International Journal of Health, Economics, and Social Sciences (IJHESS)
Vol. 7, No. 2, April 2025, pp. 754~760
DOI: 10.56338/ijhess.v7i2.7293
Website: https://jurnal.unismuhpalu.ac.id/index.php/IJHESS

Analysis of Work Shifts and Mental Workload with Work Fatigue in Water Treatment Plant Operators at Perumdam Muara Tirta Gorontalo City Using NASA-TLX and SOFI Methods

Ramadhan Utiarahman[1*], Herlina Jusuf[2], Tri Septian Maksum[3]
[1]Department of Public Health, Universitas Negeri Gorontalo, Indonesia
[2]Department of Public Health, Universitas Negeri Gorontalo, Indonesia
[3]Department of Public Health, Universitas Negeri Gorontalo, Indonesia

Article Info

Article history:

Received, 15 Mar, 2025
Revised, 06 Mar, 2025
Accepted, 24 Apr, 2025

Keywords:

Fatigue, Shift, Mental Workload

ABSTRACT

Work fatigue is a condition of workers who are weakened to do a job and have an impact on decreasing work productivity. Factors that trigger work fatigue include internal factors (age, gender, work position) and external factors (workload, length of work, work period, work shift and work environment). The purpose of this research was to analyze work shifts and mental workload with work fatigue in Water Treatment Plant operators at Perumdam Muara Tirta Gorontalo City using the NASA-TLX and SOFI methods. The type of research used was analytic observational with a cross-sectional research design. The research instrument used the NASA-TLX and SOFI questionnaires. Data were analyzed using the Spearman's Rank correlation test. The results of the study of work shifts of Water Treatment Plant operators using the fast rotation shift system. Mental workload was mostly in the moderate category with 20 operators (51.3%) and work fatigue was mostly in the moderate category with 26 operators (66.7%). There is a strong relationship between work shifts and work fatigue (ρ-value = 0.000; r = 0.653) and there is a quite strong relationship between mental workload and work fatigue (ρ-value = 0.008; r = 0.417). It is recommended that operators be able to adjust their working hours properly to the demands of duties and responsibilities outside of work.

Corresponding Author:
Ramadhan Utiarahman
Department of Public Health, Universitas Negeri Gorontalo, Indonesia
Email : ramdanutiarahman321@gmail.com

INTRODUCTION

International Labor Organization (ILO) reveals that occupational safety and health is an effort to maintain and improve the highest degree of physical, mental and social health for workers (1). These efforts are made by a workplace to create safe and comfortable conditions for workers to reduce or avoid work accidents that can cause losses to workers and the workplace environment (2).

One of the OHS problems is work accidents caused by fatigue. Fatigue is the condition of workers who are weakened to do their work and can have an impact on decreasing productivity and work endurance (3). The problem that exists almost all over the world is that work fatigue is a trivial condition and is not even a priority for companies or industries (4). Work fatigue is very influential on health and can reduce worker productivity if worker fatigue is not considered (5). Measurement of fatigue in workers is needed by companies to anticipate work accidents. One effective method for measuring fatigue is to use the Swedish Occupational Fatigue Inventory (SOFI) method. The advantages of the SOFI method compared to other work fatigue measurements are that it is more descriptive for physical fatigue and mental fatigue and there are five indicators of fatigue measurement (6).

Work fatigue can be triggered by various factors, namely internal factors and external factors. Internal factors include age, gender, work attitude and psychology, while external factors include working time, work shifts, workload and workplace environment (7).

The work shift system has a significant impact on worker fatigue levels (8). Workers on the night shift can experience considerable fatigue. This is due to the 8-hour working hours and the difference in body habits (body rhythms) that should rest at night, but are forced to work (9). Data from Jamsostek in 2021, there were 82,000 cases of work accidents, and as many as 7,961 people died due to fatigue that occurred in shift workers (10).

Work fatigue in workers can also be caused by workload due to work, one of which is high mental workload. The amount of work that is not proportional to the worker's ability both physically, expertise and time can be a source of work fatigue. This is because the source comes from work demands that exceed the limits of workers' abilities, resulting in an increase in mental workload (11). Mental workload measurement is needed by companies to determine the capacity of workers so that workload can be anticipated. There are several methods in measuring mental workload, one of which uses the National Aeronautics and Space Administration Task Load Index (NASA-TLX) method. (12). NASA TLX has several advantages, namely multidimensional measurement, fast and simple in the data presentation process compared to the SWAT method, and low research costs, but has a high sensitivity value (13).

