila Nauli Harahap[3]
Master's Program in Psychological Science, Faculty of Psychology, Universitas Persada Indonesia YAI
Corrseponding email: ukrismanti@gmail.com

ABSTRACT

This study aims to examine the effect of fatigue levels on the performance of machinist in Operational Area 1 Jakarta, with demographic characteristics namely age and length of service as moderating variables. A quantitative approach using a survey method was employed, involving 285 respondents selected through purposive sampling. Data were collected using standardized and validated instruments, namely the Individual Work Performance Questionnaire and the Fatigue Severity Scale. Data analysis was conducted using SPSS version 30. The results indicate that fatigue, age, and length of service simultaneously had a significant negative effect on performance, with a significance value of 0.001 < 0.05. Fatigue had a significant negative effect on performance, with a regression coefficient of -0.501 and a probability value of 0.001 < 0.05. Age also had a significant negative effect on performance, with a regression coefficient of -0.268 and a probability value of 0.019 < 0.05. Likewise, length of service showed a significant negative effect, with a regression coefficient of -0.318 and a probability value of 0.002 < 0.05. However, age and length of service were not found to moderate the relationship between fatigue and performance. These findings highlight the importance of fatigue management in maintaining performance, especially in occupations that impact public transportation safety, such as the railway sector. Theoretically, this study contributes to the field of industrial and organizational psychology, particularly in understanding the psychological and demographic factors that influence performance requiring high levels of concentration and physical endurance in the workplace.

Keywords : Fatigue, Performance, Train Operator, Railway, Physchology

Introduction

Transportation plays a strategic role in supporting national growth and territorial integration of the Republic Indonesia. In the context of sustainable development, transportation also contributes to realizing the archipelagic vision and strengthening national resilience, in accordance with the mandate of Pancasila and the 1945 Constitution of the Republic of Indonesia. Railways possess distinctive characteristics as an efficient means of mass transportation. According to Article 1 of Law of the Republic of Indonesia Number 23 of 2007 concerning Railways, railways are defined as an integrated system consisting of rolling stock, infrastructure, and human resources, as well as criteria, norms, requirements, and procedures for the operation of railway transportation. Train refers to railway rolling stock powered by a propulsion system, which may operate independently or be coupled with other railway vehicles, and is intended to or currently moving along railway tracks in relation to train operations.

The development of a railway system that prioritizes safety and service quality has become a key national objective. This framework implies that safety also relies heavily on the performance of machinist who play a critical role in controlling train operations. As stipulated in Article 1 of Law of the Republic of Indonesia Number 23 of 2007 on Railways, the machinist hold certificates of competence and are assigned by railway operators to be on duty during train operations. Furthermore, Article 94 of the Regulation of the Minister of Transportation of the Republic of Indonesia Number PM 24 of 2015 concerning Railway Safety Standards states that the working time for machinist in operating trains is limited to a maximum of 8 hours per day and 40 hours per week, with an effective operational time of 4 hours per day.

The operational context of railway transportation demands a high level of safety, accuracy, and work endurance. The performance of machinist not only affects the smooth running of operations but also serves as a critical determinant in preventing accidents and incidents. As stated in Article 7 of Government Regulation of the Republic of Indonesia Number 62 of 2013 on Transportation Accident Investigation, railway accidents include collisions between trains, derailments, overturning, and fires. Operational performance evaluation data of machinist from 2023 to 2025 recorded 30 train incidents involving human factors as one of the contributing causes. Among these, 9 incidents occurred in Operational Area 1 Jakarta, included trains overshooting stop limits, violating signals, and misrouting at switch points. The most dominant disruptions were caused by machinist's lack of focus, followed by non compliance with standard operating procedures (SOP), microsleep episodes, lack of tactical response, and the emergence of miscommunication.

This has occurred despite the company's ongoing commitment to strengthening human resource quality through various initiatives, including training programs, performance evaluations, enhanced supervisory functions, regulatory refreshers, incentive provision, and performance recognition. These strategic initiatives reflect a serious effort to improve personnel competence and work motivation among machinist. However, this phenomenon opens up space for further exploration of machinist's working conditions and internal factors, which may serve as important indicators for examining psychological machinistects such as fatigue that influence performance, including focus, accuracy, and decision making in carrying out duties.

In addition to operating trains in accordance with procedures, machinist are also required to maintain communication with train dispatchers, handle emergency situations, and sustain focus in a monotonous and high pressure working environment. Each machinist is provided with a confidential and personal performance report booklet, which is securely kept at the Technical Implementation Unit Crew Office. This booklet records various aspects such as mental alertness, health scores, procedural compliance, attendance, operational errors, and commendations. However, on the other hand, the centralized recapitulation system has yet to be collectively documented for comprehensive managerial purposes. The limitation of available secondary data has positioned self assessment as the preferred approach. According to Nurahaju (2023), work demands interaction with supervisors and colleagues, compliance with performance standards, and adherence to organizational rules and policies. This suggests that an individual's assessment of job satisfaction is a complex summation of various discrete and distinguishable machinistects of the job.

The field of psychology plays a crucial role in enhancing both the quality and effectiveness of organizations. The industrial psychology approach emphasizes identifying the competencies required for a particular job and enhancing performance through training programs. Meanwhile, the organizational psychology approach focuses on organizational structure, culture, and work environments that support employee comfort in performing their duties ensuring that machinistects such as human machine interaction, fatigue, stress, and ergonomics are designed to be both safe and efficient (Nurahaju, 2023). Industrial and organizational psychology is the scientific study of human behavior in the workplace (Berry, 1998). Human behavior is studied both at the individual and group levels, based on the assumption that an organization consists of various work units. Industrial and organizational psychology encompasses a body of knowledge consisting of rules, facts, and principles concerning human behavior in the workplace. Its primary aim is to enhance employee performance and well being (Nurahaju, 2023).

The scope of the modern workforce, particularly in public transportation sectors such as railways, has made performance demands increasingly complex. Fundamentally, performance is an individual matter, as each employee possesses varying levels of ability in completing their tasks. Performance refers to the work outcomes of employees in terms of both quantity and quality, measured against predetermined standards (Huseno, 2016). According to Koopmans, as cited in Widyastuti (2018), a theoretical review identifies three core dimensions underlying individual performance research, consisting of :

Table 1. Dimensions of Individual Performance

Dimensi	Keterangan
Task performance	Refers to the extent to which an individual is able to complete core tasks optimally, effectively, efficiently, and in accordance with the standards set by the organization.
Contextual performance	Reflects an individual's contributions beyond formal job duties that support the work environment, such as assisting colleagues, demonstrating loyalty, and taking initiative to improve work processes.
Counterproductive work behavior	Refers to negative behaviors that can harm the organization, such as unexplained absenteeism, rule violations, and actions that disrupt productivity.

