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Ergonomic Knowledge and Its Impact on Musculoskeletal Disorders (MSDs) Among Market Porters: A Cross-Sectional Study

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Abstract

Introduction: Musculoskeletal Disorders (MSDs) are among the most common occupational diseases affecting market porters due to non-ergonomic working conditions. Risk factors such as individual, occupational, and environmental factors contribute to the prevalence of MSDs. This study examines the relationship between ergonomic knowledge and MSDs among market porters.

Methods: This observational analytical study employed a cross-sectional approach with a total sampling technique involving 62 market porters who met the inclusion and exclusion criteria. The study was conducted from February to September 2024. Data collection included measuring ergonomic knowledge using a questionnaire and assessing MSD risk using the Nordic Body Map (NBM) questionnaire. Data were analyzed using the chi-square test to examine the relationship between variables and multiple logistic regression to explore the association between ergonomic knowledge and MSDs by controlling for the influence of other variables.

Results: The chi-square analysis revealed a significant relationship between ergonomic knowledge and MSDs (p=0.002). Logistic regression analysis showed that workers with low ergonomic knowledge had a higher risk of developing MSDs (AOR = 11.6; 95% CI = 2.221–61.278; p=0.004).

Conclusion: A significant relationship exists between ergonomic knowledge and MSDs among market porters. Preventive efforts based on participatory ergonomics are necessary to reduce MSD risk. The main limitation of this study is the use of self-reported questionnaires to assess ergonomic knowledge and MSD risk, which may introduce subjective bias.

Keywords: Musculoskeletal Disorders, MSDs, Ergonomic Knowledge

Introduction

Manual labor continues to dominate many industrial sectors, including portering, which requires intensive physical effort. One of the negative impacts of a high physical workload is an increased risk of Musculoskeletal Disorders (MSDs). Workers often face ergonomic challenges in their tasks, which a lack of proper ergonomic knowledge can exacerbate.

According to the Health and Safety Executive (HSE), approximately 6.9 million workers in the United Kingdom have lost work time due to MSDs, with the most commonly affected areas being the back (40%), upper body and neck (41%), and lower limbs (19%).[1] In Indonesia, the 2018 Basic Health Research (*Riskesdas*) reported an MSD prevalence of 7.3%, with laborers experiencing a relatively high incidence (6.1%).[2]

These data indicate that physically demanding jobs without proper ergonomic support significantly increase the risk of MSDs. MSDs arise due to non-ergonomic body positions, such as prolonged bending or repetitive heavy lifting, causing discomfort or severe musculoskeletal pain, including joints, nerves, muscles, and the spine.[3] This risk is even higher among workers with limited understanding of proper ergonomic principles. Ergonomics encompasses posture, work techniques, and workplace adjustments to better align with workers' physical capacities.[4] However, insufficient ergonomic knowledge can contribute to a higher incidence of MSDs across various manual labor sectors.

Market porters, particularly in traditional markets, rely heavily on physical strength to lift and transport goods. Their work is often performed under non-ergonomic conditions, such as repetitive lifting with a bent and twisted posture.[5] Observations in Negara district reveal that market porters work without adequate ergonomic training and have limited access to information regarding safe work techniques.

A prior study by Aminullah (2022) on market porters in Pasar Martapura found a significant relationship between ergonomic knowledge and musculoskeletal complaints, with a p-value of 0.000 (<0.05). Similarly, research by Indriyani et al. (2022) on casual laborers revealed that 25% of workers with low ergonomic knowledge experienced moderate to severe MSD complaints (p=0.000). These findings suggest that ergonomic knowledge plays a role in musculoskeletal

disorder risk. Workers' understanding of ergonomics influences their attitudes and actions, such as adopting incorrect postures and performing repetitive heavy lifting, which increases their risk of developing MSDs[6,7].

Although previous studies have explored the relationship between ergonomic knowledge and MSDs, no research has specifically examined market porters in Negara district. These workers face high risks due to heavy workloads, non-ergonomic postures, and a lack of ergonomic education. Therefore, this study addresses this gap by investigating ergonomic knowledge and its association with MSD risk among market porters. The objectives of this study are to (1) describe ergonomic knowledge among market porters, (2) assess MSD complaints among market porters, and (3) analyze the association between ergonomic knowledge and MSDs. The proposed hypothesis is that there is a significant relationship between ergonomic knowledge and MSDs among market porters.

