Analysis of Body Posture of Rice Processing Warehouse Workers Using OWAS Method (Ovako Working Analysis System)

Topan Nopanto[1], Ade Astuti Widi Rahayu[2], Fathurohman[3]
[1,2,3] Program Studi Teknik Industri, Universitas Buana Perjuangan Karawang
Jl. HS. Ronggo Waluyo, Puseurjaya, Telukjambe Timur, Karawang, Jawa Barat 41361
Email: ti18.topannopanto@mhs.ubpkarawang.ac.id, ade.widiastuti@ubpkarawang.ac.id,
fathurohman@ubpkarawang.ac.id

ABSTRACT

This research assessed the body posture of rice processing workers using the Ovako Working Analysis System (OWAS) method to identify postures leading to high musculoskeletal disorder (MSD) risks. The study observed seven workers in a rice processing warehouse, where 60% of work postures were classified as high-risk (Action Code 4). These postures, frequently involving lifting heavy loads and prolonged bending, significantly contribute to the prevalence of MSD symptoms such as back, arm, and leg pain. Data collection included systematic observation and analysis categorized by OWAS Action Codes. Immediate corrective actions, including ergonomic adjustments and improved training, are essential to mitigate these risks. The findings emphasize the need for ergonomic interventions to enhance worker safety, reduce injury risks, and improve productivity. This research provides valuable insights into the ergonomic challenges in rice processing environments, underlining the importance of regular posture assessments and proactive measures to create safer workplaces.

Keywords: *Musculoskeletal, Ovako Working Analysis System, Work posture*

Introduction

The growth of the rice processing industry, particularly the role of workers, has become crucial in performing various tasks that require interaction with equipment and the work environment. Ergonomic aspects, especially workers' body posture, are a primary concern to maintain their well-being and productivity. Posture analysis plays a significant role in understanding the impact of ergonomics on rice processing workers, and one effective method for this analysis is the OWAS (Ovako Working Posture Analysis System) method, focusing on the potential emergence of Musculoskeletal Disorders (MSDs). Among the total of 1,144,000 cases of MSDs in workers, there is a notable distribution of cases, with 493,000 cases affecting the back, 426,000 related to the upper limbs or neck, and 224,000 occurring in the lower limbs [1]–[3]. PD Sumber Barokah is a rice processing center where transporting sacks of rice and paddy still relies on human labor. This activity involves relatively long and repetitive journeys, often with heavy loads, increasing the risk of Musculoskeletal Disorders. On Monday, October 2, 2023, an initial observation was conducted on 7 workers. On Thursday, August 1, 2024, a second observation was initiated on 7 workers transporting rice and paddy at PD Sumber Barokah, who reported complaints of pain or stiffness in the arms, neck, shoulders, lower back, and legs. These complaints are expected to negatively impact work productivity and efficiency and increase the likelihood of work-related illnesses and accidents caused by work activities. Therefore, a comprehensive understanding of the spread of these symptoms is crucial to addressing the health impacts in the rice processing work environment [4]–[6]. Implementing relevant ergonomic solutions, such as adjusting equipment like trolleys, is expected to reduce MSDs and support creating a safer and healthier work environment in the rice processing sector. Therefore, preventing MSDs involves identifying risks and implementing concrete corrective actions. Based on the background of the problem above, the author is interested in further research with the title "Analysis of Body Posture of Rice Processing Warehouse Workers Using Owas Method (Ovako Working Analysis System)".

Ergonomics

The concept of ergonomics has existed since ancient times; for example, primitive people cut tools from stone. Ergonomics then rapidly developed, spearheaded by F.W. Taylor, Frank, and Lillian Gilbreth, who began to establish the term ergonomics. This occurred during the industrial revolution in the 19th century. The term ergonomics is derived from the Latin words "Ergon" (work) and "Nomos" (natural laws). It can be interpreted as studying human aspects within their work environment, viewed from physiological, psychological, technical, management, and design perspectives[7]–[11].

