MEDALION JOURNAL: Medical Research, Nursing, Health and Midwife Participation | ISSN(e): 2986-7754
Volumes 6 No. 2 (2025)

"FACTORS ASSOCIATED WITH MUSCULOSKELETAL DISORDERS (MSDS) COMPLAINTS AMONG PALM OIL HARVESTERS"

Siti Aisyah[1], Siti Maisyaroh Fitri Siregar[2], Yulizar Kasma[3], Yarmaliza[4], Fakhrurradhi Lutfhi[5]
Universitas Teuku Umar, Meulaboh
sitiaisyahsambo@gmail.com[1],sitimaisyaroh@utu.ac.id[2], yulizar@utu.ac.id[3], yarmaliza@utu.ac.id[4], luthfi@utu.ac.id[5].

Received : 25 May 2025
Revised : 01 June 2025
Accepted : 25 June 2025
Published : 10 August 2025
DOI : https://doi.org/10.59733/medalion.v6i2.209
Published links : https://medalionjournal.com/index.php/go

Abstract

Repetitive motions, poor posture, and overuse injuries may lead to musculoskeletal diseases (MSDs), which manifest as pain in the muscles, joints, and tendons. The physical demands, frequent motions, and reliance on hand tools put palm oil harvesters at a higher risk of developing MSDs than other types of workers. The purpose of this research was to identify causes of work-related injuries (MSDs) reported by palm oil harvesters in North Sumatra's PTPN IV Regional I Sei Putih. The method used was quantitative and cross-sectional in nature. Using complete sampling, 34 participants were chosen for the survey. Nordic Musculoskeletal Questionnaire (NMQ) was used for data collection. The data were examined with the use of univariate and bivariate approaches, with a significance threshold of $p < 0.05$, utilizing the Chi-square and Fisher's Exact tests. Aging ($p = 0.000$), length of service ($p = 0.001$), and smoking behaviors ($p = 0.002$) were shown to be significantly associated with complaints of MSDs. The correlation between BMI and the outcome was not statistically significant ($p = 0.704$). There was a strong correlation between age and complaints of MSDs. Companies should prioritize the implementation of ergonomic programs and frequent health monitoring as preventative measures for MSDs, particularly for employees aged 35 and above who have been with the company for at least five years, according to these results. It is also important to improve health education on the dangers of smoking. To get stronger and more thorough findings, further study with a bigger sample and deeper analysis is needed.

Keywords: ***Musculoskeletal Disorders, Palm Oil Harvesters, Age, Work Duration, Smoking Habits***

INTRODUCTION

Musculoskeletal disorders (MSDs) refer to complaints experienced by individuals in certain parts of the musculoskeletal system, with severity ranging from very mild to quite severe. Prolonged and repetitive static pressure on the muscles can damage tendons, ligaments, and joints, leading to discomfort. This discomfort may result in decreased work productivity (Ridlo et al., 2023). MSDs are not caused by a single incident but are the result of a combination and accumulation of continuous injuries over a long period. They pose significant occupational health problems due to increased healthcare costs, reduced productivity, and a lower quality of life (Hanifah, 2016). The World Health Organization (WHO) reported that MSDs accounted for 149 million cases across 160 countries, with complaint severity varying by age and diagnosis. Around 441 million people at risk of developing MSDs live in high-income developed countries, followed by 427 million in the Western Pacific region and 369 million in Southeast Asia (WHO, 2022). According to the Basic Health Research (Riskesdas) 2018, musculoskeletal disorders are common in Indonesia. Aceh Province recorded the highest prevalence (13.3%), while West Sulawesi had the lowest (3.2%). In Jambi Province, the prevalence was 8.67% or 9,511 cases. Based on medical diagnoses, MSDs incidence in 2018 ranged from 1.2% in the 15–24 year age group to 18.9% in individuals over 75 years. The highest prevalence by occupation was found in farmers (9.86%), followed by civil servants/military/state-owned employees (7.46%), fishermen (7.36%), and drivers/domestic workers (6.12%). In terms of location, 7.83% occurred in rural areas and 6.87% in urban areas.Palm oil harvesters are among the workers prone to MSDs due to the heavy physical workload involved in harvesting. This job requires high physical strength and is still carried out manually through repetitive movements (Sonia, 2023; Saputri et al., 2022; Pamungkas, 2021). In the sorting stage, harvested fruits are manually