The performance of machinist is crucial, as it impacts not only productivity but also passenger safety and the overall operation of the company. Efforts to improve machinist performance through fatigue management and the optimization of human factors are integral components of the national transportation safety management system.

Fatigue is defined as a decline in efficiency and a reluctance to perform tasks, with contributing factors being cumulative in nature (Kroemer, 1997). Fatigue also refers to both psychological and physiological deterioration that leads to reduced work capacity, often accompanied by a subjective feeling and subsequently associated with decreased work performance (Shinar, 2007). Yassierli (2020) identifies three key symptoms of fatigue: physiological changes (such as reductions in neuromuscular capacity and overall physical functioning), performance changes (including decreased output, slower reaction times, and unwillingness to continue working), and subjective sensations (such as feelings of tiredness, exhaustion, lack of motivation, and drowsiness).

Fatigue, such as a loss of motivation, can result from prolonged and continuous tasks carried out over several hours. Fatigue disrupts self regulation as a secondary effect of psychologically demanding tasks. Its impact on performance may cause skilled individuals to behave as if they were unskilled, particularly in decision making, memory, reaction time, and alertness (Salvendy, 2012). Mental workload, poor physical work environment, work life imbalance, and lack of social support can all contribute to fatigue (Robbins, 2015). Fatigue can arise from both internal and external factors. Internal factors include age, gender, nutritional status, and sleep quality, while external factors involve the work environment, workload, shift schedules, and work duration (Handayani, 2023).

An individual's physical and mental health such as metabolism, response to the environment, and energy levels—can be influenced by age in relation to performance. In general, as people age, there is a tendency for cognitive functions such as memory, problem solving, and reaction speed to decline. To mitigate the negative effects of aging on performance, it is essential to maintain a healthy lifestyle, engage in regular physical exercise, and practice mental stimulation (Nuraisyah, 2024). Physical capacity typically increases over several years and reaches its peak between the ages of 25 and 30 (Tarwaka, 2024).

According to Febriyatun (2022), length of service refers to the duration an employee has contributed their labor to a particular company. The extent to which employees can achieve satisfactory results in their work depends on specific abilities, competencies, and skills that enable them to perform their tasks effectively. Jayanti (2021) also argues that length of service is one of the factors influencing employee performance; however, if not properly managed by the organization, it may also contribute to a decline in performance.

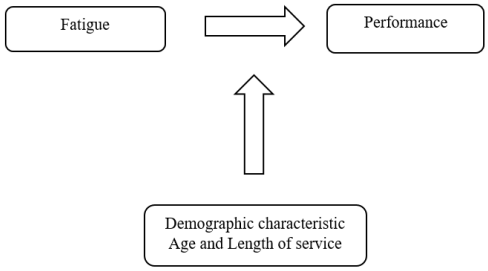
The study by Setiawan (2017) involving 74 dump truck drivers found a significant negative relationship between fatigue and performance, indicating that lower levels of fatigue are associated with higher performance. Similarly, Ilyasa (2023) in a study of 552 medical personnel also found that fatigue had a significant negative impact on performance. This finding aligns with the results of

Azki (2023) research on 38 female junior high school teachers, which also revealed that fatigue negatively affects performance.

In contrast, the study by Megowati (2021) involving 127 professional staff at Medika Mulia Hospital Tuban revealed no relationship between fatigue and performance. Similarly, Taneo's (2024) research on 100 healthcare workers at the BUMN Regional General Hospital (RSUD) in South Central Timor found that fatigue did not have a significant partial effect on performance. However, Dewi (2024), in her study of 107 employees, reported that while fatigue had a negative influence on performance, the effect was not statistically significant.

Demographic characteristics related to fatigue include age and length of service. Handayani (2023), in a study involving 45 employees at a company specializing in aircraft maintenance, repair, and inspection, found that age has an effect on fatigue. Consistent with this, Sutriso (2024) discovered a significant positive relationship between length of service and employee performance among staff at the Department of Education in Katingan Regency. Supporting this finding, Mujianto (2021), in a study of 53 employees at the Operations Department of Ahmad Yani International Airport in Semarang, also found that length of service had a significant positive effect on performance. Furthermore, Lestari (2025) identified length of service as a significant factor influencing the performance of 35 employees at Mbak Timah's Ayam Betutu restaurant. However, contrasting results were reported by Maulina (2019), whose study on 60 garment workers in Banda Sakti District, Lhokseumawe City, concluded that there was no relationship between age, length of service, and fatigue complaints.

Empirical studies in Indonesia on the impact of fatigue on individual performance in the transportation sector particularly among machinist remain limited. It is important to emphasize that operational disruptions do not necessarily indicate systemic failures, but rather reflect the complexity of work related challenges in the public transportation sector. Therefore, this study aims to contribute scientifically by analyzing individual performance and fatigue experienced by machinist in Operational Region 1 Jakarta. Specifically, it seeks to examine the influence of fatigue on performance in order to support optimal occupational safety, in alignment with the company's commitment to professionalism and operational excellence. Additionally, the study aims to identify the moderating role of demographic characteristics, namely age and length of service, in the relationship between fatigue and performance.



Picture 1. Conseptual Framework

Method

The research problem and formulated hypotheses are addressed through an approach and methods aligned with the objectives of the study. The following section presents explanations regarding data collection, sampling techniques, data processing, identification of research instruments, and data analysis.

Data Collection Methods

Primary data were collected through a survey using a structured questionnaire consisting of a series of predefined questions. Meanwhile, the secondary data used in this study included operational

performance evaluation data of machinist from 2023 to 2025, a recapitulation of train quantities based on the 2025 railway timetable, and a literature review.

Sampling Technique

Based on the 2025 railway timetable recapitulation data, Operational Region Jakarta recorded the highest number of trains compared to all other operational regions or regional divisions in Indonesia. A total of 511 trains operate in this area, consisting of 471 regular trains and 40 additional trains. This condition serves as a strong justification for selecting Jakarta as the research location, considering the high intensity of railway operations that directly affects the performance of machinist. The dense schedule of train journeys requires machinist to work at a fast, precise pace with a high level of concentration, thus posing a greater risk of fatigue compared to other operational areas. Furthermore, as the national railway transportation hub, Jakarta functions as a central node in the railway network, making machinist performance in this region highly influential for the overall safety and efficiency of the transportation system.