Based on initial observations at five Water Treatment Plants in Perumdam Muara Tirta Gorontalo City, the operator's working time is set for 24 hours a day, consisting of three shifts, namely morning, afternoon, and evening using a fast rotation shift system. Initial survey results for mental workload measurement using the NASA-TLX method showed that out of 10 operators there were 4 operators with heavy mental workload category (average WWL = 81.3-87.3), 5 operators with moderate mental workload category (average WWL = 50.6-68.6) and 1 operator with light mental workload category (average WWL = 17.3). Then for the measurement of work fatigue using the SOFI method shows that out of 10 operators there are 8 operators with moderate fatigue category (score = 52-95), and 2 operators with light fatigue category (score = 27-32).

METHODOLOGY

This research was conducted from November to December 2024 at the Water Treatment Plants in Perumdam Muara Tirta Gorontalo City. This type of research is analytic observational with a cross sectional study approach. The sample in this study was 39 Water Treatment Plant operators obtained using exhaustive sampling technique. The research instrument used NASA-TLX and SOFI questionnaires. Data were analyzed using the Spearman Rank test ($\alpha = 5\%$).

RESULT

Univariate Analysis

Table 1. Distribution of Respondents Based on Work Shifts in Water Treatment Plant Operators at Perumdam Muara Tirta Gorontalo City.

Work Shifts	n	%
Morning	13	33,3%
Afternoon	13	33,3%
Night	13	33,3%
Total	39	100%

Based on Table 1, the number of respondents in the three work shifts is the same. The morning shift was 13 operators (33.3%), the afternoon shift was 13 operators (33.3) and the night shift was 13 operators (33.3%).

Table 2. Distribution of Respondents Based on Mental Workload in Water Treatment Plant Operators at Perumdam Muara Tirta Gorontalo City.

Mental Workload	n	%
Light	1	2,6%
Moderate	20	51,3%
Heavy	18	46,1%
Total	39	100%

Based on Table 2, respondents with the most mental workload in the moderate category were 20 operators (51.3%), while the least in the light category was 1 operator (2.6%).

Table 3. Distribution of Respondents Based on Work Fatigue in Water Treatment Plant Operators at Perumdam Muara Tirta Gorontalo City.

Work Fatigue	n	%
Light	3	7,7%
Moderate	26	66,7%
High	10	25,6%
Total	39	100%

Based on Table 3, respondents with the most work fatigue in the moderate category were 26 operators (66.7%), while the least in the light category were 3 operators (7.7%).

Bivariate Analysis

Table 4. Relationship between Work Shifts and Work Fatigue in Water Treatment Plant Operators at Perumdam Muara Tirta Gorontalo City.

Work Shifts	Work Fatigue						Total		ρ-value	r
	Light		Moderate		High					
	n	%	n	%	n	%	n	%		
Morning	2	15,4	11	84,6	0	0,0	13	100,0	0,000	0,653
Afternoon	1	7,7	11	84,6	1	7,7	13	100,0		
Night	0	0,0	4	30,8	9	69,2	13	100,0		
Total	3	7,7	26	66,7	10	25,6	39	100,0		

Based on Table 4, it is known that the morning work shift has 13 operators (100.0%), most of whom are distributed in the frequency of moderate fatigue with 11 operators (84.6%) and the least in the frequency of light fatigue with 2 operators (15.4%). The afternoon shift had 13 operators (100.0%), most of whom were distributed in the moderate fatigue frequency with 11 operators (84.6%) and least in the light and high fatigue frequencies with 1 operator (7.7%) each. The night shift of 13 operators (100.0%) was most distributed in the high fatigue frequency of 9 operators (69.2%) and least in the moderate fatigue frequency of 4 operators (30.8%).

Spearman rank correlation test results obtained ρ-value = 0.000 <0.05 indicates there is a relationship between work shifts and work fatigue in Water Treatment Plant operators at Perumdam Muara Tirta Gorontalo City. The value of r = 0.653 indicates the strength of the relationship is strong and positive (unidirectional), meaning that the later the work night, the higher the work fatigue experienced by Water Treatment Plant operators at Perumdam Muara Tirta Gorontalo City.