Musculoskeletal Disorders (MSDs)

Musculoskeletal refers to complaints arising in parts of the skeletal muscles that individuals feel. These complaints can range from mild symptoms to severe pain [12]. If muscles experience repeated static loads over a long period can result in complaints such as damage to joints, ligaments, or tendons. The term used to describe this series of complaints and damage is Musculoskeletal Disorders (MSDs) or injuries to the musculoskeletal system[13], [14].

Nordic Body Map

The Nordic Body Map, according to [15]–[19], is used as a tool to assess musculoskeletal disorders (MSDs) experienced by workers. The assessment of Musculoskeletal Disorders (MSDs) complaints is conducted through the application of a questionnaire that illustrates various types of MSD complaints on a human body diagram. By utilizing this questionnaire, areas of muscles experiencing complaints can be identified, and the level of complaint can be measured from No Pain, Slight Pain, Pain, to Severe Pain [20].

Ovako Work Analysis (OWAS)

OWAS (Ovako Work Analysis System) is an ergonomic method used to evaluate postural stress on workers that can lead to musculoskeletal disorders or muscle abnormalities [21], [22]. This method is used to classify work postures and loads used during processes into several categories of work phases. Body postures are analyzed and then rated for classification[23], [24].

Table 1. OWAS Method Action Codes

	Action	Code
Back	Upright	1
	Bending forward or backward	2
	Twisting and moving sideways	3
	Twisting and moving or bending sideways and forward	4
Arm	Both arms are below shoulder level	1
	One arm is above shoulder level	2
	Both arms are above shoulder level	3
Leg	Sitting	1
	Standing with both legs straight	2
	Standing with weight on one leg	3
	Standing with both knees slightly bent	4
	Standing with one knee slightly bent	5
	Standing with one and/or both feet	6
	Moving or shifting position	7
Weight	Weight load is less than 10 kg	1
	Weight load is 10 kg - 20 kg	2
	Weight load is more than 20 kg	3

Source: [25]

Research Methods

This study uses a quantitative analysis approach with a cross-sectional design, focusing on analyzing the body posture of rice processing workers. The population of this study involved all employees, consisting of 7 randomly selected from the population. The data collection procedure used the OWAS (Ovako Work Posture Analysis System) method. The results of this analysis are interpreted to identify the level of risk of musculoskeletal injuries that may be associated with the body posture of workers.
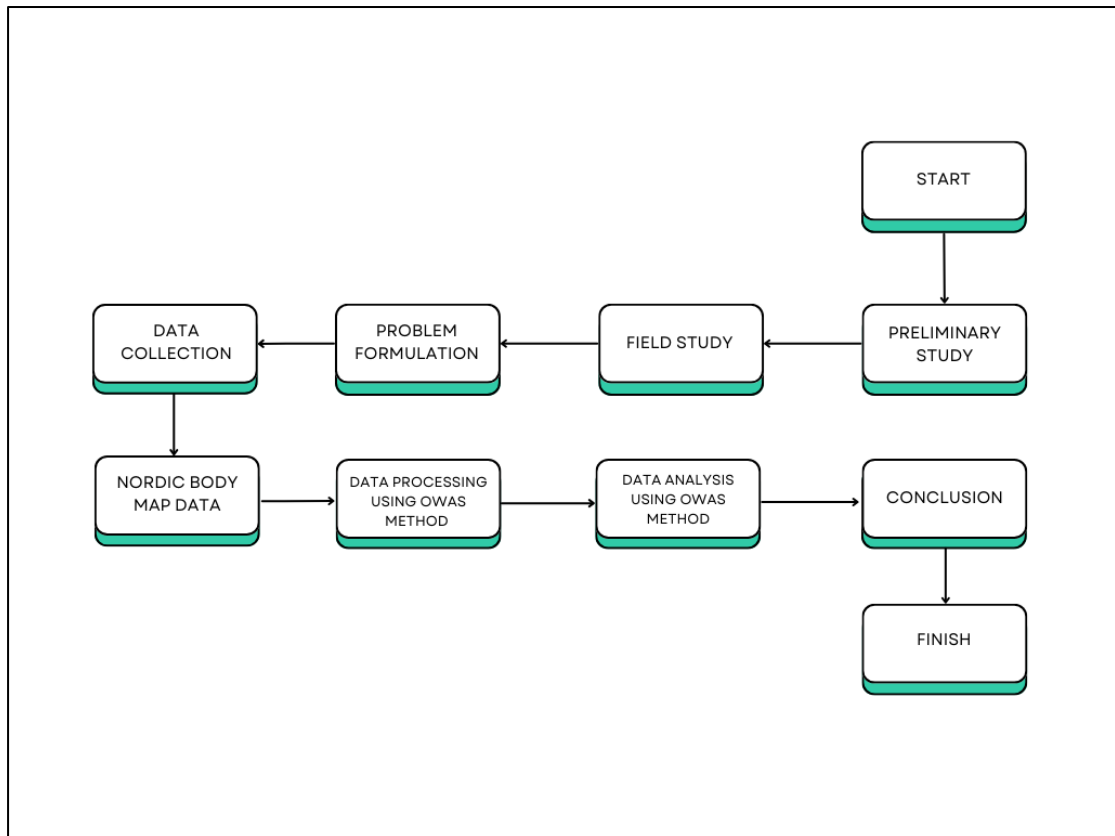
Figure 1. Research Flowchart