The population is defined as the entire group of research subjects that share specific characteristics and serve as a source of research data. This study uses a finite population scope, in which the total number is clearly defined based on particular characteristics that distinguish it from other object namely, 341 machinist in Jakarta. A portion of the population, commonly referred to as a sample, is a subset of data drawn from the population to serve as the basis for research (Lubis, 2018). This study employs a purposive sampling technique, in which the sample is selected based on the researcher's judgment or assessment in alignment with specific research objectives (Darmawan, 2013). The researcher assumes that the selected sample possesses the information needed for the study. If the Slovin formula is used to determine the sample size from a population of 341 individuals, the calculation is as follows:

$n = \frac{N}{1+Ne^2}$ thus resulting $\frac{341}{1+341(0,05)^2} = 184$ ..... (1)

Formula (1), where *n* is the sample size, *N* is the total population, and *e* represents the margin of error proportion (0.05), is based on Umar (2003). According to the guidelines of Krejcie and Morgan, for a population of 341 individuals, the recommended sample size is 181 respondents, assuming a 95% confidence level and a 5% margin of error. Therefore, the minimum required sample size is 184 respondents. This study utilized a sample of 285 respondents, which is considered representative.

Data Processing

This study employed a quantitative approach, which emphasizes the testing of theoretical frameworks by measuring research variables numerically and analyzing data using statistical procedures. The research utilized a deductive method to empirically test hypotheses, meaning that the study was conducted systematically and not based solely on subjective opinions (Putri, 2021).

Research Instrumen

Individual evaluation, a specialization within personnel psychology concerning performance appraisal, falls under the domain of industrial psychology (Purnomo, 2023). The dependent variable, performance, was measured using the *Individual Work Performance Questionnaire* (IWPQ), which is designed to assess the daily performance perceptions of machinist Psychologically and behaviorally, the IWPQ evaluates perceived performance rather than technical output or actual performance, making it suitable for use in high risk occupations. The IWPQ has undergone linguistic and cultural adaptation, and its internal reliability (Cronbach's Alpha > 0.8) is deemed adequate for various types of jobs (Widyastuti, 2018). Other test results demonstrated high item reliability (0.90–0.97), making the instrument both valid and reliable for performance assessment (Dwiliesanti, 2022). The IWPQ possesses sound psychometric properties and is appropriate for use as a self assessment tool in both research and organizational practice.

Furthermore, it serves as a valuable instrument for designing work interventions, evaluating and developing employees, and objectively and comprehensively measuring performance within the Indonesian workforce. The IWPQ consists of 18 items covering three dimensions, with all items measured using a 5 point Likert scale (1 = never, 2 = rarely, 3 = sometimes, 4 = often, 5 = always). Higher scores on the *task performance* and *contextual performance* dimensions indicate better performance, while higher scores on the *counterproductive work behavior* dimension suggest that an individual frequently exhibits negative behaviors that may harm the organization (Dwiliesanti, 2022).

Table 2. *Blueprint* IWPQ

Dimensions	Indicators
Task Performance	Able to plan work effectively to meet deadlines (Favorable)
	Consistently keeps work targets in mind (Favorable)
	Able to set priorities in completing tasks (Favorable)
	Completes work efficiently (Favorable)
	Manages work time effectively (Favorable)
Contextual Performance	Takes initiative to start new tasks after completing previous ones (Favorable)
	Willingly undertakes challenging tasks when offered (Favorable)
	Makes efforts to update job related knowledge (Favorable)
	Makes continuous efforts to improve job related skills (Favorable)
	Offers creative solutions when facing new problems (Favorable)
	Takes on additional responsibilities at work (Favorable)
	Actively seeks new challenges in the workplace (Favorable)
	Actively participates in meetings and consultations (Favorable)
Counterproductive work behavior	Complains about minor work related issues in the workplace (Unfavorable)
	Tends to exaggerate problems at work (Unfavorable)
	Tends to focus on the negative rather than the positive machinistects of the workplace (Unfavorable)
	Talks about negative machinistects of work with colleagues (Unfavorable)
	Discusses negative work related issues with people outside the workplace (Unfavorable)

The Fatigue Severity Scale (FSS) is an instrument designed to measure the severity of fatigue in individuals, by exploring its factorial structure to understand the underlying dimensions. The FSS is not intended to be a multidimensional tool, but rather a unidimensional scale, meaning it focuses on a single primary dimension fatigue severity. This dimension reflects the level of fatigue experienced by an individual and the extent to which it affects various machinistects of life, such as physical activity, social relationships, work responsibilities, motivation, and productivity (the degree to which fatigue reduces the drive to complete tasks). The FSS consists of 9 items and is measured using a 7 point Likert scale (ranging from 1 = strongly disagree to 7 = strongly agree) (Aronson, 2023).

The statements reflect the extent to which they accurately describe the individual's condition over the past week. A higher score indicates a greater level of fatigue. The FSS does not explicitly categorize its items into favorable or unfavorable; instead, all items are considered unfavorable. The FSS is a simple and reliable instrument for assessing and measuring fatigue. It demonstrates excellent scale reliability, with a Cronbach's Alpha of 0.946, indicating that the Indonesian version of the FSS is a valid and reliable tool for measuring fatigue (Rifa'i, 2016).

Table 3. *Blueprint* FSS

Dimensions	Indicator
Fatigue severity	Physical exercise causes severe fatigue.
	Easily fatigued.
	Fatigue interferes with my physical functioning.
	Fatigue prevents me from sustaining physical activity for long periods.
	Fatigue affects my work, family life, and social life.
	I am less motivated when I am fatigued.
	Fatigue leads to frequent problems.
	Fatigue interferes with my duties and responsibilities.
	Fatigue is among the most disabling symptoms that limit my activities.

Age and length of employment are among the demographic variables that influence the development of individual character. As individuals grow older, they undergo changes across various machinistects, including cognitive, emotional, and social domains. The age dimension generally includes early adolescence (15–19), young adulthood (20–24), early adulthood (25–29, 30–34), middle adulthood (35–39, 40–44), and late adulthood (45–49, >49 years). This classification aids in segmenting and analyzing age based differences in research. The World Health Organization (WHO) categorizes age in five year intervals, ranging from 0–4 years to 100 years and above. This classification is used to adjust age specific mortality rates globally (Ahmad, 2001).

