

ARTICLE INFORMATION

Received: July, 14, 2026

Revised: July, 23, 2026

Available online: July, 27, 2026

at : <https://e-jurnal.iphorr.com/index.php/minh>

Musculoskeletal complaints, work posture, and vibration exposure among bag-sewing artisans

Dakwatun Shofia^{1*}, Shofiyah Nur Rosyidah², Ragil Ismi Hartanti², Noeroel Widajati¹

¹Departemen Kesehatan dan Keselamatan Kerja, Fakultas Kesehatan Masyarakat, Universitas Airlangga

²Departemen Kesehatan dan Keselamatan Kerja, Fakultas Kesehatan Masyarakat, Universitas Jember

Corresponding author: *E-mail: dakwatunshofia01@gmail.com

Abstract

Background: Craft workers are particularly vulnerable to developing Musculoskeletal Disorders (MSDs), with reported prevalence ranging from 38.5% to 100%, including among bag artisans. MSDs are influenced by individual factors, work-related factors, and environmental conditions. The Tanggulangin area is well known as a center for the bag and suitcase industry and was identified as a population at risk based on preliminary observations.

Purpose: To describe individual factors, work-related factors, vibration exposure, and complaints of Musculoskeletal Disorders (MSDs) among bag artisans.

Method: This study employed a descriptive analytical design with a cross-sectional study. A total of 38 bag artisans participated in the study. Data were collected using the Rapid Entire Body Assessment (REBA) questionnaire to assess work posture, the Nordic Body Map (NBM) questionnaire to evaluate MSD complaints, and a vibration meter to measure vibration exposure.

Results: The findings indicated a tendency for smoking habits (OR = 1.123) and awkward working posture (OR = 1.500) to be associated with MSD complaints. Meanwhile, environmental exposure in the form of vibration intensity did not exceed the established Threshold Limit Value (TLV).

Conclusion: No statistically significant associations were identified between the examined individual or occupational factors and MSD complaints. All measured vibration exposures were below the applicable threshold limit, preventing comparison between different exposure levels.

Keywords: Bag Artisans; Musculoskeletal Disorders; Smoking Habits; Vibration Exposure; Working Posture.

INTRODUCTION

Industrial development in Indonesia has continued to expand over the years, with steady growth observed in both the formal and informal sectors. According to data released by Statistics Indonesia, as of February 2026, approximately 87.74 million individuals (59.42%) were employed in the informal sector, compared with 59.93 million workers (40.58%) in the formal sector (Statistics Indonesia, 2026). Despite its significant contribution to the national economy, the informal sector is characterized by limited occupational health and safety protections,

placing workers at greater risk of occupational hazards.

Workers across all industrial sectors are potentially exposed to occupational accidents and occupational diseases (ODs). However, this risk is particularly pronounced in the informal sector, where workers generally have lower levels of educational attainment and limited access to occupational health and safety training (Balaka, Rumbia, & Ernawati, 2022). Consequently, inadequate awareness and knowledge of workplace hazards increase workers'

susceptibility to hazardous exposures that may lead to occupational diseases. According to the Government of Indonesia, an occupational disease is defined as a disease caused by work activities and/or exposure to hazards present in the work environment (Government of Indonesia, 2019).

Musculoskeletal disorders (MSDs) are among the most prevalent occupational diseases in industrialized countries and represent a leading cause of work-related injury and disability. MSDs encompass a wide range of disorders affecting the muscles, nerves, tendons, ligaments, joints, cartilage, and intervertebral discs (Centers for Disease Control and Prevention, 2021). Globally, the World Health Organization (WHO) estimates that approximately 1.71 billion people live with musculoskeletal conditions, making them the leading cause of disability worldwide. Among these conditions, low back pain is recognized as the single leading cause of disability across 160 countries (World Health Organization, 2022).