Results and Discussion

Data analysis was done by classifying risk levels based on individual scores from the Nordic Body Map questionnaire. Next, a risk score is given by applying the OWAS method.

Table 2. PD Sumber Barokah Worker Data

No	Worker's Name	Age	Length of Service	Smoker / Non-Smoker
1	Jaja	30	4 Year	Smoker
2	Aril	35	4 Year	Smoker
3	Tohari	50	10 Year	Smoker
4	Karja	46	8 Year	Smoker
5	Lebe	50	7 Year	Smoker
6	Oyok	40	7 Year	Smoker
7	Fahri	28	2 Year	Smoker

Data analysis was conducted to identify and find the root causes of issues and provide recommendations for reducing employee injuries. The results obtained from the discussion using the OWAS method include posture classification, work posture categories, and posture assessment. Below is a summary of the results of the NBM questionnaire for the workers mentioned above.

Table 3. Summary of NDM Questionnaire for PD Sumber Barokah

No.	Type Of Complaint	Worker						
		J	A	K	F	T	L	O
0	Pain/Stiffness in the upper neck	1	2	2	1	3	4	1
1	Pain/Stiffness in the lower neck	3	3	4	3	3	3	3

2	Pain in the left shoulder	3	3	4	2	4	3	3
3	Pain in the right shoulder	3	3	4	3	4	3	3
4	Pain in the upper left arm	2	2	3	2	3	2	2
5	Pain in the back	3	3	4	3	4	2	3
6	Pain in the upper right arm	2	2	3	2	3	3	2
7	Pain in the waist	2	2	3	2	3	2	2
8	Pain in the coccyx	1	1	2	1	3	2	1
9	Pain in the buttocks	1	1	2	1	3	2	1
10	Paint in the left elbow	2	2	3	2	3	2	2
11	Pain in the right elbow	2	2	3	2	3	1	2
12	Pain in the left forearm	1	1	1	1	2	1	1
13	Pain in the right forearm	1	1	1	1	2	2	1
14	Pain in the left wrist	1	2	1	1	2	2	1
15	Pain in the right wrist	1	1	1	1	2	2	1
16	Pain in the left hand	1	1	1	1	2	2	1
17	Pain in the right hand	1	2	1	1	2	2	1
18	Pain in the left thigh	1	1	1	1	2	2	1
19	Pain in the right thigh	1	2	1	1	2	3	1
20	Pain in the left knee	2	1	2	1	2	3	2
21	Pain in the right knee	2	2	2	2	3	3	2
22	Pain in the left calf	2	2	1	2	3	3	2
23	Pain in the right calf	2	2	2	2	4	3	2
24	Pain in the left ankle	1	1	2	2	4	2	1
25	Pain in the right ankle	1	1	2	1	3	3	1
26	Pain in the left foot	2	2	1	1	3	3	2
27	Pain in the right foot	2	2	2	2	2	3	2
	Total Score	**47**	**50**	**59**	**45**	**79**	**68**	**47**

Data Processing Using the OWAS Method

One approach to addressing issues in manual material handling is the OWAS method. This method is effective for detecting disorders in the musculoskeletal system, particularly in the back, arms, and legs. It is relatively simple to apply and provides workers comfort and safety while performing manual material handling tasks.