Table 5. Relationship between Mental Workload and Work Fatigue in Water Treatment Plant Operators at Perumdam Muara Tirta Gorontalo City.

Mental Workload	Work Fatigue						Total		ρ-value	r
	Light		Moderate		High					
	n	%	n	%	n	%	n	%		
Light	0	0,0	1	100,0	0	0,0	1	100,0	0,008	0,417
Moderate	3	15,0	14	70,0	3	15,0	20	100,0		
Heavy	0	0,0	11	61,1	7	38,9	18	100,0		
Total	3	7,7	26	66,7	10	25,6	39	100,0		

Based on Table 5, it is known that light mental workload amounted to 1 operator (100.0%) who was distributed in the frequency of moderate fatigue. Moderate mental workload amounted to 20 operators (100.0%) who were mostly distributed at the frequency of moderate fatigue as many as 14 operators (70.0%) and the least were at the frequency of light and high fatigue each as many as 3 operators (15.0%). Heavy mental workload amounted to 18 operators (100.0%) who were mostly distributed in the moderate fatigue frequency of 11 operators (61.1%) and the least in the high fatigue frequency of 7 operators (38.9%). Spearman rank correlation test results obtained ρ-value = 0.008 <0.05 indicates that there is a relationship between mental workload and work fatigue in Water Treatment Plant operators at Perumdam Muara Tirta Gorontalo City. The value of r = 0.417 shows that the strength of the relationship is quite strong and positive (unidirectional), meaning that the higher the mental workload, the higher the work fatigue in Water Treatment Plant operators at Perumdam Muara Tirta Gorontalo City.

DISCUSSION

Work Shifts of Water Treatment Plant Operators at Perumdam Muara Tirta Gorontalo City

Based on the results of the study, the work shifts at the Water Treatment Plant operators is divided into three shifts, namely the morning shift (08.00-16.00), afternoon shift (16.00-24.00), and night shift (24.00-08.00) using a fast rotation shift system. Where in one week there is a rotation exchange every two days. Each shift generally has the same work activities, but the night shift will be more at risk of increasing work fatigue. This is due to disrupted cycardian rhytem (the natural state of the body) such as sleep, readiness to work, and other autonomic processes that should rest at night because of demanding work then the processes in the body are forced to be alert at work, so that the lack of rest time during night shift work.

The work shifts system is generally divided into 3 periods: morning shift, afternoon shift and night shift. Work shifts is from 08.00-16.00 WITA, 16.00-24.00 and 24.00-08.00 (14). Shift workers have several potential risk factors for fatigue. Shift workers have higher levels of fatigue than non-shift workers. Night shift workers have a higher risk of sleep disturbance, mood and distress (15).

This research is in line with research conducted by Wila et al. (2021) on employees of the Lazada Cimanggis Linehaul & Shuttle Warehouse Division, obtained employee working time, namely 24 non-stop hours with the division of working hours / shifts. The shift division is divided into 3 times, namely morning, afternoon, and night with a total working time of 8 hours. The first time division is 08.00-16.00, afternoon 16.00-24.00, also at night with working hours 24.00-08.00.

Mental Workload of Water Treatment Plant Operators at Perumdam Muara Tirta Gorontalo City

Based on the results of the study, it shows that 1 operator (2.6%) experienced light mental workload, 20 operators (51.3%) experienced moderate mental workload, and 18 operators (46.1%) experienced heavy mental workload. Light mental workload with a score (average WWL) = 17.3. Moderate mental workload with a score (average WWL) = 50-78. Heavy mental workload with a score (average WWL) = 81-96.7. The most dominant aspects affecting the mental workload of all operators are physical demand, performance and level of effort. This is due to the demands of tasks carried out simultaneously and requires operators to work optimally which will affect salaries so that operators must achieve a good level of success in completing work.

According to Henry R. Jex, mental workload is the difference between the workload demands of a task and a person's maximum mental load capacity (16). The main factors that determine mental workload are task demands, effort and performance. (17).

This research is in line with research conducted by Mohammadian et al. (2022) on mining control room operators, obtained from all operators on average have moderate mental workload. The most dominant aspects affecting the mental workload of all operators are mental demand, temporal demand and performance.