Methods

This study employed an analytical observational design with a cross-sectional approach, conducted at the traditional market in Negara district, Jembrana Regency, Bali Province, from February to November 2024. The cross-sectional design was chosen as it allows for the analysis of the association between ergonomic knowledge and Musculoskeletal Disorders (MSDs) at a single point in time, without intervention or long-term observation. The market in Negara district was selected due to the absence of similar studies in the area, even though market porters face significant risks related to heavy workloads, non-ergonomic working postures, and a lack of ergonomic education. Data collection was carried out twice in the market area, with participant involvement limited to a single day during data collection. The sampling technique used was total sampling, involving 62 workers who met the study criteria.

The inclusion criteria for this study were active market porters who agreed to participate as respondents. The exclusion criteria included workers with a history of musculoskeletal injuries or trauma occurring within the past three months, as confirmed through direct interviews with the respondents. The sample size was calculated using Lemeshow's hypothesis testing formula, with values of 0.30 and 0.10 based on previous studies.[7]

The independent variable in this study was ergonomic knowledge, assessed using an ergonomic knowledge questionnaire consisting of 18 items relevant to work-related ergonomics. The questionnaire had been tested for validity and reliability prior to its use in the main study, with all item validity scores exceeding $r > 0.361$ and a Cronbach's Alpha reliability score of 0.754. The final scores were classified into two categories: good knowledge (score >50%) and poor knowledge (score ≤50%).[8] The dependent variable was Musculoskeletal Disorders (MSDs), measured using the Nordic Body Map (NBM) questionnaire, which identifies the severity of musculoskeletal complaints experienced by workers. The NBM questionnaire demonstrated a validity score of> 0.378 and a Cronbach's Alpha 0.919.[9] The results were classified into four risk levels: low risk (score 28–49), moderate risk (score 50–70), high risk (score 71–91), and very high risk (score 92–122).[10] For further analysis, MSD complaints were grouped into two categories: low-moderate MSDs and high-very-high MSDs.

The research procedure began with informing participants about the study's objectives, methods, and potential benefits. Workers provided informed consent before participating. Data collection included demographic characteristics such as age, gender, BMI, and work duration. This was followed by the assessment of ergonomic knowledge using the questionnaire and the measurement of MSDs using the NBM questionnaire. The questionnaires used were valid and reliable, and researchers directly supervised and provided detailed explanations on how to complete them to minimize bias and enhance the study's validity.

Following data collection, statistical processing was conducted using IBM SPSS 25.0, including descriptive, bivariate, and multivariate analyses. Descriptive analysis aimed to characterize the sample based on frequency and proportion for age, gender, BMI, work duration, ergonomic knowledge, and MSDs. Bivariate analysis was performed using the chi-square test to determine relationships between variables, while multivariate analysis employed multiple logistic regression to explore the association between ergonomic knowledge and MSDs by controlling for the influence of other variables. These statistical tests were selected because the study data were categorical and did not require standard distribution assumptions, making them suitable for this study. Variables included in the logistic regression model were determined based on initial analysis and gradually eliminated until an optimal final model was achieved. A p-value of <0.05 indicated a significant relationship, while a p-value >0.05 indicated no significant relationship between the variables.

This study did not focus on subgroup analysis; therefore, no further categorization based on specific subgroups was performed. The primary objective was to explore the association between ergonomic knowledge and MSDs among market porters. Ethical approval for this study was obtained from the Research Ethics Committee of the Faculty of Medicine, Udayana University, under the ethical clearance number 0705/UN14.2.2.VII.14/LT/2024.

Results

This study employed a cross-sectional method on workers. Figure 1 illustrates the research process flow.

