

Factors Associated With Work-Related Musculoskeletal Disorders (WMSDs) Among Tofu Industry Workers In Jambi City 2026

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Abstract

Work-related musculoskeletal disorders (WMSDs) are common occupational health complaints among industrial workers who perform manual tasks and maintain non-ergonomic work postures. This study aims to analyze the factors associated with WMSD complaints among soybean curd industrial workers in Jambi City in 2026. A quantitative study design with a cross-sectional approach was used in this study. The study population consisted of 45 workers, all of whom were included in the sample using total sampling. Data collection involved observation using the Rapid Entire Body Assessment (REBA) method, measurement of postural angles using a protractor, and completion of the SNI 9011:2021 questionnaire. Data were analyzed using univariate and bivariate methods, specifically the Chi-Square test with a 95% confidence level. The results showed that 57.8% of workers experienced WMSD complaints associated with high risk. Bivariate analysis revealed a significant association between WMSD complaints and work posture ($p=0.001$), work duration ($p=0.019$), repetitive movements ($p=0.001$), and length of service ($p=0.036$), whereas age did not show a significant association ($p=0.436$). It was concluded that work posture, work duration, repetitive movements, and length of service are factors associated with WMSD complaints among tofu industry workers. Improvements in workplace ergonomics, work scheduling, and the implementation of occupational safety and health programs are necessary to reduce the risk of musculoskeletal disorders.

Keywords: WMSDs, Ergonomics, REBA, Work Posture, Industry.

INTRODUCTION

Occupational diseases are health conditions caused by exposure to risk factors in the workplace, such as physical, chemical, biological, ergonomic, and psychosocial hazards.(WHO & ILO, 2021) One preventive measure is the implementation of Occupational Safety and Health practices, as mandated by Article 86 of Indonesian Law No. 13 of 2003, to ensure worker safety and improve productivity. The International Labor Organization (ILO) reports that nearly 3 million workers die each year from work-related accidents and occupational diseases, with approximately 2.4 million of these deaths caused by occupational diseases (Takala et al., 2024). In Indonesia, there were 462,241 cases of work-related accidents and occupational diseases recorded throughout 2024, while in Jambi Province, there were 7,135 cases.(Portal Satu Data Ketenagakerjaan, 2024)

Work-related Musculoskeletal Disorders (WMSDs) are the most common type of occupational disease among workers. The WHO reports that approximately 60% of occupational diseases worldwide are musculoskeletal disorders, with about 1.71 billion people suffering from these conditions, 50–70% of whom are workers (Abebaw et al., 2024). In Indonesia, the prevalence of musculoskeletal disorders, according to Riskesdas, stands at 11.9%, rising to 24.7% when calculated based on both diagnosis and symptoms (Pah et al., 2025).

Musculoskeletal disorders are conditions characterized by discomfort or pain resulting from injuries or a series of abnormalities in the function of muscles, nerves, tendons, and the skeleton that occur during work activities (BSN, 2021). There are three factors that cause these musculoskeletal complaints: the first is excessive muscle strain, particularly among workers engaged in physically demanding activities; the second is repetitive movements; and the third is unnatural work postures (Tarwaka & SHA, 2016). Several previous studies have indicated that this disorder is generally caused by non-ergonomic work postures, repetitive activities, and prolonged muscle strain.

The tofu industry is a sector that remains dominated by manual labor, resulting in a high risk of musculoskeletal disorders. Research by Negara et al. (2023) indicates the presence of ergonomic

hazards among tofu factory workers that can lead to musculoskeletal disorders (Negara et al., 2023). Other studies have also shown that age, work period, and work posture are associated with MSDs among industrial workers. This is due to prolonged exposure to physical hazards in the workplace (Hafizhah et al., 2024).