In Indonesia, comprehensive national data on the prevalence of work-related MSDs remain limited. Nevertheless, a report from the Indonesian Ministry of Health, based on a study involving 482 workers from 12 districts and municipalities, identified MSDs as the most frequently reported occupational health problem, accounting for 16% of all workplace illnesses (Sholeha & Sunaro, 2022). Similarly, a recent study among traditional weaving artisans found that 93.4% of informal sector workers experienced MSD symptoms, highlighting the substantial burden of musculoskeletal disorders among informal workers in Indonesia (Kusuma, Adnyani, Mathar, & Karmila, 2024).

Risk factors for MSDs are divided into two categories: psychological and physical. Physical risk factors include individual factors, occupational factors, and environmental factors. Workload, frequency, duration, and posture are all occupational risk factors. MSDs arise from repetitive work activities, lifting heavy loads, abnormal postures, or prolonged static activity (Olutende, Kweyui, Wanzala, & Mse, 2022). Individual risk factors include Body Mass Index (BMI), age, length of service, gender, smoking habits, and medical history. Temperature, vibration, lighting, and noise are environmental risk factors (Siregar, Marpaung, & Jariah, 2021). Uncomfortable

temperatures and lighting in the workplace can impact workers' health. Furthermore, tools often produce vibrations, which can continuously lead to MSDs in frequently exposed body parts.

Vibration factors generated by sewing machines in the bag industry can increase the risk of MSDs. In similar industries, exposure to vibration in the workplace is known to be a significant risk factor for complaints of pain in the neck, shoulders, lower back, and upper back. This is also followed by high workloads and long working hours of eight to ten hours per day for most sewing machine operators (Khan, Ahmed, Jhilky, Galib, Tanim, & Banu, 2025). In a different industry, it was shown that 95% of respondents identified contact pressure and vibration as the main factors causing MSDs (Chellappa, Victor Rajesh, & Prakash, 2025). This indicates that physical factors such as vibration are one of the factors that increase the risk of MSDs. Previous studies have consistently demonstrated a high prevalence of musculoskeletal disorders (MSDs) among workers in the leather bag manufacturing industry. A study involving 100 sewing workers in the leather bag industry reported that 86% experienced lower back pain, 84% reported knee pain, and 74% experienced neck pain within the previous seven days (Kanniappan & Palani, 2020). Similarly, research conducted among workers in the informal leather bag industry found that repetitive movements, prolonged standing or sitting, awkward working postures, and manual material handling activities substantially increased the risk of developing MSDs (Gowtham, Eshwar, Thozhanenjan, & Vittal, 2025).

Consistent with these findings, a study conducted at a bag manufacturing company, PT Midper, identified several occupational risk factors associated with MSDs, including awkward working postures, non-ergonomic workstations, repetitive tasks, and prolonged working hours throughout the bag production process. In addition, individual characteristics such as older age, longer work tenure, and smoking habits were found to be significantly associated with the occurrence of MSD symptoms among workers (Edison, Ginanjar, & Suprayitno, 2021).

Musculoskeletal disorders (MSDs) impose substantial burdens on workers, employers, and society. For workers, MSDs can impair physical function, reduce work performance and productivity,

Dakwatun Shofia^{1*}, Shofiyah Nur Rosyidah², Ragil Ismi Hartanti², Noeroel Widajati¹

¹Departemen Kesehatan dan Keselamatan Kerja, Fakultas Kesehatan Masyarakat, Universitas Airlangga

²Departemen Kesehatan dan Keselamatan Kerja, Fakultas Kesehatan Masyarakat, Universitas Jember

Corresponding author: *E-mail: dakwatunshofia01@gmail.com

increase absenteeism, and result in considerable loss of working time. According to the U.S. Bureau of Labor Statistics, musculoskeletal disorders account for a median of 12 days away from work per case, reflecting their significant impact on workforce productivity (U.S. Bureau of Labor Statistics, 2024). Beyond their occupational consequences, musculoskeletal conditions can substantially restrict mobility, manual dexterity, and the ability to perform daily activities. These limitations may contribute to premature retirement, reduced quality of life and well-being, diminished social participation, and decreased economic productivity, thereby imposing a considerable socioeconomic burden on individuals, employers, and healthcare systems (U.S. Bureau of Labor Statistics, 2024).