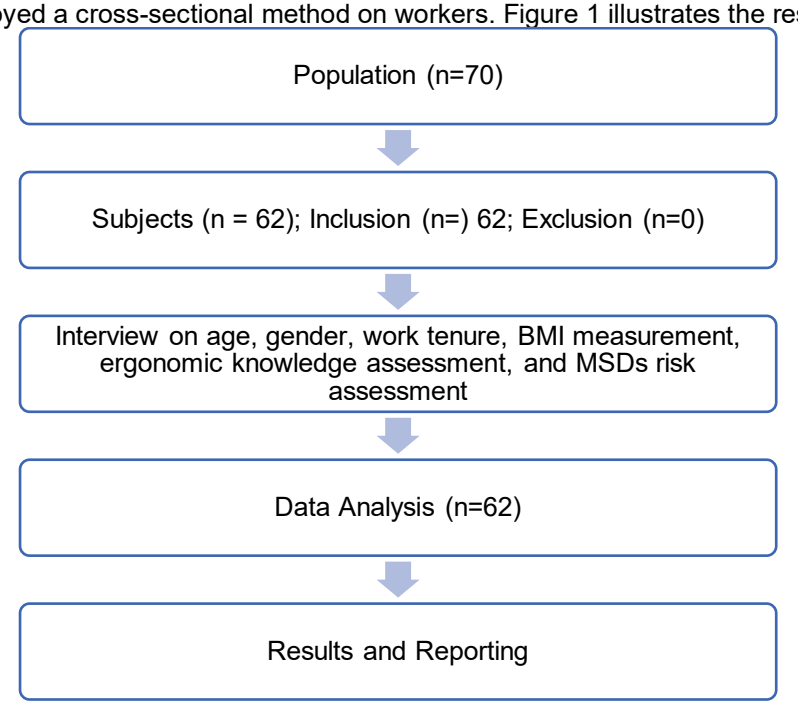

Figure 1. Research Flowchart

Based on initial observations and interviews with the head of the market porters, there were approximately 70 workers. However, only 62 workers were present and participated in this study. The absence of some workers was due to two main factors: they were no longer actively working or were unwilling to participate. Consequently, a total sampling technique was used, resulting in 62 samples that met the study criteria, with no missing data identified. The characteristics of the workers, including age, gender, BMI, and work tenure, are presented in Table 1.

Table 1. Worker Characteristics

Characteristic	Frequency (n)	Proportion (%)
Age		
≥ 35 years	51	82.3
< 35 years	11	17.7
Gender		
Male	30	48.4
Female	32	51.6
BMI		
Underweight	5	8.1
Normal	33	53.2
Overweight	24	38.7
Work Tenure		
≥5 years	44	71.0
<5 years	18	29.0

As shown in Table 1, the majority of workers were aged ≥ 35 years (51 workers, 82.3%), while those < 35 years comprised 11 workers (17.7%). The average age was 43.9 years, with the youngest being 18 and the oldest 64. Age categorization in this study was based on Tarwaka's theory, which states that the initial symptoms of MSDs typically appear at 35 years and increase with age.[3] The sample consisted of 30 male workers (48.4%) and 32 female workers (51.6%). Regarding BMI, most workers had a normal BMI (33 workers, 53.2%), followed by overweight (24 workers, 38.7%) and underweight (5 workers, 8.1%). The average BMI was 23.5, with the lowest at 17.3 and the highest at 27.0. In terms of work tenure, 44 workers (71.0%) had been working for ≥5 years, while 18 workers (29.0%) had <5 years of experience, with an average work tenure of 15.2 years (ranging from 1 to 40 years).

The following tables summarize the key findings of this study related to ergonomic knowledge, musculoskeletal disorder (MSD) risks, and their associations with various worker characteristics. Table 2 presents the distribution of respondents based on ergonomic knowledge categories, while Table 3 shows the distribution of MSD risk categories among workers. Table 4 outlines the bivariate relationship between ergonomic knowledge and the presence of MSDs. Table 5 details the relationship between worker characteristics and MSD occurrence. Finally, Table 6 presents the results of the multivariate analysis, identifying significant predictors of MSDs after adjusting for confounding variables.

Table 2. Distribution of Ergonomic Knowledge Categories

Ergonomic Knowledge	Frequency (n)	Proportion (%)
Poor	16	25.8
Good	46	74.2

As shown in Table 2, most workers had good ergonomic knowledge (46 workers, 74.2%), while 16 workers (25.8%) had poor ergonomic knowledge. The lowest score being 33.3%, the highest 94.4%, and an average score of 64.6%.