Work Fatigue of Water Treatment Plant Operators at Perumdam Muara Tirta Gorontalo City

Based on the results of the study, it shows that as many as 3 operators (7.7%) experienced light fatigue, 26 operators (66.7%) experienced moderate fatigue, and 10 operators (25.6%) experienced high fatigue. Light fatigue with a total score of 29-32. Moderate fatigue with a total score of 52-95. High work fatigue with a total score of 101-128. The most dominant dimensions felt were lack of energy, physical discomfort and sleepiness. Symptoms felt by operators such as stiffness in the shoulders, pain in the muscles caused by work such as lifting chemicals and making repairs to tools and machines. This makes the operator feel tired and has a lot less energy. Operators who work the night shift often feel sleepy, yawn, lose their vision when sleepy, and cannot concentrate while working.

Work fatigue is a group of symptoms associated with a decrease in work efficiency, skills and increased anxiety or boredom (18). Summa'mur states that there are several symptoms associated with work fatigue such as fatigue, frequent yawning, headaches, stiffness in the shoulders, pain, tremors and feeling unwell. (19).

This research is in line with research conducted by Hasan & Mohd Thamrin (2022) on truck drivers working in logistics companies, obtained the highest level of fatigue using the SOFI method, which is in the moderate category. The highest dimensions felt are lack of energy and physical exertion.

Relationship between Work Shift and Work Fatigue in Water Treatment Plant Operators at Perumdam Muara Tirta Gorontalo City

The results showed that ρ-value = 0.000 <0.05 and the value of r = 0.653, meaning that there is a relationship between work shifts and work fatigue in Water Treatment Plant operators at Perumdam Muara Tirta Gorontalo City, and the strength of the relationship between the two variables is strong with a positive relationship direction (unidirectional) which means that the later the work night, the higher the work fatigue experienced by Water Treatment Plant operators at Perumdam Muara Tirta Gorontalo City. This is because

the time to sleep at night is disturbed which results in Water Treatment Plant operators becoming often sleepy at work and difficult to concentrate on doing work. In addition, the diverse work and workload in each shift is a contributing factor to increased fatigue.

Work shifts can have a significant impact on worker fatigue levels (8). Summa'mur states that workers who work at night will experience greater levels of fatigue than workers who work in the morning or afternoon. This is due to the disruption of workers' sleep time at night, which then results in workers being sleepy and wanting to lie down but being held back due to night shift duty (20).

This research is in line with research conducted by Sumardiyono et al. (2023) on packing operators at PT So Good Food-Unit UHT Boyolali using somers'd test with a value of ρ-value = 0.000 < α = 0.05 which means there is a significant relationship between work shifts and work fatigue. Another study conducted by Russeng et al. (2021) on ATC officers at Sultan Hasanuddin International Airport Makassar using the chi square test obtained ρ-value = 0.015 <0.05 which indicates a significant relationship between work shifts and work fatigue.

Relationship between Mental Workload and Work Fatigue in Water Treatment Plant Operators at Perumdam Muara Tirta Gorontalo City

The results showed that ρ-value = 0.008 < 0.05 and the value of r = 0.417, meaning that there is a relationship between mental workload and work fatigue in Water Treatment Plant operators at Perumdam Muara Tirta Gorontalo City, and the strength of the relationship between the two variables is quite strong with a positive relationship direction (unidirectional) which means that the higher the mental workload, the higher the work fatigue of Water Treatment Plant operators at Perumdam Muara Tirta Gorontalo City. This is due to the demands of the work that must be carried out such as Water Treatment Plant operators must constantly monitor and test the physical quality of water, as well as make adjustments when faced with unexpected events such as equipment and machine breakdowns. These situations require a quick response and the right decision, as the slightest mistake can be fatal.

Mental workload is the gap between the demands of a job and the maximum mental load capacity of a worker. If work demands exceed a person's capacity, this condition can cause overstress, fatigue and work accidents. Mental workload that is too high will cause excessive energy use, thus triggering fatigue, both mental fatigue and physical fatigue (21).

This is in line with research conducted by Marfuah et al. (2024) on PT X employees using the somers'd correlation test obtained ρ-value = 0.000, which shows there is a significant relationship between mental workload and work fatigue. Another study conducted by Jalali et al. (2023) using the Structural Equation Modeling (SEM) test showed a significant positive relationship between mental workload and work fatigue (β = 0.36; p < 0.001).

CONCLUSIONS

The working shifts of Water Treatment Plant operators at Perumdam Muara Tirta Gorontalo City consist of three shifts, namely morning, afternoon and night using a fast rotation shift system. The morning work shift is carried out at 08.00-16.00 WITA, the afternoon shift starts at 16.00-24.00 WITA and the night shift at 24.00-08.00 WITA.