Data from the Jambi City Department of Trade and Industry (2024) indicate that there are 10 tofu factories spread across five subdistricts. Preliminary observations at two tofu factories indicate that, on average, workers work 7–8 hours a day, performing tasks involving lifting, bending, and repetitive movements. A preliminary survey of 10 workers using the SNI 9011:2021 questionnaire found that eight workers reported musculoskeletal complaints, primarily in the neck, shoulders, back, arms, lower back, and legs. This is because workers in the tofu industry perform many physically demanding tasks, which can increase the risk of work-related musculoskeletal disorders.

Given these circumstances, research is needed on the factors associated with work-related musculoskeletal complaints among tofu industry workers in Jambi City. The findings of this study are expected to serve as a basis for efforts to improve workplace ergonomics, prevent work-related illnesses, and enhance Occupational Safety and Health programs in the tofu industry.

RESEARCH METHODS

This study employed a quantitative design with a cross-sectional approach and was conducted from April to May 2026 to identify the factors associated with work-related musculoskeletal disorders (WMSDs) among tofu industry workers in Jambi City. The variables examined were work posture, work duration, repetitive movements, age, and work period.

The population for this study consisted of all 45 tofu industry workers in Jambi City. The sample was selected using total sampling from the entire population. The instruments used were the REBA (Rapid Entire Body Assessment) questionnaire, the SNI 9011:2021 symptom questionnaire, and a protractor to measure posture. Data collection for this study was conducted using observation and questionnaires

The analytical techniques used in this study included univariate and bivariate analysis. Univariate analysis aimed to provide an overview of the frequency distribution of each variable, while bivariate analysis aimed to determine the relationship between the independent and dependent variables. In this study, bivariate analysis used the chi-square test, with the decision rule that if the p-value is < 0.05 , a significant relationship is considered to exist, and if the p-value is > 0.05 , no significant relationship exists between the variables.

RESULTS AND DISCUSSION

Table 1. Frequency Distribution of Research Variables Among Tofu Industry Workers in Jambi City, 2026

Variable	Category	Frequency (n)	Percentage (%)
WMSDs Complaints	High Risk, jika total skor 8-16	26	57,8
	Moderate Risk, jika total skor 6	19	42,2
Work Posture	High (skor ≥ 8)	23	51,1
	Moderate (skor 4-7)	22	48,9
Work Duration	≥ 8 hours	21	46,7
	< 8 hours	24	53,3
Repetitive Movements	At Risk ≥ 10 times/minute	22	48,9
	Not At Risk < 10 times/minute	23	51,1
Age	At Risk ≥ 35 years	23	51,1
	Not At Risk < 35 years	22	48,9
Work Period	Long ≥ 5 years	27	60,0
	Short < 5 years	18	40,0

Source: Processed Primary Data, 2026

Table 1 shows that 26 respondents (57.8%) experienced WMSDs Complaints with a high risk level, while 19 respondents (42.2%) experienced complaints with a moderate risk level. The work posture of half the respondents fell into the high category with a score of ≥ 8 ; some respondents worked less than 8 hours per day; half of the respondents were at risk of repetitive movements; some respondents were in the age group of ≥ 35 years; and the majority had been working for ≥ 5 years.

Bivariate Analysis

Table 2. Results of the Bivariate Analysis of Factors Associated with WMSDs Complaints

Variabel	WMSDs Complaints				PR (95% CI)	p-value
	High Risk		Moderate Risk			
	n	%	n	%		
Work Posture						
High	19	82,6	4	17,4	10,179 (2,502 - 41,368)	0,001
Moderate	7	31,8	15	68,2		
Work Duration						
≥ 8 jam	16	76,2	5	23,8	4,480 (1,232 – 16,293)	0,019
< 8 jam	10	41,7	14	58,3		
Repetitive Movements						
≥ 10 times/minute	18	81,8	4	18,2	8,438 (2,118 – 22,607)	0,001
< 10 times/minute	8	34,8	15	65,2		
Age						
≥ 35 years	12	52,2	11	47,8	0,623 (0,189 – 2,056)	0,436
< 35 years	14	63,6	8	36,4		
Work Period						
Long ≥ 5 years	19	70,4	8	29,6	3,732 (1,062 – 13,120)	0,036
Short < 5 years	7	38,9	11	61,1		

Source: Processed Primary Data, 2026

The results of the analysis in Table 2 show that the variables of work posture, work duration, repetitive movements, and work period are significantly associated with WMSDs complaints ($p < 0.05$). Meanwhile, the age variable did not show a significant association ($p > 0.05$).