sorted using a hook (gancu). Workers often experience pain in the back, waist, elbows, and shoulders, as the fruits are positioned low, forcing them to bend over repeatedly. This awkward posture leads to fatigue and discomfort in the lower back, shoulders, arms, elbows, and wrists (Tarigan et al., 2024; Sultan et al., 2022). A study by Marinawati (2016) found that non-ergonomic work conditions, such as prolonged sitting and uncomfortable environments, contribute to increased risk of MSDs. The research emphasized that poor posture and improper tools can cause pain and muscle fatigue, particularly in the back, neck, and shoulders. Juliana Lina et al. (2023), in a study on palm oil harvesters at PTPN IV Meranti Paham Plantation, revealed that age and years of service were significantly associated with MSDs complaints, with years of service being the dominant factor. MSDs were more common among workers aged over 35 years and those who had worked more than 10 years. Prolonged and repetitive physical activity contributes to increased muscle and joint complaints. Field observations of harvesters at PTPN IV Regional I Sei Putih indicated high ergonomic risk due to uneven terrain, poor access roads, and varying tree heights. Workers often reach for fruit bunches in extreme or prolonged bending positions while using manual harvesting tools such as egrek and dodos. These conditions increase biomechanical loads, potentially causing muscle stress, fatigue, and long-term musculoskeletal damage. Thus, non-ergonomic working conditions and the repetitive, physically demanding nature of palm oil harvesting significantly increase the risk of musculoskeletal disorders among harvesters at PTPN IV Regional I Sei Putih, North Sumatra. This study aims to analyze the factors associated with musculoskeletal disorders among palm oil harvesters.

METHODS

1. Research design

This research used a cross-sectional design and a quantitative methodology based on observational analysis. In order to determine the connection between the independent factors and the dependent variable (MSDs complaints), the cross-sectional approach is used at a single moment in time.

2. Place and time

At what time?In North Sumatra Province, specifically at PT Perkebunan Nusantara IV Regional I Sei Putih in Deli Serdang Regency, this study was carried out. The research took place between August 2024 and June 2025, with data collecting taking place in the field in November of the same year. Every person who worked the land to collect oil palms was considered a part of the population. In this study, 34 participants who fulfilled the inclusion criteria were selected using a total sample approach.

3. Data analysis

Data were analyzed using univariate and bivariate analysis.

a. Univariate analysis:

Put to use for illustrating the distribution of each variable's frequency and percentage.

b. Bivariate analysis:

This method is used to ascertain the connection between the dependent variable (MSDs complaints) and the independent variables (age, BMI, job length, smoking habits). When the anticipated cell values were less than 5, Fisher's Exact Test was employed, and the chi-square test was also utilized. Statistical significance was determined by a p-value less than 0.05.

RESULTS AND DISCUSSION

Results

a. Univariate Analysis

Table 1. Distribution of Respondents by Variables at PTPN IV Regional I Sei Putih

Variable	N	%
1. Age		
<35 years	15	44.1%
≥35 years	19	55.9%
2. Body Mass Index		
Normal (18.5-25.0)	25	73.5%
Abnormal (<18.5 or >25.0)	9	26.5%
3. Work Duration		
<5 years	14	41.2%
>5 years	20	58.8%
4. Smoking Habits		
Non-smoker	10	29.4%
Smoker	24	70.6%
5. MSDs Complaints		
Low (<21)	20	58.8%
High (>21)	14	41.2%

Based on Table 1, the majority of respondents were aged ≥35 years (55.9%), while respondents aged <35 years accounted for 44.1%. For the BMI variable, most respondents had a normal BMI (18.5–25.0), accounting for 73.5%, while 26.5% had an abnormal BMI (<18.5 or >25.0). Regarding years of service, 58.8% of respondents had ≥5 years of work experience, and 41.2% had <5 years. In terms of smoking habits, 70.6% of respondents were smokers, and 29.4% were non-smokers. For MSDs complaints, most respondents (58.8%) reported low levels of complaints, while 41.2% reported high levels.

b. Bivariate Analysis

Table 2. Relationship between Age, BMI, Years of Service, and Smoking Habits with Musculoskeletal Disorders among Palm Oil Harvesters