This study classifies age into the following groups: 15–19, 20–24, 25–29, 30–34, 35–39, 40–44, 45–49, and >49 years, which can be analyzed using either ordinal or nominal scales. When age ranges are used in questionnaires and need to be analyzed as a numerical variable, midpoint coding or representative intervals [(lower limit + upper limit)/2] are required to convert the ranges into representative numerical values. Meanwhile, for the purpose of labor market analysis, length of employment is categorized into short (0–5 years), medium (6–10 years), and long (>10 years) durations (ILO, 2023).

Data Analysis

The data in this study were analyzed using SPSS version 30, including descriptive statistical analysis a branch of statistics that focuses on the collection and presentation of data, primarily concerned with describing or providing information about a dataset, condition, or phenomenon. Descriptive statistics serve to explain conditions, symptoms, and issues. This analysis involves measures such as the mean, maximum and minimum values, standard deviation, and correlations between variables (used to assess the strength of relationships between variables). When a relationship exists between variables, a change in one variable is likely to result in changes in the other variable (Hasan, 2001).

Instrument testing consists of validity and reliability tests. The validity test is used to ensure the accuracy of the questionnaire or research instrument content. The reliability test measures the consistency of the instrument in producing stable and consistent results when administered repeatedly. Reliability ensures that the items in the questionnaire are interrelated and produce trustworthy outcomes.

Classical assumption testing is conducted prior to hypothesis testing to ensure the generation of unbiased linear estimators. When these assumptions are met, the results obtained are more accurate and closer to actual conditions (Hasan, 2001). In this study, the discussion of classical assumptions is focused only on heteroscedasticity and normality. The heteroscedasticity test is used to examine the variance inconsistency in the regression model residuals from one observation to another. A good regression model exhibits homoscedasticity, meaning no heteroscedasticity is present. Meanwhile, the normality test aims to assess whether the variables in the regression model are normally distributed. A good regression model should have normally or near-normally distributed data (Ghozali, 2001).

Hypothesis testing is a procedure used to determine whether to reject or fail to reject a given hypothesis. It is a key task in inferential statistics, a branch of statistics concerned with interpreting and drawing general conclusions from available data. One of the main components of inferential statistics is regression analysis, which is used for prediction. Linear regression is a tool used to measure the influence between variables (Hasan, 2001). The F-test is used to determine whether the independent variables included in the model have a simultaneous effect on the dependent variable. In contrast, the t-test is used to assess the partial effect of a single independent variable in explaining the variation in the dependent variable. The significance level used for testing is 0.05 The coefficient of determination (R^2) is used to measure the model's ability to explain the variation in the dependent variable. The R^2 value ranges between zero and one. A low R^2 indicates that the independent variables have a limited ability to explain the variation in the dependent variable. The greater the coefficient of determination, the stronger the influence of the independent variables on the dependent variable (Ghozali, 2001).

Results

The results of data analysis and interpretation, as a response to the research problems and to demonstrate the relevance and benefits of the research objectives, are described as follows: The demographic data of the respondents, namely machinist Jakarta, are illustrated as follows:

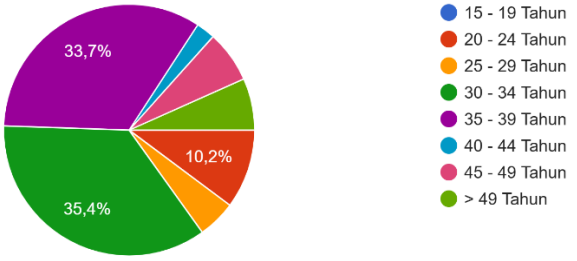


Figure 2. Age Of Respondents

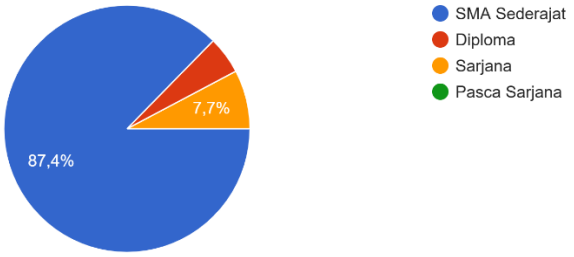


Figure 3. Educational Respondents

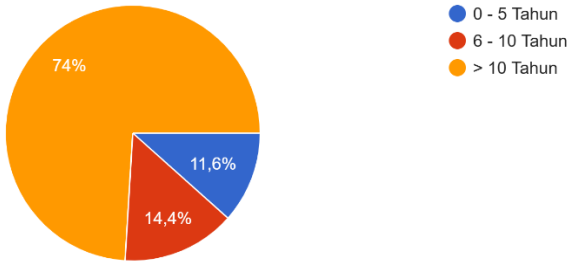


Figure 4. Respondents Length of Employment

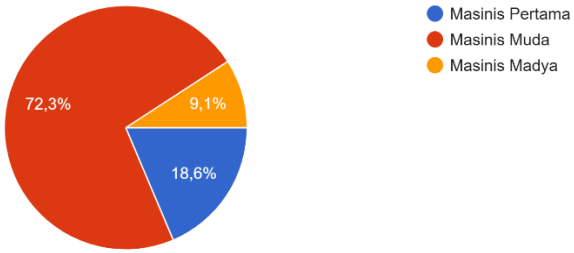


Figure 5. Occupational Position of Respondents

The majority of respondents were within the 30–34 age range, accounting for 35.4% (early adulthood), followed by those aged 35–39 at 33.7% (middle adulthood). All respondents were male, with 85.6% being married and the remaining 14.4% single. Most respondents had an educational background equivalent to senior high school (87.4%). In terms of work experience, 74% had been employed for more than 10 years. Currently, machinist Jakarta consists of 72.3% Junior Locomotive Machinist (*Masinis Muda*), 18.6% First Level Machinist (*Masinis Pertama*), and 9.1% Intermediate Machinist (*Masinis Madya*).

Analysis Descriptive Statistic

Table 4. Descriptive Statistic

	N	Min	Max	Mean	Standar Deviasi
Performance	285	3	5	4.15	.548
Fatigue	285	1	7	3.14	1.546
Age	285	22	53	35.07	7.581
Length of Employment	285	3	20	16.31	6.38
Valid N (*listwise*)	285				

Source : Processed by the Author.

