Journal Occupational Health Hygiene And Safety
Departement Public Health, UDINUS
E-ISSN: 2987-5625 ; P-ISSN: 2986-8491
http://publikasi.dinus.ac.id/index.php/johhs/index

Vol. 3, No. 2, December 2025

The Relationship Between Mental Workload, Noise, Individual Characteristics and Work Stress among Workers at PT. PLN Nusantara Power UP Muara Tawar

Kania Fitrianti Zahrah*, Ida Wahyuni, Ekawati

Occupational Health and Safety Program, Faculty of Public Health, Diponegoro University
Prof. Jacub Rais Street, Tembalang, Tembalang Sub-district, Semarang City, Central Java 50275, (024) 7460044
*Corresponding Author: *kaniafitriantiz13@gmail.com*

ARTICLE INFORMATION

Article history

Submitted: May 26, 2025

Accepted:: November 24, 2025

Keywords
Keyword 1: Work stress
Keyword 2: Mental workload
Keyword 3: Noise
Keyword 4: Individual characteristics

ABSTRACT

Work environments demanding high productivity often ignore workers' psychological aspects, triggering work stress. Job stress is an individual's response to work pressure exceeding their coping ability. A main cause is mental workload—an individual's perception of task weight to be completed within certain time and conditions. Additionally, workplace noise can worsen psychological conditions, especially if continuous. Individual characteristics such as age, length of service, and education level also determine a person's vulnerability to stress. These factors, if not properly managed, can negatively impact worker health, safety, and productivity.

This study analyzed the relationship between mental workload, noise, individual characteristics, and work stress using quantitative methods with cross-sectional design. The population comprised 134 workers in noise areas divided into 4 fields: operators, machine maintenance, electrical maintenance, and control & instrument maintenance. Using proportionate stratified sampling and accidental sampling techniques, 60 samples were obtained. Results showed 76.7% of respondents experienced moderate work stress, with the most dominant cause being qualitative overload (33.3%). Chi-square test analysis revealed a relationship between mental workload and work stress (p-value = 0.003). However, noise (p-value = 0.422), age (p-value = 0.512), length of service (p-value = 0.259), and education level (p-value = 0.201) were not related to work stress.

In conclusion, there is a significant relationship between mental workload and work stress among workers at PT. PLN Nusantara Power UP Muara Tawar. Therefore, it is important for companies to identify and manage stress-inducing factors to create a healthy and sustainable work environment.

Introduction

Every company certainly wants to achieve optimal performance within a short duration. Companies that wish to realize this need quality workers. Companies believe that the quality of skilled workers will have a direct impact on improving work quality. Workplace hazards always occur and have the potential to endanger workers safety and health.(1) Individual and psychological aspects become the main focus that needs attention. Psychological factors that are included in the types of risks in the work environment are often not recognized or are insufficiently addressed by workers and management.(2)

According to a review conducted by Northwestern National Life on American workers, 40% of workers reported facing stress in the work environment, and 25% of workers believed that their job was the main source of stress in their lives. According to the Labour Force Survey published by the Health Safety Executive (HSE), in 2019-2020, 828,000 cases were reported related to work-related stress, depression, or anxiety.(3) Furthermore, in the Asia-Pacific region, the level of workplace stress is higher compared to the global average at approximately 48%. According to the findings of the Regus survey, it is known that the stress level in Indonesia is 71%. The high level of stress in Indonesia is caused not only by internal factors, but also by work and personal factors. (4) The quantity and quality of work performed, how much or how little work is done, as well as workers perceptions of how heavy or light their workload is, all influence a person's stress level. Workers who are assigned tasks with a workload much lighter than other colleagues will experience fewer challenges in their abilities and job satisfaction. Conversely, workers who are burdened by excessive volume and complexity of work will have limitations in their ability to complete their work.(5)

In 2008, it was recorded that two million workers in the United States were at risk of experiencing hearing problems due to noise exposure in the work environment. As many as 14% of total hearing problem cases in 2007, or approximately 23,000 cases, were caused by work environments that were unsafe for hearing.(6) Excessive stress can affect a person's emotions, which can negatively impact that individual's work and performance. Individual characteristics are among the factors that contribute to the emergence of work stress and influence the intensity of stress experienced. These include age, length of service, marital status, and education level.(7)