The mental workload of Water Treatment Plant operators in Perumdam Muara Tirta Gorontalo City is mostly in the moderate category as many as 20 operators (51.3%) with an average WWL = 50-78.

Work fatigue in Water Treatment Plant operators at Perumdam Muara Tirta Gorontalo City is mostly in the moderate category as many as 26 operators (66.7%) with a total score = 52-95.

There is a relationship between work shifts and work fatigue in Water Treatment Plant operators at Perumdam Muara Tirta Gorontalo City (ρ-value = 0.000; r = 0.653)

There is a relationship between mental workload and work fatigue in Water Treatment Plant operators at Perumdam Muara Tirta Gorontalo City (ρ-value = 0.008; r = 0.417).

SUGGESTION

It is recommended to be able to adjust working hours properly to the demands of tasks or responsibilities outside of work. In addition, operators should use the rest time that has been given properly.

REFERENCES

Aprilliani, C. (2022). Keselamatan Dan Kesehatan Kerja (K3) PT Global Eksekutif (Issue March). PT. Global Eksekutif Teknologi.

Jusuf, H., Arsad, N., & Mahdang, P. A. (2023). Body Posture Analysis Using Rapid Entire Body Assessment (REBA) Method with Skeletal Muscle Complaints in Furniture Workers in Gorontalo Regency. International Journal of Health, Economics, and Social Sciences (IJHESS), 5(4), 480–483.

Malik, I., Hardi, I., & Abbas, H. H. (2021). Faktor yang Berhubungan dengan Kelelahan Kerja di PT. Industri Kapal Indonesia (Persero) Makassar. Window of Public Health Journal, 2(1), 173–183

Bunga, S., Amirudin, H., Situngkir, D., & Wahidin, M. (2021). Faktor Yang Mempengaruhi Kelelahan Kerja Pada Tenaga Kesehatan Lapangan Dompet Dhuafa Pada Masa Pandemi Covid 19. Jurnal Kesehatan Masyarakat Indonesia, 2(1), 40–51.

Susanti, S., & AP, A. R. A. (2019). Faktor yang Berhubungan dengan Kelelahan Kerja pada Pekerja PT. Maruki International Indonesia Makassar. Hasanuddin Journal of Publich Health, 2, 231–237.

Bagas, P. B., & Prastawa, H. (2023). Analisis Tingkat Kelelahan Serta Keluhan Anggota Tubuh Menggunakan Metode Swedish Occupational Fatigue Inventory (SOFI) Dan Nordic Body Map (NBM) (Studi Kasus Pekerja Divisi Produksi PT XYZ). Industrial Engineering Online Journal, 12(4)

Nur, M., Ridho, O., & Rihtianti, L. A. (2024). Gambaran Faktor Internal dan Faktor Eksternal dengan Kelelahan Kerja pada Perawat Rumah Sakit Umum Daerah Dr . Soeroto Ngawi. Media Gizi Kesmas, 13(1), 257–265.

Safirin, M. T., Islami, M. C. P., Sari, R. N., Panjaitan, A. L. M., & Marwadelia, A. (2023). Analisis Shift Kerja Terhadap Kelelahan Pegawai Produksi Melalui Pengukuran Beban Kerja Fisik Menggunakan Metode Cardiovasculair Load (CVL) dan Perhitungan Konsumsi Energi Pada Perusahaan Pabrikasi di Surabaya. Waluyo Jatmiko Proceeding, 16(1), 511–520.

Lestari S, A. D., Batara, A. S., & Mutthalib, N. U. (2021). Faktor yang berhubungan dengan Kelelahan Kerja pada Karyawan di PT Sumber Graha Sejahtera Luwu. Window of Public Health Journal, 1(6), 1145–1156.

Karama, M. F. (2022). Perbedaan Kelelahan Kerja Antara Shift Pagi dan Shift Malam pada Petugas Operasional Terminal Tipe A Dungingi Kota Gorontalo. In Skripsi. Universitas Negeri Gorontalo

Marfuah, N., Sumardiyono, S., & Fauzi, R. P. (2024). Hubungan Beban Kerja Mental dengan Kelelahan Kerja dan Stres Kerja pada Pegawai PT X. Jurnal Kesehatan Masyarakat, 12(2), 140–147.