Sidoarjo Regency is home to the Tanggulangin bag and suitcase manufacturing industry, which is centered in Kedensari Village and is recognized as one of Indonesia's leading leather goods production hubs. Products manufactured in Tanggulangin are widely known for their durability and high quality, with an estimated service life of more than five years. The industry comprises entrepreneurs, skilled artisans, and production workers. A typical enterprise employing approximately 15 artisans is capable of producing around 200 women's bags, 100 men's bags, and 25 large suitcases or golf bags per month, depending on product size and design complexity (Januarta & Yasin, 2025). The Tanggulangin industrial center is the largest bag manufacturing and trading hub in Kedensari Village, producing approximately 1,500 bags per day for distribution to markets across Indonesia. Bag production involves several sequential stages, including material cutting, molding, sewing, assembly, and packaging. Among these, the sewing process requires specialized technical skills, sustained concentration, and a high degree of precision to ensure that products meet established quality standards. The sewing stage also exposes workers to various ergonomic risk factors. These include prolonged static postures, repetitive upper-limb movements, non-ergonomic workstation designs, and repetitive tasks such as pattern stitching and thread trimming, all of which may increase the risk of developing musculoskeletal disorders (MSDs). A preliminary survey conducted by the researchers found that 10 of the 11 sewing artisans working in the

Tanggulangin industrial center reported experiencing MSD symptoms within the previous seven days, highlighting the need for further investigation into occupational risk factors among this workforce.

Based on the issues outlined above, further investigation is warranted to identify the factors associated with musculoskeletal disorders (MSDs) among bag artisans, particularly those engaged in sewing activities. This study examines the association between machine vibration exposure, individual worker characteristics, and working posture and the occurrence of MSD symptoms among sewing artisans in the informal bag manufacturing sector. Although ergonomic hazards in manufacturing have been widely investigated, evidence from small-scale informal bag industries remains limited, particularly regarding the combined effects of repetitive sewing tasks, prolonged working durations, and machine vibration exposure. The high potential for MSDs resulting from exposure to machine vibration, non-ergonomic working postures, and individual worker characteristics may adversely affect workers' productivity, physical functioning, and quality of life. Therefore, the findings of this study are expected to provide evidence for the development of targeted ergonomic interventions and occupational health programs aimed at reducing the burden of MSDs and improving the health and well-being of workers in the informal bag manufacturing industry.

RESEARCH METHOD

This study employed a descriptive analytical design with a cross-sectional study. The study was conducted in March 2023 at the Tanggulangin bag and suitcase industry center in Sidoarjo Regency, Indonesia. The study population comprised sewing artisans working in the informal bag manufacturing sector. Because the total number of eligible sewing workers was limited, all workers were included using a total sampling technique. A total of 38 artisans participated in the study, representing a 100% response rate. The inclusion criterion was willingness to participate in the study and provide written informed consent.

Primary data were collected through interviews, direct observation, and workplace measurements, while secondary data were obtained from relevant institutional records.

Dakwatun Shofia^{1*}, Shofiyah Nur Rosyidah², Ragil Ismi Hartanti², Noeroel Widajati¹

¹Departemen Kesehatan dan Keselamatan Kerja, Fakultas Kesehatan Masyarakat, Universitas Airlangga

²Departemen Kesehatan dan Keselamatan Kerja, Fakultas Kesehatan Masyarakat, Universitas Jember

Corresponding author: *E-mail: dakwatunshofia01@gmail.com

The study examined three groups of independent variables, namely individual factors, occupational factors, and environmental factors, with musculoskeletal disorder (MSD) symptoms as the dependent variable.