Variable	MSDs Complaints						p-value
	High		Low		Total		
	n	%	n	%	n	%	
1. Age							
<35 years	1	6,7	14	93,3	6,7	15	0,000
≥35 years	13	68,4	6	31,6	68,4	19	(Chi-square)
2. BMI							
Normal	11	44,0	14	56,0	44,0	73,5	0,704
Abnormal	3	33,3	6	66,7	9	26,5	(Fisher)
3. Work Duration							
<5 years	1	7,1	13	92,9	7,1	41,2	0,001
≥5 years	13	65,0	7	35,0	65,0	58,8	(Chi-square)
4. **Smoking Habit**							
Non-smoker	0	0,0	10	100,0	10	29,4	0,002
Smoker	14	58,3	10	41,7	24	70,6	(Fisher)
Total	14	41,2	20	58,8	34	100,0	

Note: p-values were calculated using the Chi-square test, except for BMI and smoking habits, which were analyzed using Fisher's Exact Test due to expected cell frequencies <5.

1. **Association between Age and Musculoskeletal Disorders (MSDs) Complaints**
   An association between respondent age and reports of MSDs was found to be statistically significant (p = 0.000) in the Chi-square test. The majority of those who reported MSDs were between the ages of 35 and 44. Hence, it is reasonable to assume that the risk of MSDs among palm oil harvesters is influenced by age.
2. **Association between Body Mass Index (BMI) and Musculoskeletal Disorders (MSDs) Complaints**
   CorrelationWith a p-value of 0.704, Fisher's Exact Test found no statistically significant correlation between BMI and MSD symptoms. This research found no statistically significant relationship between body mass index (BMI) and the frequency of reports of MSDs, as the proportions of complaints from participants with normal and abnormal BMI were comparable.
3. **Association between Years of Service and Musculoskeletal Disorders (MSDs) Complaints**
   Musculoskeletal Disorders (MSDs)A statistically significant correlation between years of service and complaints of MSDs was found in the Chi-square test analysis (p = 0.001). Those who had worked for at least five years were more prone to complain about MSDs than those who had worked for less than five years. Therefore, musculoskeletal issues are thought to be significantly influenced by years of employment.
4. **Association between Smoking Habits and Musculoskeletal Disorders (MSDs) Complaints**
   Fisher's Exact Test revealed a significant association between smoking habits and MSDs complaints (p = 0.002). All respondents who experienced MSDs complaints were smokers, while non-smokers did not report any complaints. Therefore, smoking habits can be categorized as a risk factor associated with the occurrence of musculoskeletal disorders.

Discussion

This study was conducted on 34 respondents who were oil palm harvesters. The results showed that all respondents experienced musculoskeletal disorder (MSD) complaints at varying levels. Measurements were carried out using the Nordic Musculoskeletal Questionnaire (NMQ), which covers 28 body areas. The most frequently reported body parts with complaints included the back, shoulders, knees, thighs, and waist, which are the primary areas actively involved in harvesting activities. Complaints were also found in the neck, upper arms, forearms, elbows, and wrists, although at lower frequencies. Repetitive work activities such as reaching, bending, cutting palm fruit bunches, and lifting loads contributed to the emergence of complaints in the musculoskeletal system. In addition, non-ergonomic working positions and varied field conditions such as sloped terrain and uneven surfaces exert high mechanical pressure on workers' bodies, thereby increasing the potential for MSD complaints in certain body parts.

a. Relationship between Age and Musculoskeletal Disorders (MSDs) Complaints

The results of this study showed a significant relationship between age and musculoskeletal disorders (MSDs) complaints (p = 0.000). The majority of respondents aged ≥35 years tended to experience high levels of MSD complaints (68.4%), compared to only 6.7% of respondents aged <35 years. This finding indicates that age is an important risk factor in increasing the likelihood of musculoskeletal complaints among oil palm harvesters. Observation of the complaint distribution among the older age group revealed a tendency for higher complaint intensity in specific body parts, particularly the back, waist, shoulders, and neck. These areas are the body parts most actively and dominantly used during the harvesting process, such as when lifting, reaching for palm fruit bunches, carrying heavy loads, and bending repeatedly. Meanwhile, in the younger age group, the complaints reported tended to be milder, more limited, and many respondents reported no complaints in most of the 28 body areas assessed. This pattern reinforces the notion that increasing age correlates with a broader spread of musculoskeletal complaints due to a decline in the body's physical adaptability to work demands.