PT. PLN Nusantara Power UP Muara Tawar with a capacity of 2.290 MW produced by 5 blocks using gas fuel, was established to support the electrical system of Java, Madura,

Bali (JAMALI). The high-performance demands at the power plant require achieving targets, both in terms of time and optimal results. In addition, noisy working environment conditions can add to the mental workload and affect worker comfort. Physical work environment conditions have an impact on mental workload. This confirms that a good work environment is a determining factor in achieving optimal worker performance in an organization or company.(8)

The factors that have been previously described can be one of many causes that trigger work stress. If the stress-triggering factors in workers are not addressed promptly and properly, there is concern that the level of work stress will increase significantly. The negative impacts of uncontrolled work stress can include decreased work capacity and performance, reduced employee creativity and productivity, deteriorating quality of communication between employees, and increased absenteeism rates. These consequences are not only detrimental to employees, such as disrupted physical and mental health, but also negatively impact the company in the form of decreased operational efficiency and target achievement. Thus, good work stress management is crucial for building a healthy work environment, improving worker welfare, and ensuring the company's overall productivity sustainability. Therefore, based on the problems and literature review that have been conducted, this encourages the researcher to conduct an in-depth study on work stress among workers at PT. PLN Nusantara Power UP Muara Tawar in relation to mental workload, noise, and individual characteristics.

Methods

This type of research uses quantitative research with a cross-sectional approach. The population in this study consists of workers at PT. PLN Nusantara Power UP Muara Tawar who work in noise areas with longer exposure duration compared to workers in other fields, totaling 134 people. The required sample from each field was determined using proportionate stratified sampling technique to determine the number of samples used proportionally across groups that are part of the entire population, and 60 samples were obtained from the total existing population. Sample selection was conducted using accidental sampling technique. Data collection was performed using the NASA-TLX questionnaire for mental workload measurement and the Work Stress Diagnostic Survey questionnaire for work stress measurement. There are two types of analysis used, namely univariate analysis with presentation through frequency distribution tables to obtain the distribution and percentage of each variable, and bivariate analysis conducted using the Chi-Square statistical test. This

research has obtained ethical approval from the Health Research Ethics Committee with number 109/EA/KEPK-FKM/2025.

Results

Table 1. Frequency Distribution of Work Stress, Mental Workload, Noise, Age, Education Level, Length of Service of PT. PLN NP UP Muara Tawar Workers

Variable	Number (n)	Percentage (%)
Work Stress		
Severe	2	3.3
Moderate	46	76.7
Mild	12	20.0
Mental Workload		
Heavy	22	36.7
Moderate	37	61.7
Light	1	1.7
Noise		
Above TLV (>85 dBA)	37	61.7
Below TLV (≤85 dBA)	23	38.3
Age		
Older (>35 years)	26	43.3
Younger (≤35 years)	34	56.7
Education Level		
Bachelor's Degree	41	68.3
Diploma	11	18.3
High School Equivalent	8	13.3
Length of Service		
Long (>10 years)	33	55.0
New (≤10 years)	27	45.0

(Note: "TLV" (Threshold Limit Value) in occupational health terminology. "dBA" is the standard unit for noise measurement in decibels A-weighted.)

Based on the information presented in Table 1, it can be concluded that the level of work stress experienced by the majority of respondents falls into the moderate category with 46 people (76.7%), the majority of respondents' mental workload falls into the moderate category with 37 people (61.7%), the majority of respondents' noise levels fall into the above TLV (>85 dBA) category with 37 workers (61.7%), most respondents are in the younger age group, namely ≤35 years, totaling 34 workers (56.7%). The majority of respondents have an education level in the bachelor's degree category, totaling 41 workers (68.3%), most respondents have a length of service in the long category, namely >10 years, totaling 33 workers (55.0%).