Table 3. Distribution of MSD Risk Categories

Complaint Level	Frequency (n)	Proportion (%)
Very High	0	0
High	10	16.1
Moderate	52	83.9
Low	0	0

Table 3 shows that most workers reported moderate MSD complaints (52 workers, 83.9%), while 10 workers (16.1%) reported high complaints. The lowest score at 50, the highest at 84, and an average complaint score of 59.6. The most frequently reported complaint location was the lower back (59 workers, 95.2%), followed by the upper back (54 workers, 87%), and the lower neck, knees, and right foot, each affecting 51 workers (82.3%).

Table 4. Relationship Between Ergonomic Knowledge and Musculoskeletal Disorders (MSDs)

Variable	MSDs		Total	p
	High - Very High	Low - Moderate		
Ergonomic Knowledge				
Poor	7 (43.8%)	9 (56.3%)	16 (100.0%)	0.002
Good	3 (6.5%)	43 (93.5%)	46 (100.0%)	

As shown in Table 4, chi-square analysis demonstrated a significant relationship between ergonomic knowledge and MSD complaints (p = 0.002).

Table 5. Relationship Between Worker Characteristics and Musculoskeletal Disorders (MSDs)

Variable	MSDs		Total	p
	High - Very High	Low - Moderate		
Age				
≥ 35 Years	10 (19.6%)	41 (80.4%)	51 (100.0%)	0.185
< 35 Years	0 (0.0%)	11 (100.0%)	11 (100.0%)	
Gender				
Male	5 (16.7%)	25 (83.3%)	30 (100.0%)	1.000
Female	5 (15.6%)	27 (84.4%)	32 (100.0%)	
BMI				
Non-Normal	5 (17.2%)	24 (82.8%)	29 (100.0%)	1.000
Normal	5 (15.2%)	28 (84.8%)	33 (100.0%)	
Work Tenure				
≥ 5 Years	10 (22.7%)	34 (77.3%)	44 (100.0%)	0.027
< 5 Years	0 (0.0%)	18 (100.0%)	18 (100.0%)	

As shown in Table 5, chi-square analysis revealed that only work tenure was significantly associated with MSD complaint levels (p = 0.027), whereas age (p = 0.185), gender (p = 1.000), and BMI (p = 1.000) showed no significant associations. MSDs tend to increase over time, meaning that the longer a person works, the greater their exposure to risk factors contributing to MSDs.[11] Based on the test results, the variables that entered the multivariate model to be controlled by analysis were variables with a p value <0.25, work tenure and age.

Table 6. Multivariate Analysis Results

Variable	Final Model	
	p	AOR (95% CI)
Ergonomic Knowledge	0.004	11.6 (2.221 - 61.278)
Work Tenure	0.998	181345068.1 (0.000)
Age	0.998	300945580.7 (0.000)

As shown in Table 6, multivariate analysis aims to examine the relationship between ergonomic knowledge and MSDs by controlling for the influence of other variables. Multivariate analysis indicated that among the three variables included, ergonomic knowledge was significantly associated with MSD complaints (AOR = 11.6; 95% CI = 2.221 - 61.278; p = 0.004). This finding suggests that workers with poor ergonomic knowledge are 11.6 times more likely to experience MSD complaints than those with good knowledge.

Discussion

Characteristics of Research Subjects

The study results indicate that the proportion of workers aged ≥35 years was 51 individuals (82.3%), while those under 35 years old accounted for 11 individuals (17.7%). This finding aligns with Hanif (2020), which demonstrated that

market porters are predominantly aged ≥35 years.[12] Regarding gender, the proportion of male workers was 30 (48.4%), while female workers accounted for 32 (51.6%). This indicates that both men and women play a significant role in the profession of market porters.

The proportion of workers with normal BMI was 33 (53.2%), overweight BMI was 24 (38.7%), and underweight BMI was 5 (8.1%). These results are consistent with Devi et al. (2017), which found that most workers had a normal BMI (67.1%).[13] The association between BMI and musculoskeletal disorders (MSDs) arises when an individual's BMI falls outside the normal range, increasing the likelihood of experiencing MSDs.[14] Regarding work tenure, the proportion of workers with ≥5 years of tenure was 44 (71.0%), while those with <5 years of tenure accounted for 18 (29.0%). This finding aligns with Rahmawati (2020), which showed that workers predominantly had ≥5 years of tenure (84.7%).[14] Longer work tenure results in prolonged exposure to work conditions, leading to physical complaints due to occupational demands.[15]

Regarding ergonomic knowledge, the proportion of workers with good ergonomic knowledge was 46 (74.2%), while those with poor knowledge accounted for 16 (25.8%). These results indicate that the majority of workers had good ergonomic knowledge. Regarding MSD complaints, the proportion of workers with moderate complaints was 52 (83.9%), while those with high complaints accounted for 10 (16.1%). There were no workers with low or very high complaints. Observations indicated that these complaints were related to work processes involving lifting, lowering, transferring, and holding objects, with some workers also placing loads on their heads.