This finding is consistent with research by Alfiani et al. (2023), which found that degenerative processes in muscles and joints with aging are key factors contributing to increased MSD complaints. Similarly, Fanjaniaina et al. (2022) reported that older workers have a higher risk of complaints compared to younger workers. However, not all studies support this result. A study by Syfanah and Zulhayudin (2022) on farmers in Purwakarta Sub-district, Cilegon, found no significant relationship between age and MSD complaints, possibly due to differences in job characteristics, work posture, and physical conditions across populations. From a physiological perspective, the theory proposed by Tarwaka (2015) explains that as age increases, there is a decline in the musculoskeletal system's capacity, including reduced strength, muscle elasticity, and physical endurance. Individuals over the age of 35 are more vulnerable to

musculoskeletal disorders due to their limited ability to adapt to heavy and repetitive physical work demands. This supports the study's findings that age is an essential factor to consider in preventing MSD complaints among workers in the plantation sector.

b. Relationship between Body Mass Index (BMI) and MSDs Complaints

The results of this study indicate that there was no statistically significant relationship between Body Mass Index (BMI) and musculoskeletal disorders (MSDs) complaints ($p = 0.704$). However, descriptive analysis of the primary data showed that workers with abnormal BMI, particularly in the older age group, tended to experience complaints in more body regions compared to younger workers with normal BMI. This suggests that although BMI is not a statistically dominant factor, it may still have an impact on musculoskeletal conditions, especially when combined with other factors such as age and work duration. This finding is consistent with studies conducted by Fanjaniaina et al. (2022), Dyana et al. (2023), and Tiara Devi et al. (2017), which stated that BMI does not have a significant relationship with MSD complaints. They agreed that ergonomic factors such as work posture, intensity of physical workload, and worker age have a greater influence on musculoskeletal complaints than BMI status alone. These studies were conducted on worker groups engaged in heavy and repetitive physical activities, similar to the context of oil palm harvesters in this study. Theoretically, abnormal BMI—whether overweight or underweight—still has the potential to exacerbate biomechanical stress on the body. Individuals with excess BMI are likely to experience increased pressure on the spine and joints, while those with low BMI may have reduced muscle strength and physical endurance, both of which can trigger musculoskeletal complaints. Abnormal BMI can also affect body posture, increase muscle tension, and cause soft tissue irritation around joints, ultimately impacting productivity and work safety, particularly in physically demanding and repetitive work environments such as the plantation sector (Andini, 2019)

c. Relationship between Years of Service and MSDs Complaints

The analysis using the chi-square test showed a significant relationship between work duration and musculoskeletal disorders (MSDs) complaints ($p = 0.001$). Respondents with a work duration of ≥5 years experienced more MSD complaints compared to those with <5 years of service. This indicates that work duration is one of the significant factors influencing the occurrence of musculoskeletal system disorders among plantation workers. This finding is also supported by trends observed in the primary data. Most respondents with longer work durations reported complaints in multiple body regions based on the Nordic Musculoskeletal Questionnaire (NMQ), particularly in the back, waist, shoulders, neck, and knees—areas most actively used in the palm oil harvesting process. Meanwhile, respondents with shorter work durations (<5 years) tended to report milder complaints with fewer affected body regions. This pattern indicates that the longer the work duration, the greater the accumulation of physical workload experienced by the body, thus increasing the risk of developing MSD complaints.

This finding is consistent with the results of a study conducted by Indriyani et al. (2022) on daily laborers at the Department of Public Works in Palembang, which stated that the longer a person works, the greater the accumulation of physical stress that contributes to the risk of musculoskeletal disorders. Similar results were reported by Ebu To et al. (2020) among gas station operators in Kupang City, and by Fanjaniaina et al. (2022), who emphasized that work durations of more than four years increase the risk of MSD complaints in retail workers. However, a study by Syfanah and Zulhayudin (2022) found different results among farmers in Cilegon City, where work duration was not significantly related to MSDs. This may be due to differences in daily workload, working posture, and ergonomic exposure across different job types. MSD complaints are often found among workers with relatively short work durations, typically less than five years. This condition may be due to a lack of work experience, the body not yet being accustomed to physical workload, and an ongoing adaptation process to job activities, tools, and the work environment (Santosa, 2018; Irawati et al., 2020). On the other hand, longer work duration also carries its own risks. The longer someone works, the greater their exposure to repeated ergonomic risk factors such as monotonous movements, awkward postures, and cumulative physical stress. Prolonged exposure can lead to damage to muscle and skeletal tissues, thereby increasing the likelihood of MSD complaints among workers (Oley et al., 2018).