The significant association between work posture and WMSDs complaints indicates that workers' body posture while working plays a role. This finding is consistent with the study by Rebecca et al. (2021), which found an association between work posture and musculoskeletal pain complaints among workers at Tofu Factory X (Olivya Putri et al., 2021). Similarly, a study conducted by Fierdania and Hadi (2026) found a relationship between work posture and GOTRAK complaints among workers in the QC unit at PT. X (Yusvita & Nugroho, 2026). Based on observations and calculations using the REBA method, workers in the tofu industry in Jambi City scored between 5 and 10, which indicates a moderate to high risk. This is because the respondents' work practices do not adhere to ergonomic principles, such as bending the head downward, hunching the body, repeatedly lifting loads, and standing in a static position for too long. To reduce the risk of WMSDs complaints, the following measures should be implemented: improving proper work techniques, using assistive devices to reduce physical strain, and adjusting desk heights so they are not lower than the worker's body to prevent prolonged hunching.

There is a significant association between work duration and GOTRAK complaints. This finding is consistent with research by (Pratiwi et al., 2026) and (Yusup et al., 2025), which indicates an association between work duration and musculoskeletal complaints. Work performed over long periods without adequate rest breaks can reduce the body's capacity and lead to muscle pain. Workers in the tofu industry in Jambi City work for extended periods while standing nonstop from the start of the production process until the end. The researchers recommend taking periodic micro-breaks of 1–3 minutes and performing stretches to reduce muscle tension.

There is a significant association between repetitive movements and GOTRAK complaints. This finding is consistent with the research by (Hudriah & Kalla, 2022) and (Felicia et al., 2024), which identified an association between repetitive movements and musculoskeletal complaints. However, different results were found in the study by (Dwilago et al., 2022), which did not find an association between repetitive movements and musculoskeletal complaints. Several measures can be taken to reduce the frequency of repetitive movements and thereby minimize the risk of musculoskeletal disorders among workers. These include implementing job rotation so that the same muscle groups are not continuously engaged, providing short breaks at regular intervals, and encouraging workers to stretch their muscles during work.

There was no significant association between age and WMSDs symptoms among tofu industry workers. According to the analysis, older respondents (aged ≥ 35 years) had a higher risk of experiencing WMSDs symptoms compared to younger respondents (aged < 35 years). This finding is consistent with previous research that found no association between age and WMSDs complaints, as younger and older workers have different physical characteristics (Maulidia et al., 2025). Another study supporting these results was conducted by Aulia Fadhli et al. (2024), which also found no association between age and WMSDs complaints. (Lubis et al., 2024). However, the results of this study contradict the findings of a previous study by Raihan and Arief (2024), which identified an association between age and WMSDs complaints (Raihan & Setyawan, 2024). This is because age is not the primary risk factor, although it does not rule out the possibility that workers aged ≥ 35 years may experience certain complaints indicative of musculoskeletal disorders.

There is a significant association between length of service and musculoskeletal complaints. This finding is consistent with the research by (Wildasari & Rizki Nurcahyo, 2023) and (Indriyani et al., 2022) which found an association between length of service and musculoskeletal complaints. However, a different result was found in the study by Tazkia et al. (2026), which found no association between length of service and musculoskeletal complaints. Length of service is one of the risk factors in the work environment that can affect workers' health and increase the likelihood of musculoskeletal complaints, particularly in jobs that require significant physical exertion (Tarwaka & SHA, 2016).