Relationship Between Ergonomic Knowledge and Musculoskeletal Disorders (MSDs)

Analyzing the relationship between ergonomic knowledge and MSDs using the chi-square test with Fisher's exact test yielded a p-value of 0.002 ($p<0.05$), indicating a significant relationship between knowledge and MSDs among market porters. The findings showed that among workers with poor knowledge, 7 (43.8%) experienced high to very high MSDs, while 9 (56.3%) had low to moderate MSDs. Among those with good knowledge, 3 (6.5%) experienced high to very high MSDs, while 43 (93.5%) had low to moderate MSDs. This aligns with Aminullah (2022), who studied cargo porters at Martapura Market and found a significant relationship ($p=0.000$). This indicates that information-dependent behaviour is better than uninformed.[6]

Other studies by Balaputra & Sutomo (2017) on nurses ($p=0.014$) and Indriyani et al. (2022) ($p=0.000$) also confirmed a relationship between ergonomic knowledge and MSD complaints. Ergonomics is the study of human behavior in work.[16,7] Knowledge is the result of 'knowing' and this occurs after people perceive a certain object. This theory states that knowledge or the cognitive domain is a very important domain in shaping a person's actions. Knowledge affects the way individuals perceive risk, which is the basis for the formation of attitudes, and from positive attitudes will emerge healthy and adaptive behaviour or actions.[17] Workers with good ergonomic knowledge adopt positive attitudes, influencing their actions in preventing MSDs. Conversely, poor ergonomic knowledge affects attitudes and behaviors, increasing the likelihood of MSD complaints.[18]

Relationship Between Worker Characteristics and Musculoskeletal Disorders (MSDs)

The analysis of the relationship between age and MSDs using the chi-square test with Fisher's exact test yielded a p-value of 0.185 ($p>0.05$), indicating no significant relationship between age and MSDs among market porters. The findings showed that among workers aged ≥35 years, 10 (19.6%) experienced high to very high MSDs, while 41 (80.4%) had low to moderate MSDs. All workers under 35 years old (11 individuals, 100%) experienced low to moderate MSDs, with none experiencing high to very high MSDs. This finding is consistent with Dyana et al. (2023) in a study on fish loaders at UD Mina Karya Karangasem, which found no significant relationship between age and MSDs.[19] Differences in results may arise due to an uneven distribution of age data.

The relationship between gender and MSDs, analyzed using the chi-square test with Fisher's exact test, yielded a p-value of 1.000 ($p>0.05$), indicating no significant relationship between gender and MSDs among market porters. The results showed that among male workers, 5 (16.7%) experienced high to very high MSDs, while 25 (83.3%) had low to moderate MSDs. Among female workers, 5 (15.6%) experienced high to very high MSDs, while 27 (84.4%) had low to moderate MSDs. This aligns with Cheisario & Wahyuningsih (2022), who found no significant relationship between gender and MSDs among workers at PT. X.[20] Differences in findings may be due to male and female workers being exposed to similar working conditions, including the type of loads handled.

The analysis of the relationship between BMI and MSDs using the chi-square test with Fisher's exact test resulted in a p-value of 1.000 ($p>0.05$), indicating no significant relationship between BMI and MSDs among market porters. Among workers with abnormal BMI, 5 (17.2%) experienced high to very high MSDs, while 24 (82.8%) had low to moderate MSDs. Among those with normal BMI, 5 (15.2%) experienced high to very high MSDs, while 28 (84.8%) had low to moderate MSDs. This is consistent with Kusmawan (2021), who found no significant relationship between BMI and MSDs among traditional transport workers.[21] Differences in results may be due to most respondents having normal BMI.