The average performance score was 4.15 (rounded to 4) on a scale ranging from 3 to 5, indicating that, in general, the respondents demonstrated a high level of performance. The low standard deviation (0.548) suggests that the distribution of performance scores among respondents was relatively narrow, meaning most respondents provided answers close to the average (homogeneous).

The respondents' fatigue had an average score of 3.14 (rounded to 3) on a scale from 1 to 7, indicating that the overall level of fatigue was in the low category. However, the relatively high standard deviation (1.546) indicates a considerable degree of variability or differences in fatigue among individuals.

In terms of demographic characteristics, the average age of respondents was in the middle adulthood category (35 years). With a standard deviation of 7.581, this indicates a considerable age variation among respondents, ranging from early adulthood (22 years) to near retirement age (53 years). The majority of respondents had a length of employment of 20 years, while a small portion had shorter tenure, with a minimum of 3 years.

Based on Pearson correlation analysis of 285 respondents, there was a significant negative relationship between fatigue and performance ($r = -0.431$, $p < 0.001$), indicating that higher fatigue are associated with lower performance. Meanwhile, age was not significantly correlated with performance ($r = -0.110$, $p = 0.064$), suggesting that age does not directly affect performance. The interaction variable between fatigue and age also showed a significant negative relationship with performance ($r = -0.403$, $p < 0.001$), indicating the potential presence of a moderation effect. Length of employment showed a negative correlation with performance ($r = -0.230$, $p = 0.000$), indicating that the longer the duration of employment, the lower the performance score tends to be, although the relationship is weak. Both fatigue and length of employment, when considered separately, had a significant negative effect on performance. However, the interaction between fatigue and length of employment was not significant ($p = 0.143$), suggesting that length of employment does not significantly moderate the effect of fatigue on performance.

Instrument Testing

All items of the IWPQ (Individual Work Performance Questionnaire) related to the performance variable showed significant correlations with the total score ($r \geq 0.30$), indicating that all items are valid in measuring the construct of individual work performance. The item with the strongest validity was the statement *"I come up with creative solutions when facing new problems"* ($r = 0.695$). No items needed to be removed based on the validity results. The reliability test showed that the Cronbach's Alpha value for the IWPQ instrument was 0.858, which falls within the good category. This indicates that the items in the questionnaire have high internal consistency and are therefore appropriate for measuring performance in this study.

All items of the FSS (Fatigue Severity Scale), related to the fatigue level variable, demonstrated strong validity ($r \geq 0.50$), confirming that each item validly measures the dimension of fatigue. The item with the highest correlation was *"Fatigue is among the most disabling symptoms that limit my activities"*, which was highly representative of the fatigue construct ($r =$

0.900). The reliability test showed a Cronbach's Alpha value of 0.935, indicating very high internal consistency. This means that all items in the scale consistently measure the same overall construct. The FSS instrument is therefore suitable for assessing fatigue in this population.

Classical Assumption Testing

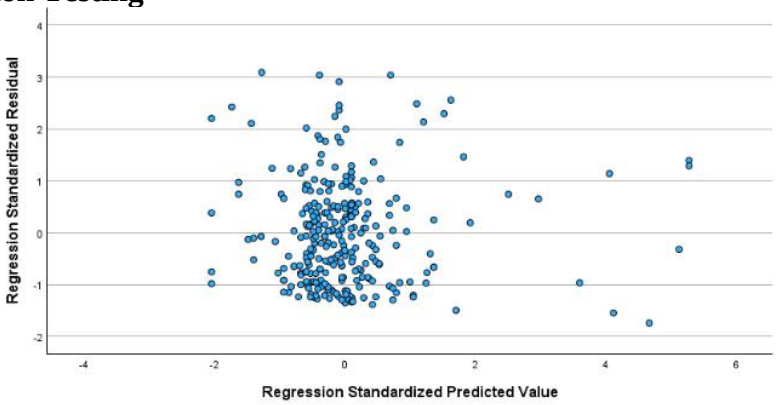


Figure 6. *Scatterplot* Testing Heteroscedasticity

The scatterplot showed that the data points were randomly distributed with no clear pattern (e.g., no funnel shaped or directional spread), indicating the absence of heteroscedasticity. Therefore, the regression model meets the assumption of homoscedasticity, meaning the residual variance is constant.

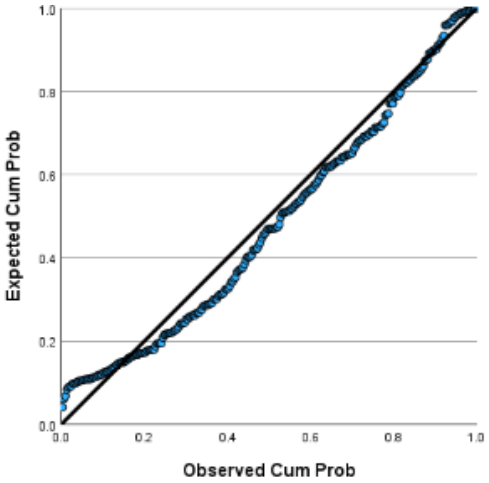


Figure 7. *P-P plot* of Normality Test

In the normality test, the P-P plot shows that the residual points are distributed along and follow the diagonal line, indicating that the residuals approximate a normal distribution. This supports the conclusion that the assumption of normality is met, allowing the analysis to proceed to hypothesis testing.

Hipotesis Testing

The F-test yielded a significance value of 0.001 < 0.05, indicating that the regression model is simultaneously significant. The t-test showed that fatigue level had a significant negative effect on performance, with a regression coefficient of -0.501 and a p-value of 0.001 < 0.05. Thus, H_0 is rejected, and the proposed hypothesis is confirmed.

Age also had a significant negative effect on performance, with a regression coefficient of -0.268 and a p-value of 0.019 < 0.05. However, the interaction between fatigue and age did not significantly moderate the effect of fatigue on performance, with a p-value of 0.078 > 0.05. Therefore, H_0 is not rejected, and the proposed hypothesis fails to be confirmed. Nevertheless, the interaction between fatigue and age can be considered marginally significant, indicating a tendency

toward moderation. The positive direction of the interaction suggests that age may moderate the relationship between fatigue and performance the older the individual, the weaker the negative effect of fatigue on performance.

Length of employment also had a significant negative effect on performance, with a regression coefficient of -0.318 and a p-value of $0.002 < 0.05$. However, the interaction between fatigue and length of employment was not significant ($p = 0.143$), indicating that length of employment does not moderate the effect of fatigue on performance. Therefore, H_0 is not rejected, and the proposed hypothesis fails to be confirmed.