Individual factors included age, gender, length of employment, and smoking habits. Smoking habits were classified according to the average number of cigarettes smoked per day into non-smoker, light smoker (<10 cigarettes/day), moderate smoker (10–20 cigarettes/day), and heavy smoker (>20 cigarettes/day). For the analysis of associations with MSD symptoms, smoking status was further dichotomized into smoker and non-smoker.

Working posture was assessed using the Rapid Entire Body Assessment (REBA) method developed by Hignett and McAtamney (2000). Workers were observed while performing their routine sewing activities, and the posture of the neck, trunk, legs, upper arms, lower arms, and wrists was evaluated together with load/force, coupling, and activity level. The final REBA score ranges from 1 to 15, with higher scores indicating greater ergonomic risk. Ergonomic risk levels were classified according to the original REBA criteria as very low (score = 1), low (scores 2–3), medium (scores 4–7), high (scores 8–10), and very high (scores 11–15). Higher REBA scores indicate a greater need for ergonomic intervention.

Hand-arm vibration generated by sewing machines was measured using a calibrated vibration meter under normal working conditions. Measurements were expressed as acceleration in meters per second squared (m/s^2) and evaluated according to the exposure limits recommended by ISO 5349-1:2001 (Mechanical vibration—Measurement and evaluation of human exposure to hand-transmitted vibration). Vibration exposure was classified as below or above the applicable Threshold Limit Value (TLV). In this study, all measured vibration levels were below the recommended exposure limit,

resulting in homogeneous exposure among participants.

MSD symptoms were assessed using the Nordic Body Map (NBM) questionnaire, which was developed based on the Standardized Nordic Musculoskeletal Questionnaire (Kuorinka, Jonsson, Kilbom, Vinterberg, Biering-Sørensen, Andersson, & Jørgensen, 1987). The questionnaire evaluates discomfort in 28 anatomical body regions experienced during the previous seven days. Each body region was rated on a four-point scale: 1 = no pain, 2 = mild pain, 3 = moderate pain, and 4 = severe pain. Individual scores were summed to obtain a total NBM score ranging from 28 to 112, with higher scores indicating greater severity of musculoskeletal complaints. Based on the classification proposed by Setyanto et al. (2015), the total scores were categorized as low (28–49), moderate (50–70), high (71–91), and very high (92–112) levels of MSD complaints.

Descriptive statistics were used to summarize respondents' characteristics, ergonomic risk factors, vibration exposure, and MSD symptoms. Categorical variables were presented as frequencies and percentages. Cross-tabulation analysis was performed to examine the distribution of MSD symptoms across the independent variables. Odds ratios (ORs) with 95% confidence intervals (95% CIs) were calculated to describe the strength of association between individual factors, working posture, vibration exposure, and MSD symptoms.

The study protocol was approved by the Health Research Ethics Committee (KEPK), Faculty of Dentistry, University of Jember (Approval No. 1922/UN25.8/KEPK/DL/2023). Written informed consent was obtained from all participants prior to data collection, and all procedures were conducted in accordance with the ethical principles of the Declaration of Helsinki (World Medical Association, 2013).

Dakwatun Shofia^{1*}, Shofiyah Nur Rosyidah², Ragil Ismi Hartanti², Noeroel Widajati¹

¹Departemen Kesehatan dan Keselamatan Kerja, Fakultas Kesehatan Masyarakat, Universitas Airlangga

²Departemen Kesehatan dan Keselamatan Kerja, Fakultas Kesehatan Masyarakat, Universitas Jember

Corresponding author: *E-mail: dakwatunshofia01@gmail.com

RESEARCH RESULTS

Table 1. Distribution of Participant Characteristics (N=38)