The relationship between work tenure and MSDs, analyzed using the chi-square test with Fisher's exact test, yielded a p-value of 0.027 ($p<0.05$), indicating a significant relationship between work tenure and MSDs among market porters. Among workers with ≥5 years of tenure, 10 (22.7%) experienced high to very high MSDs, while 34 (77.3%) had low to moderate MSDs. Among those with <5 years of tenure, all 18 (100%) had low to moderate MSDs, with none experiencing high to very high MSDs. This finding aligns with Rahmawati (2020), who studied cargo workers at Panorama Market in Bengkulu.[14] Long work tenure can lead to fatigue and repetitive exposure to strenuous activities, increasing physical complaints. Continuous adaptation to repetitive tasks may also influence physical endurance against pain.[22]

Multivariate Analysis

The multivariate analysis using the backward method found that ergonomic knowledge had a significant relationship with MSDs among market porters (AOR = 11.6; 95% CI = 2.221–61.278; p = 0.004). This finding indicates that workers with poor ergonomic knowledge are 11.6 times more likely to experience MSD complaints than those with good knowledge.

These results are consistent with a study by Balaputra & Sutomo (2017), which reported a significant association between knowledge and MSD complaints. Their study found that workers with poor ergonomic knowledge were 16.5 times more likely to experience MSD complaints than those with good knowledge. These findings suggest that workers who understand ergonomic principles tend to have fewer injuries and work-related problems. Knowledge, beliefs, and attitudes play a crucial role in workplace accidents.[16]

MSDs are an imbalance of activity to muscular and skeletal capabilities. These complaints can arise as a result of repetitive static loading on the muscles over a long period of time. A lack of understanding of ergonomic principles can lead to improper or non-ergonomic working postures, making workers highly susceptible to MSDs. Therefore, workers need training on safe work methods and techniques to improve their knowledge and reduce the risk of injury.[3]

A limitation of this study is using a questionnaire as the measurement method, which is inherently subjective as it relies on individual understanding. Differences in perception and pain tolerance among study subjects may introduce bias in measuring MSD complaints. Additionally, this study did not control for factors such as work posture, workload, and education level, which may influence the relationship between ergonomic knowledge and MSD complaints. Future research should consider these factors to provide more comprehensive results.

Nonetheless, this study indicates that workers with poor ergonomic knowledge are at a higher risk of developing MSDs than those with good knowledge. However, the subjects in this study were limited to market porters in Negara District, meaning the results may differ if conducted in other locations.

This study did not receive funding from government agencies, private institutions, or non-profit organizations.

Conclusion

There is a significant relationship between ergonomic knowledge and musculoskeletal disorders (MSDs) among market porters. The majority of workers demonstrated good ergonomic understanding (74.2%). Meanwhile, MSD complaints were predominantly moderate (83.9%). However, the prevalence of MSD complaints, particularly in the lower back and spine, indicates that good ergonomic knowledge does not always translate into optimal application in work practices. Potential barriers include non-ergonomic work habits and a lack of ergonomic facilities or equipment. Therefore, preventive efforts and participatory ergonomic interventions are needed to enhance occupational health and safety more comprehensively, such as implementing more practical ergonomic training to further educate workers and providing work aids to reduce the risk of MSDs.