d. Relationship between Smoking Habits and MSDs Complaints

The results of the Fisher's Exact Test showed a significant relationship between smoking habits and musculoskeletal disorders (MSDs) complaints ($p = 0.002$). In this study, none of the non-smoking respondents experienced high-level MSD complaints, while the majority of respondents who smoked reported complaints ranging from mild to severe. Although these results are identical to those produced by the chi-square test, the Fisher's Exact

Test was more appropriate methodologically due to the presence of cells with expected values less than 5 in the contingency table. Primary data revealed that nearly all respondents who experienced complaints in multiple body areas were active smokers. Many of them, particularly those with longer work durations, reported pain in areas such as the back, neck, shoulders, legs, and ankles. In contrast, among non-smoking respondents, MSD complaints were minimal and not widely distributed across body parts. This pattern reinforces the statistical results that smoking habits may increase the risk of musculoskeletal disorders, especially when combined with other risk factors such as age and work duration. This finding is in line with the study by Hanif (2020), which reported a moderate relationship between smoking habits and MSD complaints among loading workers at UD Maju Makmur Surabaya. Putri and Ardi (2020) also found a significant relationship among workers in the weaving industry in Bantul, where smoking was proven to increase the risk of muscle and skeletal complaints.

Further explanation was provided by Gunung et al. (2020), who stated that smoking reduces lung capacity and decreases oxygen intake to body tissues. This reduced oxygen supply hampers muscle metabolism, accelerates fatigue, and ultimately increases the risk of MSDs—especially in physically demanding jobs. Physiologically, smoking causes vasoconstriction and reduces the lungs' ability to deliver sufficient oxygen to muscle tissues. Hanif (2020) explained that low oxygen levels in the blood disrupt the energy production process from carbohydrates, which in turn leads to lactic acid accumulation in the muscles. This accumulation results in pain, stiffness, and muscle tension—hallmarks of musculoskeletal disorders. Therefore, smoking not only affects the respiratory system but also indirectly lowers physical fitness and increases the body's susceptibility to muscle and skeletal injuries.Thus, both empirical findings and physiological theory suggest that smoking habits are a real risk factor contributing to the increased occurrence of MSD complaints, and should be a key focus in occupational health prevention and intervention efforts, especially in physically demanding work environments such as palm oil harvesting.

CLOSING

Conclusion

1. Oil palm harvesters at PTPN IV Regional I Sei Putih in 2024 reported significantly more musculoskeletal problems (MSDs) as they became older (p-value = 0.000).
2. Oil palm harvesters in PTPN IV Regional I Sei Putih in 2024 reported a significantly higher number of MSDs complaints while working for longer periods of time (p-value = 0.001).
3. Oil palm harvesters in PTPN IV Regional I Sei Putih in 2024 who smoke have a higher risk of complaining about MSDs (p-value = 0.002).
4. The 2024 PTPN IV Regional I Sei Putih oil palm harvesters' Body Mass Index (BMI) was not significantly correlated with their reports of MSDs (p-value = 0.704).
5. In conclusion, the factors that significantly influence MSDs complaints are age, work duration, and smoking habits. Preventive efforts and ergonomic interventions are needed, especially for workers aged ≥35 years and with ≥5 years of work duration.

REFERENCES

Andini, R. (2019). Body mass index as a risk factor for musculoskeletal disorders. Sandi Husada Scientific Health Journal, 8(2), 316–320. [https://doi.org/10.35816/jiskh.v10i2.178].

Devi, T., Purba, I., & Lestari, M. (2017). Risk factors of musculoskeletal disorders (MSDs) complaints on rice transportation activities at PT. Buyung Poetra Pangan Pegayut Ogan Ilir. Journal of Public Health Science, 8(2), 125–134. [https://doi.org/10.26553/jikm.2016.8.2.125-134].

Fanjaniaina, S., Cahyati, W. H., & Koesyanto, H. (2022). The relationship between age, BMI, and work duration with musculoskeletal disorders (MSDs) complaints among sales promotion girls (SPG). Indonesian Journal of Public Health Promotion (JPPKMI), 3(1), 62–70. [https://journal.unnes.ac.id/sju/index.php/jppkmi].

Hanif, A. (2020). The relationship between age and smoking habits with musculoskeletal disorders (MSDs) complaints among freight workers at UD Maju Makmur, Surabaya City. Medical Technology and Public Health Journal, 4(1), 7–15. [https://doi.org/10.33086/mtphj.v4i1.715].