Variable	Results
Age (Mean±SD)(Range)(Year)	(37.39 ± 10.67)(19-53)
Age (n/%)	
< 30 years	12/31.6
≥ 30 years	26/68.4
Gender (n/%)	
Male	15/39.5
Female	23/60.5
Length of Employment (n/%)	
< 3 years	20/52.6
≥ 3 years	18/47.4
Smoking Habit (n/%)	
Non-smoker	27/71.1
Light Smoker	4/10.5
Moderate Smoker	6/15.8
Heavy Smoker	1/2.6
Exercise Habits (n/%)	
Never exercise	20/52.6
Occasionally (1-2 times/week)	18/47.4
Often (≥ 3 times/week)	0/0.0
Work Posture (n/%)	
Medium	18/47.4
High	20/52.6
MSDs (n/%)	
No Complaints	11/28.9
Low	18/47.4
Moderate	9/23.7

A total of 38 sewing artisans participated in the study. The participants had a mean age of 37.39 ± 10.67 years (range: 19-53 years), with most workers aged ≥30 years (68.4%). Female workers accounted for 60.5% of the sample, while 39.5% were male. More than half of the participants had worked for less than three years (52.6%).

Most participants were non-smokers (71.1%), whereas 28.9% reported current smoking, including light (10.5%), moderate (15.8%), and heavy smokers (2.6%). Regarding lifestyle, 52.6% reported never engaging in regular exercise, while the remaining 47.4% exercised occasionally (1–2 times per week).

Ergonomic assessment using the Rapid Entire Body Assessment (REBA) showed that 52.6% of workers were exposed to a high-risk working posture, while 47.4% were classified as having a medium-risk posture. Assessment of musculoskeletal symptoms using the Nordic Body Map (NBM) revealed that 47.4% of participants experienced low-level MSD symptoms, 23.7% experienced moderate symptoms, and 28.9% reported no musculoskeletal complaints. No participants were classified as having high or very high levels of MSD symptoms.

Dakwatun Shofia^{1*}, Shofiyah Nur Rosyidah², Ragil Ismi Hartanti², Noeroel Widajati¹

¹Departemen Kesehatan dan Keselamatan Kerja, Fakultas Kesehatan Masyarakat, Universitas Airlangga

²Departemen Kesehatan dan Keselamatan Kerja, Fakultas Kesehatan Masyarakat, Universitas Jember

Corresponding author: *E-mail: dakwatunshofia01@gmail.com

Table 2. Association Between Individual Factors, Occupational Factors, and Musculoskeletal Disorder (MSD) (N = 38)

Variable	No MSD Complaints	Low MSD Complaints	Moderate MSD Complaints	OR	95% CI	p-value
Age (n/%)						
< 30 years	3/25.0	6/50.0	3/25.0	1.333	0.283–6.279	1.000
≥ 30 years	8/30.8	12/46.1	6/23.1			
Gender (n/%)						
Male	3/20.0	8/53.3	4/26.7	2.133	0.463–9.839	0.470
Female	8/34.8	10/43.5	5/21.7			
Length of Employment (n/%)						
< 3 years	5/25.0	11/55.0	4/20.0	1.500	0.367–6.137	0.724
≥ 3 years	6/33.3	7/38.9	5/27.8			
Smoking Habit (n/%)						
Non-smoker	8/29.6	12/44.5	7/25.9	1.123	0.235–5.359	1.000
Smoker	3/27.3	6/54.5	2/18.2			
Exercise Habits						
Never exercise	7/35.0	9/45.0	4/20.0	1.885	0.446–7.969	0.485
Occasionally (1-2 times/week)	4/22.2	9/50.0	5/27.8			
Work Posture (n/%)						
Medium	6/33.3	7/38.9	5/27.8	1.500	0.367–6.137	0.724
High	5/25.0	11/55.0	4/20.0			

The bivariate analysis showed that none of the investigated factors had a statistically significant association with musculoskeletal disorder (MSD) complaints among bag sewing artisans ($p > 0.05$). However, several factors demonstrated a tendency toward increased MSD complaints.

Workers aged <30 years had a 1.33-fold higher tendency for MSD complaints compared with workers aged ≥30 years (OR = 1.333; 95% CI: 0.283–6.279; $p = 1.000$). Male workers showed a higher tendency for MSD complaints than female workers (OR = 2.133; 95% CI: 0.463–9.839; $p = 0.470$).