Table 2. Cross-Tabulation of Frequency Distribution of Independent Variables with Dependent Variable

Variable	Work Stress						Total		P
	Severe		Moderate		Mild				
	f	%	f	%	f	%	f	%	
Mental Workload									**0.003**
Heavy	1	4.5	21	95.5	0	0.0	22	100	
Moderate	1	2.7	25	67.6	11	29.7	37	100	
Light	0	0.0	0	0.0	1	100	1	100	
Noise									**0.422**
Above TLV (>85 dBA)	2	5.4	29	78.4	6	16.2	37	100	
Below TLV (≤85 dBA)	0	0.0	17	73.9	6	26.1	23	100	
Age									**0.512**
Older (>35 years)	1	3.8	18	69.2	7	26.9	26	100	
Younger (≤35 years)	1	2.9	28	82.4	5	14.7	34	100	
Length of Service									**0.259**
Long (>10 years)	1	3.0	23	69.7	9	27.3	33	100	
New (≤10 years)	1	3.7	23	85.2	3	11.1	27	100	
Education Level									**0.201**
Bachelor's Degree	2	4.9	34	82.9	5	12.2	41	100	
Diploma	0	0.0	7	63.6	4	36.4	11	100	
High School Equivalent	0	0.0	5	62.5	3	37.5	8	100	

(Note: "TLV" (Threshold Limit Value) as mentioned previously.)

Based on the results presented in Table 2, out of 60 respondents with heavy mental workload, the majority experienced moderate work stress totaling 21 respondents (95.5%), workers with moderate mental workload mostly experienced moderate work stress totaling 25 respondents (67.6%), and workers with light mental workload experienced mild work stress totaling 1 respondent (100.0%). Based on bivariate analysis using the Chi-Square test, a significance result (p) = 0.003 was obtained, which is less than the α value (0.05). It can be concluded that there is a relationship between mental workload and work stress among workers at PT. PLN Nusantara Power UP Muara Tawar.

Based on the data in Table 2, out of 60 respondents exposed to noise above the TLV (>85 dBA), the majority experienced moderate work stress totaling 29 respondents (78.4%), while workers exposed to noise below the TLV (≤85 dBA) mostly experienced moderate work stress totaling 17 respondents (73.9%). Based on bivariate analysis using the Chi-Square test, a significance result (p) = 0.422 was obtained, which is greater than the α value (0.05). It can be concluded that there is no relationship between noise and work stress among workers at PT. PLN Nusantara Power UP Muara Tawar.

According to the information in Table 2, out of 60 respondents, it is known that older workers (>35 years) mostly experienced moderate work stress totaling 18 respondents (69.2%), while younger workers (≤35 years) mostly experienced moderate work stress totaling 28 respondents (82.4%). Based on bivariate analysis using the Chi-Square test, a significance

result (p) = 0.512 was obtained, which is greater than the α value (0.05). It can be concluded that there is no relationship between age and work stress among workers at PT. PLN Nusantara Power UP Muara Tawar.

Based on the results presented in Table 2, out of 60 respondents, it is known that workers with long length of service (>10 years) mostly experienced moderate work stress totaling 23 respondents (69.7%), while workers with short length of service (≤10 years) mostly experienced moderate work stress totaling 23 respondents (85.2%). Based on bivariate analysis using the Chi-Square test, a significance result (p) = 0.259 was obtained, which is greater than the α value (0.05). It can be concluded that there is no relationship between length of service and work stress among workers at PT. PLN Nusantara Power UP Muara Tawar.

Based on the data in Table 2, out of 60 respondents, it is known that workers with bachelor's degree education level mostly experienced moderate work stress totaling 34 respondents (82.9%), workers with diploma education level mostly experienced moderate work stress totaling 7 respondents (63.6%), and workers with high school equivalent education level mostly experienced moderate work stress totaling 5 respondents (62.5%). Based on bivariate analysis using the Chi-Square test, a significance result (p) = 0.201 was obtained, which is greater than the α value (0.05). It can be concluded that there is no relationship between education level and work stress among workers at PT. PLN Nusantara Power UP Muara Tawar.