Additional Information

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References

1. Health and Safety Executive (HSE). Work related musculoskeletal disorder statistics (WRMSDs) in Great Britain, 2019 [Internet]. 2019 [cited 2025 May 30]. Available from: http://www.hse.gov.uk/statistics/lfs/index.htm
2. Kementerian Kesehatan Republik Indonesia. Laporan Nasional Riskesdas 2018. Jakarta: Badan Penelitian dan Pengembangan Kesehatan; 2019.
3. Tarwaka. Ergonomi industri: dasar-dasar pengetahuan ergonomi dan aplikasi di tempat kerja. Edisi revisi II. Surakarta: Harapan Press; 2015.
4. Mayasari D, Saftarina F. Ergonomi sebagai upaya pencegahan musculoskeletal disorders pada pekerja. J Kedokt Kesehat Univ Lampung. 2016;1(2):369–79.
5. Prayogi WT, Sultan M, Hardianti DN, Ramdan IM, Lestari IAID. Pengaruh beban, postur, dan masa kerja terhadap keluhan musculoskeletal disorders (MSDs) pada buruh angkut pasar. Health Saf Environ J. 2024;3(1).
6. Aminullah MH. Hubungan pengetahuan, sikap kerja dan masa kerja dengan keluhan musculoskeletal disorders (MSDs) pada buruh angkut barang di Pasar Martapura Kabupaten Banjar [Skripsi]. Banjarbaru: Fakultas Kesehatan Masyarakat; 2022.
7. Indriyani I, Badri PRA, Oktariza RT, Ramadhani RS. Analisis hubungan usia, masa kerja dan pengetahuan terhadap keluhan musculoskeletal disorders (MSDs). J Kesehat. 2022;13(1):186–91.
8. Budiman RA. Kapita selekta kuesioner: pengetahuan dan sikap dalam penelitian kesehatan. Jakarta: Salemba Medika; 2013. p. 4–8.
9. Dewi DKYK, Vitasari P, Kiswandono K. Identifikasi keluhan fisik pada karyawan pencetakan gula menggunakan Nordic Body Map. J Valtech. 2023;6(1):22–6.
10. Dewi NF. Identifikasi risiko ergonomi dengan metode Nordic Body Map terhadap perawat poli RS X. J Sos Hum Terapan. 2020;2(2):15.
11. To KE, Berek NC, Setyobudi A. Hubungan masa kerja, jenis kelamin dan sikap kerja dengan keluhan muskuloskeletal pada operator SPBU di Kota Kupang. Media Kesehat Masyarakat. 2020;2(2):42–9.
12. Hanif A. Hubungan antara umur dan kebiasaan merokok dengan keluhan musculoskeletal disorders (MSDs) pada pekerja angkat angkut UD Maju Makmur Kota Surabaya. Med Technol Public Health J. 2020;4(1):7–15.

13. Devi T, Purba I, Lestari M. Risk factors of musculoskeletal disorders (MSDs) complaints on rice transportation activities at PT. Buyung Poetra Pangan Pegayut Ogan Ilir. J Ilmu Kesehat Masyarakat. 2017;8(2):464354.
14. Rahmawati U. Faktor-faktor yang berhubungan dengan keluhan musculoskeletal disorders pekerja pengangkut barang di Pasar Panorama Kota Bengkulu. J Kesehat Lingkung. 2020;17(1):49–56.
15. Adriansyah M, Mallapiang F, Ibrahim H. Faktor yang berhubungan dengan keluhan musculoskeletal disorders (MSDs) pada penenun Lipa' Sa'be Mandar di Desa Karama Kecamatan Tinambung Kabupaten Polewali Mandar. Hig J Kesehat Lingkung. 2019;5(2):79–85.
16. Balaputra I, Sutomo AH. Pengetahuan ergonomi dan postur kerja perawat pada perawatan luka dengan gangguan muskuloskeletal di dr. H. Koesnadi Bondowoso. Berita Kedokt Masyarakat. 2017;33(9):5–448.
17. Notoatmodjo S. Promosi kesehatan dan perilaku kesehatan. Jakarta: Rineka Cipta; 2014.
18. Purwantini D. Tingkat pengetahuan posisi ergonomi dalam pencegahan nyeri punggung bawah. J Penelit Kesehat. 2016;6(2):79–84.
19. Dyana IPNA, Rusni NW, Sukmawati NMH. Faktor-faktor yang berhubungan dengan keluhan musculoskeletal disorders (MSDs) pada pekerja pengangkat ikan di Usaha Dagang Mina Karya Karangasem. AMJ Aesculapius Med J. 2023;3(1):93–100.
20. Cheisario HA, Wahyuningsih AS. Faktor–faktor yang berhubungan dengan terjadinya keluhan musculoskeletal disorder pada pekerja di PT. X. Indones J Public Health Nutr. 2022;2(3):329–38.
21. Kusmawan D. Faktor risiko musculoskeletal disorder (MSDs) pada pekerja angkut tradisional di Pasar Angso Duo Kota Jambi. J Ind Hyg Occup Health. 2021;6(1):9–22.
22. Triastuti D, Afni N, Nur ARAC. Faktor-faktor yang berhubungan dengan keluhan nyeri otot (musculoskeletal disorders) pada tenaga kerja bongkar muat di Pelabuhan Pantoloan Palu. J Kolaboratif Sains. 2020;3(3):98–106.