The coefficient of determination (R^2) was 0.202 or 20.2%, which means that the model was able to explain only approximately 20.2% of the variance in performance, while the remaining 79.8% is accounted for by other factors not examined in this study.

Discussion

Based on the measurement results, overall performance was found to be high and stable. This is reflected in both task performance and contextual performance scores, which consistently reached a level of 4 on a maximum scale of 5. Meanwhile, counterproductive work behavior had an average score of 2, indicating that detrimental behaviors toward the organization were relatively low. These findings suggest that individuals are capable of effectively carrying out core job duties while also demonstrating positive social behavior within the workplace. In terms of performance distribution by age and length of service, the performance score remained consistently at 4 across all groups. This indicates no significant differences in performance based on age or tenure, suggesting that machinist across various categories exhibit uniform levels of job performance.

The average fatigue was at a score of 3, indicating a low category on a maximum scale of 7. Among the age groups 20–24 and 40–44 years, the fatigue score was 2, while other age groups consistently scored 3 without significant spikes. This may suggest that individuals in these age ranges possess certain resilience or emotional maturity that helps reduce their perception of fatigue. In terms of length of service, employees with 6–10 years of experience recorded the highest fatigue score of 4. This pattern may reflect differences in fatigue related to career phase dynamics, such as career stagnation or adaptive pressures that typically emerge during mid career. Conversely, those with less than 5 years of service had a lower fatigue score of 2, possibly due to higher motivation or less complex job demands. Meanwhile, employees with more than 10 years of service showed a fatigue score of 3, suggesting that their accumulated experience allows them to better manage fatigue.

Based on the simultaneous test (F-test) results, it was demonstrated that fatigue, age, and length of service all have a significant negative effect on performance. According to Robbins (2015), psychological, situational, and environmental factors influence performance. High levels of stress and fatigue can reduce work performance (Luthans, 2011). Moreover**,** older employees or those with certain health conditions tend to experience fatigue more quickly.

From a psychological perspective, performance is influenced by internal factors such as fatigue, motivation, and perception of the job. Fatigue affects not only the physical machinistect but also an individual’s cognitive and affective states. If left unaddressed, fatigue can lower motivation, impair concentration, and disrupt emotional stability, ultimately leading to a decline in both the quality and quantity of work output. The industrial and organizational psychology approach views fatigue as part of the dynamic interaction between the individual and their work environment (Munandar, 2001).

The t-test results show that fatigue levels have a significant negative effect on performance, which aligns with previous studies indicating that fatigue is an important factor in determining an individual's level of performance (Risnawati, 2016; Kude, 2023). Fatigue can be viewed as a container filled with various pressures, requiring a recovery process to prevent it from overflowing and negatively impacting health (Kroemer, 1997). Fatigue is a crucial aspect in determining

fluctuations in performance and cannot be overlooked, as it may lead to safety risks, particularly in certain types of jobs (Risnawati, 2016).

Long term productivity resilience may stem from effective emotional regulation, including the ability to maintain emotional balance or manage negative energy such as stress, anxiety, and frustration, as these can disrupt focus and concentration, lower work quality, and increase the risk of fatigue. Mental fatigue plays a critical role in influencing focus and productivity by impairing the ability to concentrate (Susanti, 2024). From the perspective of industrial and organizational psychology, performance is not solely about achieving targets, but also about understanding how individuals function within specific psychosocial contexts. Performance is influenced by various factors, including personal factors such as ability, motivation, and commitment all of which are highly susceptible to fatigue caused by prolonged job stress and insufficient recovery. Such fatigue may reduce concentration, work speed, and accuracy, ultimately having a negative impact on work outcomes (Armstrong & Baron, 1998).

Demographic factors such as age and length of service also show a significant negative partial effect on performance, highlighting the importance of addressing individual needs and characteristics, as each employee has a different capacity for coping with job demands (Armstrong & Baron, 1998). Likewise, the relationship between tenure and performance was found to be statistically significant, although the correlation was weak and negative. This may occur when employees with longer tenure do not necessarily demonstrate higher performance; in fact, performance may decline due to factors such as burnout, routine adaptation, or long term fatigue. Performance management should take into account differences in needs based on age, tenure, experience, and both physical and mental readiness. However, age and tenure were not found to moderate the effect of fatigue on the performance of machinist employees.

The results of this study contradict the findings of Ardiani (2022), which indicated that length of service had a positive influence on the performance of 35 employees at PT Telekomunikasi Indonesia (Persero) or PT Telkom (Persero). Similarly, Maulani (2020), in a study of 71 coal transportation drivers at PT Bukit Makmur in South Kalimantan, found that length of service had a significant relationship with fatigue.

Based on the above research, it is evident that performance is not solely influenced by fatigue, but can also be explained by other factors such as self control, job stress, and sleepiness levels. Self control refers to an individual's ability to regulate thoughts, behaviors, and emotions, as well as to restrain impulses or desires that conflict with prevailing norms or values. Indicators of self control include discipline, delayed gratification, and regulation. Its dimensions encompass patience, time management, and emotional awareness. Self control is closely related to an individual's emotional condition, which can influence the attitudes they display. A person who struggles to manage their emotions tends to have difficulty establishing communication with others. In contrast, individuals who are emotionally intelligent and capable of controlling their emotions are more likely to have a strong sense of self-awareness and interact effectively with others. A study of 103 civil servants ein the Civil Service Police Unit of Karawang Regency indicated that self control has a significant influence on improving performance (Amelia, 2025).

Emotional conditions that arise as a response to both external and internal organizational pressures can be described as work stress. Simply put, work stress is associated with the negative feelings employees experience toward their jobs. When individuals are under stress, they tend to experience tension, which leads to changes in physical condition, thoughts, and emotions. If left unaddressed, stress can impair one's ability to interact effectively with their environment. A study involving 100 professional employees at a state owned hospital in South Central Timor revealed that work stress has a negative and significant partial effect on performance (Taneo, 2024). Uncontrolled stress also contributes to fatigue. A significant decline in performance may result from long term unmanaged stress, which leads to extreme mental, emotional, and physical exhaustion (Susanti, 2024). Work related stressors such as excessive workload, long working hours, and

monotonous work environments are major contributors to chronic fatigue. In this context, it is essential to maintain a balance between job demands and individual capacity, including through work shift policies, adequate rest periods, and psychosocial interventions (Robbins & Judge, 2015).