Discussion

The Relationship Between Mental Workload and Work Stress

Based on statistical data analysis, there is a relationship between mental workload and work stress among workers at PT PLN Nusantara Power UP Muara Tawar. This implies that the higher the intensity of mental workload received by workers, the more significant the level of work stress they experience. According to the research results, the performance aspect is the main factor affecting the mental workload felt by workers. This is evident from the NASA-TLX questionnaire results, where the performance dimension obtained the highest weight and score. The performance aspect describes the extent to which success is achieved in completing tasks in alignment with established objectives. (8) In the work stress variable, based on the results of the work stress diagnostic survey questionnaire, the dominant dimension that emerged was qualitative overload. Qualitative overload occurs when the work assigned exceeds the capacity or ability of workers, which can result in mental fatigue and risk causing work stress.(9)

High mental workload has the potential to cause work stress, especially among workers responsible for operational continuity and maintenance with complex systems. In work environments that demand precision and alertness in decision-making, workers face various challenges that increase stress levels. They have diverse responsibilities, ranging from continuous system monitoring to equipment maintenance and repair. They are required to remain vigilant about changing conditions, able to make quick decisions, and work with high levels of precision. In implementation, workers are often faced with situations that require them to maintain concentration for extended periods without many opportunities to rest, potentially increasing cognitive load and mental pressure. Additionally, some workers also perform tasks that are actually under the responsibility of other departments. This overlap not only adds to their workload but also requires them to handle tasks outside their core expertise, which indirectly increases workload and stress risk.

The results of this study support findings from research conducted by Amirul et al., which stated a relationship between mental workload and work stress with a p-value of 0.029. This occurs because CCR workers at PT. PJB UP Paiton are responsible for monitoring machines used in the production process. This monitoring requires them to continuously be in front of monitors for extended periods, which can cause fatigue, monotony, and boredom. This condition risks decreasing focus levels at work. To maintain concentration, workers need to exert great effort so that the production process continues without obstacles. The greater the effort expended, the higher the mental workload experienced by workers. (10)

The Relationship Between Noise and Work Stress

Based on statistical test results, it was found that there is no relationship between noise and work stress among workers at PT. PLN Nusantara Power UP Muara Tawar. This is due to efforts made by PT. PLN Nusantara Power UP Muara Tawar to reduce the impact of high noise levels, which have been implemented by providing Personal Protective Equipment for workers in areas with noise levels such as earplugs and earmuffs. In work areas with significant noise levels, safety warning signs regarding noise hazards have been installed so that workers or people passing through the area remain vigilant about using PPE, especially when machines are operating, to reduce noise exposure to workers. In addition, the company conducts routine monitoring to ensure the availability, use, condition, and effectiveness of PPE used by workers.

This research reinforces findings from research conducted by Ray et al., which stated that there is no relationship between noise and work stress with a p-value of 0.522. This is because work in the Smelting section of PT Antam UPBN Kolaka always uses earplugs while working; furthermore, the ferronickel processing plant operates in three shifts per day, with each shift lasting eight hours, seven days a week. Workers are also given three rest breaks each day. HSE PT. Antam UPBN Kolaka routinely conducts supervision or patrols and implements sanctions for workers who violate work regulations, including non-compliance in the use of PPE, such as earplugs during work. (10)

However, the findings in this study differ from research results conducted by Eka et al., which concluded there is a relationship between noise and work stress with a p-value of 0.02. This is caused by noise levels in the PTPLN area exceeding the NAV (Threshold Limit Value), which causes difficulty for employees to concentrate while working, discomfort due to work equipment, and increased emotions. Consequently, this can cause hearing disorders and damage to the eardrum, including both temporary and permanent hearing damage.(11)

The Relationship Between Age and Work Stress

Based on statistical data analysis, no relationship was found between age and work stress among workers at PT. PLN Nusantara Power UP Muara Tawar. Workers at PT. PLN Nusantara Power UP Muara Tawar experience work stress levels that are not influenced by age. Both younger and older workers have the same likelihood of facing work stress, because each worker, whether young or old, has their respective workload that is adjusted to the position they hold. This research produces findings that are aligned with a study conducted by Muhammad Nurdin et al., which shows no relationship between age and work stress with a p-value of 0.202. This is hypothesized to occur because workers with older age at PT X power plant tend to have lower stress levels as a result of their more mature experience in facing work pressure. (12)

However, the findings in this study do not correspond with research results by Zulkifli et al., which stated that there is a relationship between age and work stress with a p-value of 0.031. This is because the older a worker's age, the higher the likelihood of suffering from work stress. The cause is the company's lack of attention to the type of work given to service well company employees as well as excessive task burdens on workers under 40 years of age. Older workers tend to have worse health conditions compared to younger workers.(13)

The Relationship Between Length of Service and Work Stress

Statistical analysis results show that there is no relationship between length of service and work stress among workers at PT. PLN Nusantara Power UP Muara Tawar. This occurs because in this study, length of service does not affect the level of work stress experienced. This is due to the distribution of workload being relatively uniform, without explicitly differentiating between workers with long or short tenure. Both workers with years of experience and those newly joined are given relatively similar obligations and work demands, so length of service does not become the main determinant in the emergence of work stress.