Regarding occupational characteristics, workers with shorter employment duration (<3 years) had a 1.50-fold higher tendency for MSD complaints compared with those with longer employment duration (≥3 years) (OR = 1.500; 95% CI: 0.367–6.137; $p = 0.724$). Smoking habits also showed a tendency toward MSD complaints, with smokers having a slightly higher likelihood compared with non-smokers (OR = 1.123; 95% CI: 0.235–5.359; $p = 1.000$).

Workers who never exercised had a higher tendency for MSD complaints compared with those who exercised occasionally (OR = 1.885; 95% CI: 0.446–7.969; $p = 0.485$). Furthermore, workers exposed to high-risk working postures based on REBA assessment had a 1.50-fold higher tendency for MSD complaints compared with those with medium-risk postures (OR = 1.500; 95% CI: 0.367–6.137; $p = 0.724$).

This study did not identify sufficient statistical evidence to demonstrate a significant association between age, gender, length of employment, smoking habits, exercise habits, working posture, and MSD complaints among bag sewing artisans. All p-values were greater than 0.05, and the 95% confidence intervals (CIs) for all odds ratio (OR) estimates included 1, indicating that the observed associations were not statistically significant.

Dakwatun Shofia^{1*}, Shofiyah Nur Rosyidah², Ragil Ismi Hartanti², Noeroel Widajati¹

¹Departemen Kesehatan dan Keselamatan Kerja, Fakultas Kesehatan Masyarakat, Universitas Airlangga

²Departemen Kesehatan dan Keselamatan Kerja, Fakultas Kesehatan Masyarakat, Universitas Jember

Corresponding author: *E-mail: dakwatunshofia01@gmail.com

The wide ranges of the 95% CIs suggest that the OR estimates had limited precision, which may be attributed to the relatively small sample size ($n = 38$). Therefore, the results of this study only describe the dominant groups based on individual, occupational, and vibration factors associated with MSDs.

Table 3. Vibration Measurement Results of Sewing Machines (N = 38)

Vibration Axis	Mean $\pm$ SD (m/s ²)	Range (m/s ²)	
		Minimum	Maximum
X-axis	1.999 $\pm$ 0.917	0.834	4.969
Y-axis	1.951 $\pm$ 0.855	0.755	4.476

Table 3 presents the results of environmental factor assessment in the form of sewing machine vibration intensity and its relationship with musculoskeletal disorder (MSD) complaints. Vibration exposure was measured on 38 sewing machines used by workers in the sewing section of the bag and suitcase manufacturing industry center using a vibration meter.

The odds ratio (OR) for vibration intensity could not be calculated because the measured vibration exposure showed no variability among participants. Measurements performed at two observation points, namely the X-axis and Y-axis, demonstrated homogeneous exposure levels, with all recorded values being ≤ 5 m/s².

The results showed that the mean vibration intensity on the X-axis was 1.999 ± 0.917 m/s², with values ranging from 0.834 to 4.969 m/s². Meanwhile, the mean vibration intensity on the Y-axis was 1.951 ± 0.855 m/s², with values ranging from 0.755 to 4.476 m/s². All measurements obtained from both axes were classified within the same category, namely vibration exposure below 5 m/s². Therefore, the association between vibration intensity and MSD complaints could not be statistically analyzed due to the absence of exposure variation.

DISCUSSION

The respondents' age was determined based on the number of years elapsed from birth until the time of data collection. All 38 respondents were classified as being within the productive age range according to the International Labour Organization, which defines the working-age population as individuals aged 15–64 years (International Labour Organization, 2013). The findings from the bag and suitcase manufacturing industry center showed that the majority of workers

were aged ≥ 30 years. This distribution may reflect the characteristics of informal craft industries, where workers tend to remain in the occupation for extended periods and accumulate technical skills through years of experience. Workers with longer experience may have developed better sewing skills and greater familiarity with workplace demands, which may reduce work-related stress and contribute to fewer perceived workplace complaints compared with younger workers (Ramayanti & Koesyanto, 2021).