Work Posture Analysis of Employees Moving Rice Using the Ovako Working Postures Analysis System

Figure 2. Rice Moving Activity

One of the activities at PD Sumber Barokah is moving rice. In this activity, employees lift rice above their shoulders, which leads to complaints of pain in the right and left shoulders among the employees working in this position. The employees' activity can be seen in Figure 3.

Table 3. OWAS Classification Results

BACK	ARMS	1			2			3			4			5			6			7			legs use of force
		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	
1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	1	1	1	1	1	1	
	2	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	1	1	1	1	1	1	
	3	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	1	1	1	1	1	2	
2	1	2	2	3	2	2	3	2	2	3	3	3	3	3	3	3	2	2	2	2	3	3	
	2	2	2	3	2	2	3	2	3	3	3	4	4	3	4	4	3	3	4	2	3	4	
	3	3	3	4	2	2	3	3	3	3	3	4	4	4	4	4	4	4	4	2	3	4	
3	1	1	1	1	1	1	1	1	1	2	3	3	3	4	4	4	1	1	1	1	1	1	
	2	2	2	3	1	1	1	1	1	2	4	4	4	4	4	4	3	3	3	1	1	1	
	3	2	2	3	1	1	1	2	3	3	4	4	4	4	4	4	4	4	4	1	1	1	
4	1	2	3	3	2	2	3	2	2	3	4	4	4	4	4	4	4	4	4	2	3	4	
	2	3	3	4	2	3	4	3	3	4	4	4	4	4	4	4	4	4	4	2	3	4	
	3	4	4	4	2	3	4	3	3	4	4	4	4	4	4	4	4	4	4	2	3	4	

Based on Table 4, the work activity of employees moving rice has a score of 4 for the back due to twisting and bending sideways and forward, a score of 2 for the arms due to one arm being above shoulder level, a score of 7 for the legs due to movement and shifting, and a score of 3 for the load due to the weight being more than 20 kg. After inputting the posture scores for the rice moving activity into the OWAS table, the final score is 4.

Analysis of Employees' Posture in Rice Shoveling Using the OWAS Method

Figure 3. Shoveling Rice

Another activity at PD Sumber Barokah is shoveling rice. In this activity, employees shovel rice using a scoop while bending forward and resting their hands on the scoop, leading to complaints of pain in the back and hands. The employees' activity can be seen in Figure 4.

Table 5. OWAS Classification Results

BACK	ARMS	1			2			3			4			5			6			7			legs use of force
		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	
1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	1	1	1	1	1	1	
	2	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	1	1	1	1	1	1	
	3	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	1	1	1	1	1	2	

BACK	ARMS	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
	1	2	2	3	2	2	3	2	2	3	3	3	3	**3**	3	3	2	2	2	2	3	3
2	2	2	2	3	2	2	3	2	3	3	3	4	4	3	4	4	3	3	4	2	3	4
	3	3	3	4	2	2	3	3	3	3	3	4	4	4	4	4	4	4	4	2	3	4
	1	1	1	1	1	1	1	1	1	2	3	3	3	4	4	4	1	1	1	1	1	1
3	2	2	2	3	1	1	1	1	1	2	4	4	4	4	4	4	3	3	3	1	1	1
	3	2	2	3	1	1	1	2	3	3	4	4	4	4	4	4	4	4	4	1	1	1
	1	2	3	3	2	2	3	2	2	3	4	4	4	4	4	4	4	4	4	2	3	4
4	2	3	3	4	2	3	4	3	3	4	4	4	4	4	4	4	4	4	4	2	3	4
	3	4	4	4	2	3	4	3	3	4	4	4	4	4	4	4	4	4	4	2	3	4

Based on Table 5, the work activity of employees involved in rice husking has a score of 2 for the back due to bending forward or backward, a score of 1 for the arms due to both arms being below the shoulders, a score of 5 for the legs due to standing with one knee slightly bent, and a score of 1 for the load due to the load weight being less than 10 kg. After inputting the employee's work posture scores with the rice husking activity in the OWAS table, a value of 3 is obtained.