The findings in this study are consistent with research conducted by Rahmawati et al., which stated that there is no relationship between length of service and work stress with a p-value of 0.339. This is because generator machine workers with more than 10 years of service tend to be better able to control stress because they have become accustomed to work routines and are more responsive to problems in their work.(14)

However, the findings of this study are not aligned with research by Manabung et al., which stated that there is a relationship between length of service and work stress with a p-value of 0.021. This occurs because workers with longer service periods have better understood and comprehended their job tasks, have more experience, and are stronger in facing pressures that arise in the work environment. This differs from workers who have shorter tenure. This is due to the lack of experience of these workers in facing, overcoming, and resolving problems that arise in the work environment, which has the potential to cause work-related stress.(1)

The Relationship Between Education Level and Work Stress

Based on statistical tests, it can be concluded that there is no relationship between education level and work stress among workers at PT. PLN Nusantara Power UP Muara Tawar. This occurs because the work system in the company is already regulated through fixed Standard Operating Procedures (SOPs). Workers perform tasks based on predetermined work guidelines, so the success of job performance is more determined by adherence to SOPs and work experience compared to educational background.

The results of this study are consistent with research conducted by Muhammad Nurdin et al., which stated that there is no relationship between education level and work stress with a p-value of 0.085. This is indicated by the characteristics of work in the operation and maintenance section at PT X power plant, which places more emphasis on abilities and skills

that are not only obtained through formal education. Every worker accepted at PT X will undergo education and training related to plant operation and maintenance, and participate in routine training held every year.(5)

However, the research results obtained show differences from the research findings of Candraditya and Dwiyanti, which indicate a relationship between education level and work stress with a p-value of 0.000. This phenomenon is supported by observations of workers at PT. X, where severe stress levels are generally found in individuals with final education of Senior High School or equivalent and Diploma, in contrast to mild stress levels that are more dominant among Bachelor's degree graduate workers. Based on this analysis, it can be concluded that education level has the potential to influence respondents' work stress levels. It is assumed that workers with higher education levels tend to only experience mild stress, considering their better understanding in managing work demands according to their personal capacity.(15)

Conclusion

Based on the research results, it is known that there is a relationship between mental workload and work stress, while no relationship was found between noise, age, length of service, education level and work stress. The recommendations that can be implemented by the company are conducting periodic mapping of internal training needs tailored to the specific needs of workers, providing socialization about mental workload and work stress to workers, and providing a safe and comfortable psychological consultation forum for workers. Meanwhile, recommendations that can be implemented by workers are prioritizing tasks according to urgency and main responsibilities, utilizing rest time properly, taking short breaks (timeouts) when starting to feel pressured or tense due to work activities, and building open and active communication among team members**.**

Reference

1. Amalia R, Herwanto D, Rana Zahra W. Analisis Potensi Bahaya Dan Risiko Kecelakaan Kerja Dengan Menggunakan Metode Hazard Identification Risk Assessment And Risk Control (HIRARC) Pada Pemotongan Kayu. Ind Inov J Tek Ind [Internet]. 2023;13(1):13–9. Available from: http://dx.doi.org/10.36040/industri.v13i1.4523
2. Mualim M, Adeko R. Faktor-Faktor Yang Berhubungan Dengan Stres Kerja Pada Pekerja Bagian Dryer PT. Bukit Angkasa Makmur (BAM) Di Kabupaten Bengkulu Tengah. J Nurs Public Heal [Internet]. 2020;8(1):79–86. Available from: http://dx.doi.org/10.37676/jnph.v8i1.1017