Puyuhiyo, Z., Wolok, E., & Lahay, I. H. (2024). Pengukuran Beban Kerja Pekerja Di UD. Bintang Jaya Mandiri Menggunakan CVL Dan NASA-TLX. Jurnal Peradaban Sains, Rekayasa Dan Teknologi, 12(1), 56–66

Rahdiana, N., Hakim, A., & Sukarman. (2021). Pengukuran Beban Kerja Mental Bagian Marketing PT. Pindo Deli di Masa Covid-19 dengan Metode NASA TLX. Jurnal Sistem Teknik Industri, 23(1), 9–21.

Pradina, T. M., & Febrianto, K. (2022). Hubungan Antara Shift Kerja dengan Stres Kerja Pada Petugas Lembaga Pemasyarakatan. Borneo Student Research, 3(2), 1884–1889.

Seo, J. W., Lee, J., Jeon, S., Hwang, Y., Kim, J., Lee, S., & Kim, S. J. (2023). Fatigue and somatization in shift-workers: Effects of depression and sleep. Journal of Psychosomatic Research, 173, 111467.

Nasution, M. S. S. (2022). Analisis Beban Kerja Mental Pada Quality Control di PT Sinar Mas Agro Resources And Technology Tbk. In Skripsi. Universitas Medan Area.

Mosi, B. S. (2022). Analisis Hubungan Beban Kerja Mental Dan Massa Kerja Dengan Stress Kerja Pada Pegawai Kantor Di Dinas Penanaman Modal, Energi Sumber Daya Mineral Dan Transmigrasi Provinsi Gorontalo. In Skripsi. Universitas Negeri Gorontalo.

Ramadhani, A. (2023). Pengaruh Beban Kerja Terhadap Kelelahan Kerja Pada Karyawan PT. JNE EXPRESS Cabang Umum Medan. In Skripsi. Universitas Medan Area.

Andriani, A. E. (2021). Faktor Yang Berhubungan Dengan Tingkat Kelelahan Kerja Pada Pekerja Pembangunan Jembatan Ploso Jombang. In Skripsi. Stikes Bakti Husada Mulia Madiun.

Aini, Z. K., & Paskarini, I. (2022). Hubungan Beban Kerja Fisik dan Shift Kerja dengan Kelelahan Kerja Subjektif Pekerja Shift (Studi Pada Pekerja Shift di Puskesmas Kepohbaru, Kab. Bojonegoro). Preventif : Jurnal Kesehatan Masyarakat, 13(4), 596–610.

Febrilliandika, B. (2020). Pengukuran Beban Kerja Mental Kuliah Daring Mahasiswa Teknik Industri USU Dengan Metode NASA-TLX. Seminar Dan Konferensi Nasional IDEC, 9, 1–7

Hasan, A., & Tamrin, S. B. M. (2022). Risk factors and evaluation of occupational fatigue among logistic truck drivers in Malaysia. Safety and Health at Work, 13, S201–S202.

Jalali, M., Esmaeili, R., Habibi, E., Alizadeh, M., & Karimi, A. (2023). Mental workload profile and its relationship with presenteeism, absenteeism and job performance among surgeons: The mediating role of occupational fatigue. Heliyon, 9(9), 19258.

Mohammadian, M., Parsaei, H., Mokarami, H., & Kazemi, R. (2022). Cognitive demands and mental workload: A filed study of the mining control room operators. Heliyon, 8(2), 08860.

Russeng, S. S., Saleh, L. M., Mallongi, A., & Hoy, C. (2021). The relationship among working period, work shift, and workload to work fatigue in air traffic controllers at Sultan Hasanuddin Airport. Gaceta Sanitaria, 35, S404–S407.

Wila, A. R., Husniati, R., & Fadlillah, A. M. (2021). Pengaruh Shift kerja Dan Stres Kerja Terhadap Kinerja Pegawai Divisi Linehaul & Shuttle Warehouselazada Cimanggis. Jurnal Ekonomi Dan Bisnis, 3(2), 6.

Sumardiyono, Pertiwi, M. P., & Nugroho, D. (2023). Hubungan Beban Kerja Fisik dan Shift Kerja dengan Kelelahan Kerja Pada Karyawan Operator Packing di PT So Good Food-Unit UHT Boyolali. Journal of Applied Agriculture, Health, and Technology, 2(2), 1–9.