In relation to fatigue, one associated factor is the level of sleepiness, which is measured by an individual's tendency to fall asleep in various activity situations. This machinistect includes responses to passive situations (sitting quietly, waiting, or being in a calm environment), passive social environments (while socializing or being in a crowd), and situations that require alertness (standing while waiting, watching something, or driving a vehicle). A study involving 84 resident doctors at Dr. Sardjito General Hospital confirmed that the level of sleepiness is correlated with the degree of fatigue (Sudira, 2018).

Conclusion

Based on the analysis of 285 respondents from MACHINIST Daop 1 Jakarta, it was found that fatigue have a significant negative effect on performance. The higher the level of fatigue experienced, the lower the level of individual performance. The study revealed that 95.8% of machinist personnel reported that fatigue during duty contributed to incidents. The interaction between fatigue and demographic characteristics such as age and length of service was not statistically proven to significantly moderate the relationship, although the moderating effect of age was marginally significant. This indicates that demographic characteristics of age and tenure have not been confirmed as factors that strengthen or weaken the effect of fatigue on performance. The distribution of performance scores across age and length of service remained consistently high in all groups. This suggests that there are no substantial differences in performance based on age range or length of service, meaning that machinist personnel across various categories exhibit uniform performance. The average level of fatigue fell within the low category, indicating that individuals may possess certain endurance or emotional experience that helps reduce the perception of fatigue.

This study found that neither age nor length of service significantly differentiates performance, which may indicate that the organization has successfully maintained stable performance standards across demographic groups. The regression model in this study explains only 20.2% of the variation in performance, suggesting that the majority of performance variation is influenced by other factors beyond fatigue level, age, and tenure. Nevertheless, sustained fatigue without intervention may lead to systemic performance decline and pose risks to occupational safety, particularly in critical work environments such as the railway sector. While tenure may serve as a moderator, it does not necessarily influence all variable constellations. Moderation effects emerge when the relationship structure is indeed shaped by tenure related experience, not merely due to generalized assumptions.

Fatigue are closely related to decreased performance. Therefore, if not yet implemented, it is essential for the workplace environment in general to manage fatigue through balanced work rest scheduling, attention to ergonomics, and physical and mental well being of employees. This allows employees to improve awareness of how to cope with fatigue. In addition, psychology based organizational strategies such as fatigue and alertness management training or awareness programs, occupational counseling, or mental health initiatives can help maintain the performance stability of machinist working within high risk operational systems.

Employees are encouraged to develop greater awareness of their physical and psychological conditions, particularly in recognizing and managing fatigue. Measures such as maintaining sleep quality, monitoring nutritional intake, and optimizing rest periods can help sustain performance and ensure stability in fulfilling responsibilities that demand accuracy, high concentration, and emotional regulation. To gain a more comprehensive understanding, future research is recommended to include additional variables that may contribute to explaining variations in performance. This study supports the importance of examining the relationship between psychological factors such as fatigue and demographic characteristics in influencing job

performance. These findings can serve as a foundation for the development of more contextual and adaptive work behavior sciences, particularly in understanding the importance of fatigue management in professions that require high levels of concentration, such as machinist.

References

Indonesia. (2007). *Undang-Undang RI Nomor 23 Tahun 2007 tentang Perkeretaapian*. Lembaran Negara RI Tahun 2007 Nomor 65, Tambahan Lembaran Negara RI Nomor 4722. Sekretariat Negara.

Indonesia. (2013). *Peraturan Pemerintah RI Nomor 62 Tahun 2013 tentang Investigasi Kecelakaan Transportasi*. Lembaran Negara RI Tahun 2013 Nomor 156, Tambahan Lembaran Negara RI Nomor 5448. Sekretariat Negara.

Indonesia. (2015). *Peraturan Menteri Perhubungan RI Nomor PM 24 Tahun 2015 tentang Standar Keselamatan Perkeretaapian*. Berita Negara RI Tahun 2015 Nomor 422.

Ahmad, A. (2001). *Age Standardization of Rates: A New WHO Standard*. Geneva: World Health Organization.

Amelia, D.N. (2025). *Pengaruh Kontrol Diri dan Kecerdasan Emosional terhadap Kinerja Pegawai ASN Satuan Polisi Pamong Praja Kabupaten Karawang. Management Studies and Entrepreneurship Journal, 6(3), 3129-3141*.

Ardiani, Febryatun dan Sri Ernawati. (2022). *Pengaruh Masa Kerja dan Komitmen Organisasi terhadap Kinerja Karyawan pada PT Telekomunikasi Indonesia (Persero) Bima. Jurnal Bina Bangsa Ekonomika, 15(2), 2721-7213.*

Armstrong, M. and A. Baron. (1998). *Performance Management: The New Realities*. London: Institute of Personnel and Development.

Aronson, K. (2023). *Validity and Reliability of The Fatigue Severity Scale in A Real-World Interstitial Lung Disease Population. BMC Pulmonary Medicine, 23(1), 294.*

Azki, A. (2023). *Pengaruh Kepuasan Kerja, Beban Kerja, dan Kelelahan Kerja terhadap Kinerja Guru di Yayasan Waqaf Ar Risalah. Jurnal Ilmiah Mahasiswa Perbankan Syariah, 5(1), 2776-5172.*

Berry, M. (1998). *Psychology at Work: An Introduction to Industrial and Organizational Psychology*. Boston: McGraw-Hill Book Co.

Darmawan, D. (2013). *Metode Penelitian Kuantitatif*. Bandung: PT Remaja Rosdakarya Offset.

Dewi, S. (2024). *Pengaruh Konflik Kerja, Kelelahan Kerja, dan Beban Kerja terhadap Kinerja Karyawan PT Usaha Karya Cilacap. Jurnal Akuntansi dan Pajak, 24(2).*

Dwiliesanti, W.G. dan A. Yudiarso. (2022). *Rasch Analysis of The Indonesian Version of Individual Work Performance Questionnaire. Jurnal Pengukuran Psikologi dan Pendidikan Indonesia, 11(2), 153-167.*

Ghozali, I. (2001). *Aplikasi Analisis Multivariate dengan Program SPSS*. Semarang: Badan Penerbit Universitas Diponegoro.