Posture analysis of rice drying employees using the OWAS method
Postures Analysis System (OWAS)

Another activity at PD Sumber Barokah is rice drying. In this activity, employees dry the rice with a slightly bent body position and hands holding the broom load, so that employees complain of pain in the back and hands. Employee activity can be seen in Figure 5.

Figure 4. Drying Rice

Table 4. OWAS Classification Results

		1			2			3			4			5			6			7			legs
BACK	ARMS	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	use of force
	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	1	1	1	1	1	1	
1	2	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	1	1	1	1	1	1	
	3	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	1	1	1	1	1	2	
	1	2	2	3	**2**	2	3	2	2	3	3	3	3	3	3	3	2	2	2	2	3	3	
2	2	2	2	3	2	2	3	2	3	3	3	4	4	3	4	4	3	3	4	2	3	4	
	3	3	3	4	2	2	3	3	3	3	3	4	4	4	4	4	4	4	4	2	3	4	
	1	1	1	1	1	1	1	1	1	2	3	3	3	4	4	4	1	1	1	1	1	1	
3	2	2	2	3	1	1	1	1	1	2	4	4	4	4	4	3	3	3	3	1	1	1	
	3	2	2	3	1	1	1	2	3	3	4	4	4	4	4	4	4	4	4	1	1	1	
	1	2	3	3	2	2	3	2	2	3	4	4	4	4	4	4	4	4	4	2	3	4	
4	2	3	3	4	2	3	4	3	3	4	4	4	4	4	4	4	4	4	4	2	3	4	
	3	4	4	4	2	3	4	3	3	4	4	4	4	4	4	4	4	4	4	2	3	4	

Based on Table 6, the work activity of employees drying rice has a score of 2 for the back due to bending forward or backward, a score of 1 for the arms due to both arms being below shoulder level, a score of 2 for the legs due to standing with both legs straight, and a score of 1 for the load due to the weight being less than 10 kg. After inputting the posture scores for the rice drying activity into the OWAS table, the final score is 2.

Analysis of the OWAS Scoring Results
Below is a summary of the scores for the three evaluated work postures.

Table 5. Posture Scoring Summary

No	Work Posture	Back	Arms	Legs	Use of force	OWAS Score
1	Lifting rice	4	2	7	3	4
2	Shoveling rice	2	1	5	1	3
3	Drying rice	2	1	2	1	2

Based on the OWAS scores, they can be classified according to the level of risk and corrective actions, as shown in the table above. After determining the risk level of the work postures, the OWAS score categorization results are as follows:

Table 6. Recap of Scores Based on Categories

OWAS Score Value	Action	Work Posture
4	Comprehensive action is required immediately	Lifting rice
3	Immediate action is required	Shoveling rice
2	Action may be needed in the future	Drying rice

Based on the table above, the results indicate that the three tasks performed by employees—rice moving, rice shoveling, and rice drying—pose a high risk of musculoskeletal disorders (MSDs). Therefore, actions must be taken to improve posture or working conditions. Suggested improvements can be seen in Table 5 as follows:

Table 9. Suggested Improvements

Work Posture	Improvement Suggestions
Lifting rice	Using lifting aids such as a trolley
Shoveling rice	Modifying tools to make them easier to use and reduce fatigue that can cause pain
Drying rice	Doing warm-up exercises before performing rice drying activities to minimize muscle complaints in the hands and back

Conclusion

This study concludes that rice processing workers are at substantial risk of MSDs due to poor posture during high-risk activities like moving. Immediate ergonomic interventions, such as training and equipment modifications, are recommended to mitigate these risks. Furthermore, the study highlights the importance of regular posture assessments in identifying and addressing emerging risks. Future research should explore the longitudinal effects of ergonomic changes in similar industrial settings, providing a broader understanding of their impact on worker health and productivity.