3. Ningrum FIK, Marsanti A, Wibowo PA. Hubungan Intensitas Kebisingan Dengan Stres Kerja Pada Pekerja Bagian Produksi. Media Bina Ilm. 2022;17(2):253–62.
4. Nafs T. Pengaruh Beban Kerja terhadap Stres Kerja pada Guru Tahfidz di Pesantren Terpadu Darul Qur'an Mulia. Acta Psychol [Internet]. 2020;2(2):199–208. Available from: http://dx.doi.org/10.21831/ap.v2i2.35106
5. Suryani AI, Muliawan P, Adiputra N. Hubungan beban kerja dengan stres kerja pada karyawan garmen di kota Denpasar. J Penelit dan Kaji Ilm Kesehat Politek Medica Farma Husada Mataram. 2020;6:143–8.
6. Mauliya D, Putra G. Evaluasi Tingkat Kebisingan Ruang Operator Di Unit Pelaksana Pembangkitan Nagan Raya (UPKNGR). SITEKIN J Sains, Teknol dan Ind. 2022;20(1):98–107.
7. Awalia MJ, Medyati NJ, Giay ZJ. Hubungan Umur Dan Jenis Kelamin Dengan Stress Kerja Pada Perawat Di Ruang Rawat Inap RSUD Kwaingga Kabupaten Keerom. JISIP (Jurnal Ilmu Sos dan Pendidikan) [Internet]. 2021;5(2). Available from: http://dx.doi.org/10.36312/jisip.v5i2.1824
8. 'Aini ZK, Paskarini I. Hubungan Beban Kerja Fisik dan Shift Kerja dengan Kelelahan Kerja Subjektif Pekerja Shift (Studi Pada Pekerja Shift di Puskesmas Kepohbaru, Kab. Bojonegoro). Prev J Kesehat Masy [Internet]. 2022;13(4):596–610. Available from: http://dx.doi.org/10.22487/preventif.v13i4.330
9. Nugroho BYS, Putri VA, Rahmadani FV, Maharani LF, Wulandari EE, Pratama BA, et al. Age, Sleep, Fatigue, and Body Mass Index Patterns in Central Java Bus Drivers: Multi-Route Occupational Health Assessment. Indones J Occup Saf Heal. 2025;14(2):178–87.
10. Putra RVD, Zainuddin A, Yasnani Y. Faktor Yang Berhubungan Dengan Stres Kerja Pada Pekerja Bagian Smelting PT Antam Unit Bisnis Pertambangan Nikel Kolaka. J Kesehat Lingkung Univ Halu Oleo [Internet]. 2023;4(3). Available from: http://dx.doi.org/10.37887/jkl-uho.v4i3.46692
11. Putri DN, Lestari F. Analisis Penyebab Kecelakaan Kerja Pada Pekerja di Proyek Konstruksi : Literatur Review. J Kesehat Masy [Internet]. 2023 Jun 1 [cited 2023 Jul 12];7(1):444–60. Available from: http://journal.universitaspahlawan.ac.id/index.php/prepotif/article/view/13281
12. Yoni B, Nugroho S, Widianawati E, Wulan WR, Keselamatan P, Kerja K, et al. Gambaran Keluhan Otot Antara School From Home Dan Work From Home Dalam Pandemi Covid-19. VISIKES J Kesehat Masy [Internet]. 2020 Nov 3 [cited 2022 Feb 20];19(2). Available from: http://publikasi.dinus.ac.id/index.php/visikes/article/view/4030
13. Nurdin DM, Suroto S, Lestantyo D. Hubungan Antara Bagian Operasi Dan Pemeliharaan Terhadap Stres Kerja Pada Pekerja Di Pembangkit Listrik PT X. Jambura J Heal Sci Res [Internet]. 2024;6(4):374–85. Available from: http://dx.doi.org/10.35971/jjhsr.v6i4.27091
14. Justin YK. Hubungan Kebisingan Dan Tekanan Panas Dengan Stres Kerja Pada Pekerja Mebel Bagian Milling di PT Alis Jaya Ciptatama Klaten. J Kesehat Masy [Internet]. 2022;10(2):148–55. Available from: http://dx.doi.org/10.14710/jkm.v10i2.32265
15. Mirani N, Sumardi. Hubungan Beban Kerja dan Stres Kerja dengan Kelelahan Kerja pada Perawat di Instalasi Bedah Sentral Rumah Sakit Umum Daerah Kota Langsa Tahun 2019. J EDUKES (Jurnal Penelit Edukasi Kesehatan) [Internet]. 2020;30–9. Available from: http://dx.doi.org/10.52136/edukes.v3i1.24