Handayani, M. dan C. Demiyati. (2023). *Hubungan Faktor Individu dan Faktor Pekerjaan dengan Tingkat Kelelahan Kerja di Dinas A PT X Tahun 2022. Jurnal Kesehatan Masyarakat, 11(4).*

Hasan, I. (2001). *Pokok-Pokok Materi Statistik 1: Statistik Deskriptif.* Jakarta: PT Bumi Aksara.

Huseno, T. (2016). *Kinerja Pegawai*. Malang: Media Nusa Creative.

International Labour Organization. (2023). *International Classification of Status in Employment (ICSE-18) Manual*. Geneva: International Labour Office.

Ilyasa, H.F. dan N. R. Juliardi (2023). *Analisis Pengaruh Beban Kerja, Stres Kerja, Kelelahan Kerja, dan Lingkungan Kerja terhadap Kinerja Tenaga Medis. Jurnal Sains dan Teknologi, 2(4), 791-802.*

Jayanti dan Dewi. (2021). *Dampak Masa Kerja, Pengalaman Kerja, Kemampuan Kerja terhadap Kinerja Karyawan. Jurnal Ekonomi Pembangunan, Manajemen, dan Bisnis Akuntansi, 1(2), 75-84.*

Kroemer. K. (1997). *Fitting the Task to The Human. A Textbook of Occupational Ergonomics (7th ed.).* CRC Press.

Kude, L. (2023). *Pengaruh Kelelahan Kerja terhadap Kinerja Pegawai pada Kantor KPU Provinsi Gorontalo. Journal of Management and Business, 6(2), 215-226.*

Lestari, P. dkk. (2025). *Faktor yang Memengaruhi Kinerja Karyawan dengan Masa Kerja sebagai Variabel Moderator. RIGGS, 4(1), 132-138.*

Lubis, M.S. (2018). *Metodologi Penelitian*. Yogyakarta: Deepublish.

Luthans, F. (2011). *Organizational Behavior: An Evidence-Based Approach*. IAP.

Maulani, Akhmad, dkk. (2020). *Shift Kerja dan Masa Kerja terhadap Kelelahan Kerja pada Pengemudi Angkutan Batu Bara. Jurnal Penelitian dan Pengembangan Kesehatan Masyarakat Indonesia, 1(1).*

Maulina. (2019). *Hubungan Usia, Lama Bekerja, dan Durasi Kerja dengan Keluhan Kelelahan Mata pada Penjahit Sektor Usaha Informal di Kecamatan Banda Sakti Kota Lhokseumawe Tahun 2018. Jurnal Averrous, 5(2), 44-58.*

Megowati, K.W. (2021). *Hubungan Kelelahan (Fatigue) dan Beban Kerja terhadap Kinerja Tenaga Kesehatan di Rumah Sakit Medika Mulia Tuban. Jurnal of Public Health Science Research, 2(2), 20-26.*

Mujianto, Gracia Elora dan Indarto. (2021). *Moderasi Komitmen Afektif terhadap Hubungan Masa Kerja dan Perceived External Prestige dengan Kinerja Karyawan. Jurnal Riset Ekonomi dan Bisnis, 14(1), 52-63.*

Munandar, A. (2001). *Psikologi Industri dan Organisasi*. Jakarta: UI Press.

Nurahaju, R. (2023). *Psikologi Industri Organisasi*, Surabaya: Scopindo Media Pustaka.

Nuraisyah, P.S. dan I. J. Fitria (2024). *Pengaruh Stres Kerja dan Beban Kerja terhadap Kinerja Karyawan dengan Faktor Usia sebagai Variabel Moderating di PD. Pido Busana. Jurnal Ekonomika45, 12(1).*

Purnomo, S. dan K. A. Yudhianto. (2023). *Psikologi Industri dan Organisasi*. Yogyakarta: Pustaka Baru Press.

Putri, R. (2021). *Metodologi Penelitian Sosial*. Aceh: Anggota IKAPI.

Rifa'i. (2016). *Validity and Reliability Fatigue Severity Scale in Patients with Systemic Lupus Erythematosus in Indonesia. Indonesian Journal of Rheumatology, 8.*

Risnawati. (2016). *Kelelahan Kerja terhadap Kinerja Karyawan pada PT Bank Mandiri (Persero) Tbk Cabang Medan Imam Bonjol. Jurnal Ilmiah Manajemen dan Bisnis, 17(1).*

Robbins, S.P. and T. A. Judge. (2015). *Organizational Behavior (16th ed.).* Pearson Education.

Salvendy, G. (2012). *Handbook of Human Factors and Ergonomics (4th ed.).* Beijing: Tsinghua University.

Setiawan, B.S.A.D. (2017). *Hubungan Kelelahan terhadap Kinerja Supir Dump Truck. Jurnal Psikoborneo, 5(1), 145-153.*

Shinar, D. (2007). *Traffic Safety and Human Behavior*. London: Elsevier.

P. G. Sudira, P.G. (2018). *Hubungan Tingkat Kantuk terhadap Derajat Kelelahan Dokter Residen di RSUP dr. Sardjito. Jurnal Berkala Neurosains, 17(3).*

Susanti, A. (2024). *Psikologi Produktivitas: Meningkatkan Kinerja Individu dan Tim di Tempat Kerja*. Surabaya: Garuda Mas Sejahtera.

Sutrisno, Tri, dan Fitriani. (2024). *Analisis Dampak Lamanya Masa Kerja terhadap Kinerja dan Efektivitas Pelayanan Publik di Dinas Pendidikan Kabupaten Katingan. Jurnal Pendidikan Pancasila dan Kewarganegaraan, 5(1), 2723-7001.*

Taneo, G.A. (2024). *Pengaruh Kelelahan Kerja, Stres Kerja, Beban Kerja, dan Motivasi Kerja terhadap Kinerja Tenaga Profesional Pemberi Asuhan Lainnya. Journal Syntax Idea, 6(5).*

Tarwaka (2024). *Ergonomi untuk Keselamatan, Kesehatan Kerja dan Produktivitas (Edisi 1).* Surakarta: UNIBA PRESS.

Umar, H. (2003). *Metode Penelitian untuk Skripsi dan Tesis Bisnis*, Jakarta: Raja Grafindo Persada.

Widyastuti, T dan R. Hidayat. (2018). *Adaptation of Individual Work Performance Questionnaire (IWPQ) into Bahasa Indonesia. International Journal of Research Studies in Psychology, 7(2), 101-112.*

Yassierli. (2020). *Ergonomi Industri*. Bandung: PT Remaja Rosdakarya.