Indriyani, I., Badri, P. R. A., Oktariza, R. T., & Ramadhani, R. S. (2022). Analysis of the relationship between age, work duration, and knowledge with musculoskeletal disorders (MSDs) complaints. Health Journal, 13(1), 186–191. [https://doi.org/10.26630/jk.v13i1.2821].

Irawati, N., Yogisutanti, G., & Sitorus, N. (2020). The relationship between nutritional status, work duration, and working posture with musculoskeletal disorders among tailors in West Java. JPH RECODE, 4(1).

Lina, J., Hartono, Riama, M., Br S., Bukit, R., & Muharraran, F. (2023). The influence of risk factors on palm oil harvesters toward musculoskeletal disorders (MSDs) complaints at PTPN IV Meranti Paham Plantation Unit. Jurnal Kesmas Prima Indonesia, 7(2), 202–208.

Pamungkas, J. P. (2021). The relationship between working posture and musculoskeletal complaints among palm oil factory workers in the processing division of PT. Perkebunan Nusantara VI, Tanjung Lebar Unit \[Undergraduate thesis, Jambi University].

Rahmawati, A. S., & Dewi, R. P. (2020). The relationship between working posture, work duration, and smoking habits with musculoskeletal disorders (MSDs) among traditional weavers at "KURNIA" Kraoyak Wetan, Sewon, Bantul. Ahmad Dahlan University Repository, 274–282.

Ramisah Alfiani, R., Listyandini, R., & Fathimah, A. (2023). Factors associated with musculoskeletal disorders (MSDs) complaints among tailors at Pasar Anyar Bogor in 2022. Promotor, 6(3), 204–212. [https://doi.org/10.32832/pro.v6i3.246].

Rendisetiawan, R., Dahlan, M., & Nengsi, S. (2023). The relationship between awkward working posture and musculoskeletal disorders (MSDs) among sanitation workers at the Department of Environment and Forestry. Peqguruang Conference Series Journal, 5(1), 418. [https://doi.org/10.35329/jp.v5i1.2557].

Ridlo, A. J., & Fasya, A. H. Z. (2023). Overview of musculoskeletal disorders (MSDs) complaints among PDKB workers at PT. PLN (Persero) UP3 South Surabaya. Sehat Rakyat: Public Health Journal, 2(2), 258–266.

Ministry of Health of the Republic of Indonesia. (2018). Basic Health Research (Riskesdas). Health Research and Development Agency. [https://www.litbang.kemkes.go.id/laporan-riset-kesehatan-dasar-riskesdas-2018/].

Saputri, A. I., Ramdan, I. M., & Sultan, M. (2022). Working posture and musculoskeletal disorders among palm oil harvesters at PT. Inti Energi Kaltim, Berau District. Tropical Public Health Journal.

Santosa, A., & Ariska, D. K. (2018). Factors associated with the incidence of musculoskeletal disorders among batik workers in Sokaraja District, Banyumas. Journal of Health Sciences, 16(1), 42–46.

Sonia, N. (2023). Risk factors of musculoskeletal disorders (MSDs) among palm oil fruit harvesters at PTPN VI Rimbo Satu Unit, Tebo District, Jambi Province \[Undergraduate thesis, Jambi University].

Sultan, M., Saputri, A. I., & Ramdan, I. M. (2022). Working posture and musculoskeletal disorders among palm oil harvesters at PT. Inti Energi Kaltim, Berau District. Tropical Public Health Journal, 2(2), 54–59.

Suoth, L. F., & Asrifuddin, A. (2018). The relationship between working posture and work duration with musculoskeletal disorders among fishermen in Batukota Village, Lembeh Utara District, Bitung City in 2018. Kesmas Journal, 7(5), 1–9.

Syfanah, H., & Zulhayudin, M. F. (2022). Factors associated with musculoskeletal disorders (MSDs) complaints among farmers in Purwakarta Village, Cilegon City. Periodical of Occupational Safety and Health, 1(1), 1–7.

Tarigan, H. P., Hasibuan, Y. M., & Utama, D. W. (2024). Working posture analysis of sorting operators at a palm oil factory using RULA and REBA methods at PT. London Sumatra, Tbk Begerpang Palm Oil Mill. IRA Journal of Applied Mechanical Engineering, 3(1), 11–19.

World Health Organization. (2022). Musculoskeletal health.[https://www.who.int/news-room/fact-sheets/detail/musculoskeletal conditions]