References

[1] H. A.Cheisario andA. S.Wahyuningsih, "Faktor – Faktor Yang Berhubungan Dengan Terjadinya Keluhan Muskuloskeletal Disorder Pada Pekerja Di PT. X," *Indones. J. Public Heal. Nutr.*, vol. 2, no. 3, pp. 329–338, 2022, doi: 10.15294/ijphn.v2i3.55016.

[2] W.Anggraini andA. M.Pratama, "Analisis Postur Kerja Dengan Menggunakan Metode Ovako Working Analysis System (Owas) Pada Stasiun Pengepakan Bandela Karet (Studi Kasus Di Pt. Riau Crumb Rubber Factory Pekanbaru)," *J. Sains, Teknol. dan Ind.*, vol. 10, no. 1, pp. 10–18, 2012.

[3]   B.Hilman Fauzi, "Mengurangi Kelelahan Otot Dengan Menggunakan Metode OWAS dan REBA (Studi Kasus di CV. Meteor Custom)," *J. REKAYASA dan OPTIMASI Sist. Ind.*, vol. 02, no. 1, pp. 16–21, 2020.

[4]   R.Ramisah Alfiani, R.Listyandini, andA.Fathimah, "Faktor-Faktor yang Berhubungan dengan Keluhan Musculoskeletal Disorders (MSDs) pada Penjahit di Pasar Anyar Bogor Tahun 2022," *Promotor*, vol. 6, no. 3, pp. 204–212, 2023, doi: 10.32832/pro.v6i3.246.

[5]   A.Syukur, "Perancangan Alat Bantu Proses Pemasangan Daun Pintu Menggunakan Metode Verein Deutcher Ingenieure (VDI) 2222." uin suska riau, 2021.

[6]   L.Handoko andH. N.Amrullah, "Pengaruh Faktor Pekerjaan Terhadap Tingkat Risiko Musculoskeletal Disorders (MSDs) Pada Tenaga Kerja di Sektor Pendidikan," *Heal. Res. J.*, vol. 1, no. 01, pp. 26–34, 2024.

[7]   A. J.Nugroho, *Tinjauan Produktivitas Dari Sudut Pandang Ergonomi*. 2021.

[8]   R.Krismanto andA. N.Hidayat, "Identifikasi Risiko Ergonomi Dengan Metode Nordic Body Map Terhadap Operator Final Inspection Di PT. JKLM," *Pros. Sains dan Teknol.*, vol. 1, no. 1, pp. 589–595, 2022.

[9]   M. I. H.Umam, N.Nofirza, M.Rizki, andF. S.Lubis, "Optimalisasi Jumlah Kebutuhan Tenaga Kerja pada Stasiun Kerja Hoisting Crane Menggunakan Metode Work Sampling (Studi Kasus: PT. X)," *J. Tek. Ind. J. Has. Penelit. dan Karya Ilm. dalam Bid. Tek. Ind.*, vol. 5, no. 2, pp. 125–129, 2020.

[10]   A.Anwardi, N.Nofirza, andH.Jasri, "Perancangan Alat Bantu Memanen Karet Ergonomis Guna Mengurangi Resiko Musculoskeletal Disorder Menggunakan Metode RULA dan EFD," *J. Tek. Ind. J. Has. Penelit. dan Karya Ilm. dalam Bid. Tek. Ind.*, vol. 5, no. 2, p. 139, 2020, doi: 10.24014/jti.v5i2.9000.

[11]   E.Safira, N.Nofirza, A.Anwardi, H.Harpito, M.Rizki, andN.Nazaruddin, "Evaluation of Human Factors in Redesigning Library Bookshelves for The Blind Using The Ergonomic Function Deployment (EFD) Method," in *Proceedings the 3rd South American International Industrial Engineering and Operations Management Conference*, 2022.

[12]   E. F.Agustin andR. A.Darajatun, "Analisis Postur Kerja Pekerja Gudang Barang Jadi Menggunakan Metode Ovako Work Posture Analysis System (OWAS) di PT Victorindo Kimiatama," *Go-Integratif J. Tek. Sist. dan Ind.*, vol. 4, no. 01, pp. 61–75, 2023.