CONCLUSION

Based on the research findings, it can be concluded that complaints of work-related musculoskeletal disorders (WMSDs) among tofu industry workers in Jambi City are associated with work posture, work duration, repetitive movements, and length of service. Non-ergonomic working conditions, relatively long working hours, repetitive tasks, and longer tenure contribute to an increased risk of musculoskeletal disorders among these workers. Conversely, age was not found to be associated with work-related musculoskeletal disorders (WMSDs) and is therefore not a major factor influencing the occurrence of these disorders among tofu industry workers. Therefore, prevention efforts should focus on applying ergonomic principles in the workplace, improving work posture, regulating work duration and providing adequate rest periods, implementing job rotation, and carrying out sustainable Occupational Safety and Health programs to reduce the risk of musculoskeletal disorders and improve workers' health and productivity.

REFERENCES

- Abebaw, T., Destaw, B., Yenealem, D. G., Tesfaye, A. H., Melaku, C., Mamaye, Y., Bezie, A. E., & Abere, G. (2024). *Work-related musculoskeletal disorders: prevalence, associated factors, and impact on quality of life among kitchen workers in hospitality industry, Bahir Dar City, Northwest Ethiopia*, 2023. May, 1–13. <https://doi.org/10.3389/fpubh.2024.1358867>
- BSN. (2021). *Pengukuran dan Evaluasi Potensi Bahaya Ergonomi di Tempat Kerja*.
- Dwilago, I. T., Anggraini, M. T., & Setiawan, R. (2022). Hubungan Gerakan Berulang dan Posisi Kerja dengan Keluhan Musculoskeletal Disorders pada Pekerja Fillet Ikan di Kota Tegal. *Medica Arteriana (Med-Art)*, 4(2), 90–97. <https://jurnal.unimus.ac.id/index.php/MedArt>
- Felicia, C., Arganata, F. Z., & Fitr, N. (2024). Hubungan Postur Kerja dan Gerakan Berulang dengan Musculoskeletal Disorders (MSDs) pada Pekerja Pembuat Sol Sepatu di Mergelo Mojokerto. *Inovasi Kesehatan Global*, 1(3), 119–127.
- Hafizhah, N. A., Fanani, E., & Marji. (2024). *Analisis Masa Kerja , Posisi Kerja dan Keluhan Musculoskeletal Disorders pada Driver Ojek di Kota Malang*. 6(3), 278–292. <https://doi.org/10.17977/um062v6i32024p278-292>
- Hudriah, E., & Kalla, R. (2022). Analisis Hubungan Kejadian Musculoskeletal Disorders (MSDS) Pada Pekerja Buruh di PT. Sukses Mantap Sejahtera (SMS) Kabupaten Dompu NTB 2022. *Journal of Muslim Community Health (JMCH)* 2023, 4(3), 134–144. <https://doi.org/10.52103/jmch.v4i3.1138>JournalHomepage:<https://pasca-umi.ac.id/index.php/jmch>
- Indriyani, Putri Rizki Amalia Badri, Rury Tiara Oktariza, R. S. R. (2022). Analisis Hubungan Usia, Masa kerja dan Pengetahuan terhadap Keluhan Musculoskeletal Disorders (MSDs). *Jurnal Kesehatan*, 13, 186–191.
- Lubis, A. F. S., Warouw, S., Ardiansyah, Nababan, D., & Sitorus, M. E. (2024). *Analisis Faktor-Faktor Yang Berhubungan Dengan Keluhan Gangguan Otot Rangka Akibat Kerja di PT. Bukit Intan Abadi Medan*. 7(1), 1640–1646.
- Maulidia, I., Susilowati, I. H., & Nugraha, S. (2025). Analisis Faktor Risiko Ergonomi yang Berhubungan dengan Keluhan GOTRAK pada Karyawan PT. X 2025. *Public Health and Safety International Journal*, 5(2), 592–603.
- Negara, N. L. G. A. ., Haryawan, I. G. ., Prihastini, K. ., Biomi, A. ., & Dharmayanti, C. . (2023). *Potensi Bahaya Kerja pada Pekerja di Pabrik Tahu Kelurahan Tonja-Denpasar*. 2(1), 7–11.
- Olivya Putri, R., Jayanti, S., Kurniawan, B., Keselamatan, P., Kerja, K., Masyarakat, K., Diponegoro, U., Prof, J. H., Soedarto, S. H., & Keselamatan, B. (2021). Hubungan Postur Kerja dan Durasi Kerja Dengan Keluhan Nyeri Otot Pada Pekerja Pabrik Tahu X di Kota Semarang (The

- Relationship between Work Posture and Work Duration with Complaints of Muscle Pain in Tofu X Factory Workers in Semarang City). *Jurnal Kesehatan Masyarakat*, 9(6), 733–740. <http://ejournal3.undip.ac.id/index.php/jkm>
- Pah, Y. L. A., Ruliati, L. P., & Sahdan, M. (2025). *Analisis Faktor Ergonomi dengan Kelelahan Kerja dan Keluhan Musculoskeletal Disorders pada Pekerja Tenun Ikat di Desa Numponi Kabupaten Malaka*. 3(April).
- Portal Satu Data Ketenagakerjaan. (2024). *Kasus Kecelakaan Kerja Tahun 2024*. <https://satudata.kemnaker.go.id/data/kumpulan-data/2447>
- Pratiwi, R. J., Nirmala, F., & Harleli. (2026). *Hubungan Masa Kerja, Durasi Kerja, dan Postur Kerja saat mengemudi dengan Kleuhan Musculoskeletal Disorder (MSDs) pada Sopir Mobil Pnumpang Antar Kota di Sulawesi Tenggara*. 03(02), 235–247.
- Raihan, M., & Setyawan, A. (2024). *Faktor-Faktor yang Berhubungan dengan Keluhan GOTRAK pada Pekerja Porter di Stasiun X Tahun 2024*. 1(3), 936–944.
- Takala, J., Härmäläinen, P., Sauni, R., Nygård, C. H., Gagliardi, D., & Neupane, S. (2024). Global, Regional and Country level Estimates of the Work-related Burden of Diseases and Accidents in 2019. *Scandinavian Journal of Work, Environment and Health*, 50(2), 73–82. <https://doi.org/10.5271/sjweh.4132>
- Tarwaka, & SHA, B. (2016). *Ergonomi untuk Keselamatan, Kesehatan Kerja dan Produktivitas*. <http://shadibakri.uniba.ac.id/wp-content/uploads/2016/03/Buku-Ergonomi.pdf>
- WHO, & ILO. (2021). *WHO/ILO Joint Estimates of the Work-related Burden of Disease and Injury, 2000–2016*.
- Wildasari, T., & Rizki Nurcahyo. (2023). Hubungan Antara Postur Kerja, Umur, Masa Kerja Dengan Keluhan Musculoskeletal Disorders (MSDs) Pada Pekerja di CV. Sada Wahyu Kabupaten Bantul Yogyakarta. *Jurnal Lentera Kesehatan Masyarakat*, 2(1).
- Yusup, M., Ito, Y. R., & Uzma, W. (2025). *Hubungan Sikap kerja, Durasi Kerja dan Masa kerja dengan Keluhan Musculoskeletal Disorders (MSDs) pada Karyawan Universitas X 2024*. 5(2), 16–26.
- Yusvita, F., & Nugroho, H. (2026). Hubungan Postur Kerja dengan Keluhan Gangguan Otot Rangka Akibat Kerja (GOTRAK) pada Pekerja Unit Quality Control (QC) PT. X Banten. *MANUJU: MALAHAYATI NURSING JOURNAL*, 81, 333–341.