[13]   R.Asnel andA.Pratiwi, "Analisis Faktor-Faktor Yang Mempengaruhi Keluhan Musculoskeletal Disorder Pada Pekerja Laundry," *Public Heal. Saf. Int. J.*, vol. 1, no. 01, pp. 45–53, 2021, doi: 10.55642/phasij.v1i01.23.

[14]   M. Y.MF, R.Kurnia, G. D. N.Kusuma, and..., "Studi Risiko Ergonomi dan Keluhan Subjektif Work-Related Musculoskeletal Disorders (WMSDs) pada Penjahit di Kota Tanjungpinang," *... dan Manaj. Ind. ...*, 2023, [Online]. Available: http://jurnal-tmit.com/index.php/home/article/view/271

[15]   N. F.Dewi, "Identifikasi Risiko Ergonomi dengan Metode Nordic Body Map Terhadap Perawat Poli RS X," *J. Sos. Hum. Terap.*, vol. 2, no. 2, pp. 125–134, 2020, doi: 10.7454/jsht.v2i2.90.

[16]   Y. P.Yusdystira, "Recommendations for work posture using nordic body maps and RULA methods," *AIP Conference Proceedings*, vol. 2882, no. 1. 2023. doi: 10.1063/5.0176488.

[17]   O.Adiyanto, "Application of Nordic Body Map and Rapid Upper Limb Assessment for Assessing Work-related Musculoskeletal Disorders: A case study in Small and Medium Enterprises," *Int. J. Integr. Eng.*, vol. 14, no. 4, pp. 10–19, 2022, doi: 10.30880/ijie.2022.14.04.002.

[18]   M. Z.Gasyanin, "The use of nordic body map and rapid upper limb assessment (RULA) methods in textile companies," *AIP Conference Proceedings*, vol. 2882, no. 1. 2023. doi: 10.1063/5.0176487.

[19]   N.Nelfiyanti, "Identification of Ergonomic Issues Among Malaysian Automotive Assembly Workers by Using the Nordic Body Map Method," *Lecture Notes in Mechanical Engineering*, vol. 46. pp. 69–81, 2021. doi: 10.1007/978-981-15-9505-9_8.

[20]   S. F.Zahra andH.Prastawa, "Analisis Keluhan Muskuloskeletal Menggunakan Metode Nordic Body Map (Studi Kasus: Pekerja Area Muat PT Charoen Pokphand Indonesia Semarang)," *Ind. Eng. Online J.* , vol. 12, pp. 1–9, 2023.

[21]   M.Nur, A.Ghallib, A. A.Karim, andR. K.Sari, "Analisis Postur Tubuh Pekerja Unit Finishing Pada Produksi Kertas Menggunakan Metode Ovako Working Analysis System (OWAS)," *J. Teknol. dan Manaj. Ind. Terap.*, vol. 2, no. 4, pp. 278–286, 2023.

[22]   D.Kee, "Comparison of OWAS, RULA and REBA for assessing potential work-related musculoskeletal disorders," *Int. J. Ind. Ergon.*, vol. 83, p. 103140, 2021.

[23]   D.Andrian andR.Renilaili, "Pengukuran Tingkat Risiko Ergonomi Dengan Menggunakan Metode Ovako Working Analysis System (OWAS) Untuk Mengurangi Risiko Muscoleskeletal," *Integr. J. Ilm. Tek. Ind.*, vol. 6, no. 1, p. 32, 2021, doi: 10.32502/js.v6i1.3793.

[24]   M. F.Fahmi andD.Widyaningrum, "Analisis Penilaian Postur Kerja Manual Guna Mengurangi Risiko Musculoskeletal Disorders (MSDS) Menggunakan Metode OWAS Pada UD. Anugrah Jaya," *J. Tek. Ind. J. Has. Penelit. dan Karya Ilm. dalam Bid. Tek. Ind.*, vol. 8, no. 2, pp. 168–174, 2022.

[25]   T. I.Oesman andPurwanto, "Penilaian Postur Kerja Guna Evaluasi Tingkat Resiko Kerja Dengan Metode Rapid Office Strain Assessment (Rosa)," *J. Tek. Ind. Mesin, Elektro dan Ilmu Komput.*, pp. 37–42, 2017.