Contrary to some previous assumptions, several studies have reported that men may experience a higher prevalence of musculoskeletal disorders (MSDs) than women in certain occupational settings. A study involving 70 tailors found that MSD complaints were more frequently reported among male workers (57%) compared with female workers (43%). However, differences were observed in the distribution of pain locations, with female operators more commonly reporting neck discomfort, whereas male operators more frequently experienced lower back pain (Dattani, 2025). The differences in MSD prevalence between men and women may be related to variations in anatomical and physiological characteristics, including body composition, muscle strength, and joint structure. These differences may influence the body's response to physical demands, workload, and occupational activities. Previous research has indicated that men tend to have a higher proportion of MSD complaints in occupations involving greater physical demands, heavy equipment handling, or tasks requiring higher levels of muscular strength (Nurshabrina, Andarini, Idris, & Anggraeni, 2023).

Length of employment refers to the duration that respondents have worked, calculated from the time they first started their occupation until the time of data collection. This factor is closely related to individual work experience, skill development, and adaptation to

Dakwatun Shofia^{1*}, Shofiyah Nur Rosyidah², Ragil Ismi Hartanti², Noeroel Widajati¹

¹Departemen Kesehatan dan Keselamatan Kerja, Fakultas Kesehatan Masyarakat, Universitas Airlangga

²Departemen Kesehatan dan Keselamatan Kerja, Fakultas Kesehatan Masyarakat, Universitas Jember

Corresponding author: *E-mail: dakwatunshofia01@gmail.com

workplace conditions. Workers with longer employment duration are generally considered to have greater familiarity with their tasks, better technical skills, and improved adaptation to occupational demands. In contrast, workers with shorter employment duration may have more limited experience and require a longer adjustment period to effectively perform their tasks.

In the Tanggulangin bag and suitcase industry center, sewing activities require specialized skills, sustained concentration, and high precision to ensure that products meet consumer quality standards. Therefore, workers with shorter employment duration may experience a higher tendency for musculoskeletal complaints due to limited adaptation to repetitive sewing activities, prolonged working postures, and ergonomic demands. Workers with longer employment duration may have developed work strategies and physical adaptation that help them manage occupational demands more effectively. This adaptation process may contribute to reduced work-related stress and improved work performance (Ilmiati, 2020).

A lack of experience in performing repetitive tasks may also contribute to inappropriate ergonomic postures and increased muscle stiffness, which can elevate mechanical loading on muscles and joints and potentially increase the likelihood of musculoskeletal discomfort (Ajhara, Novianus, & Muzakir, 2022). However, prolonged employment duration may also represent cumulative exposure to occupational risk factors. Previous research among batik artisans reported that longer work duration was associated with MSD complaints due to continuous static loading and repetitive movements that may contribute to muscle fatigue and tissue strain over time (Arini & Haqi, 2021).

In the present study, workers with shorter employment duration (<3 years) demonstrated a higher tendency for MSD complaints compared with those with longer employment duration (OR = 1.500), although the association was not statistically significant ($p = 0.724$). This finding suggests that both adaptation among experienced workers and cumulative exposure among long-term workers may influence MSD occurrence, and further studies with larger sample sizes are needed to clarify this relationship.

Most respondents in this study were non-smokers, which may be related to the higher proportion of female participants compared with male participants. Although smoking prevalence among women has increased over time, smoking remains substantially more common among men. This finding is consistent with a national study involving 12,591 individuals aged ≥ 15 years, which reported that the majority of smokers in Indonesia were male (95%) (Salsabila, Indraswari, & Sujatmiko, 2022). Smoking has been suggested as a potential risk factor for musculoskeletal disorders (MSDs), particularly low back pain. Cigarette smoking may contribute to back pain through several physiological mechanisms, including reduced oxygen supply to tissues, impaired nutrient delivery to intervertebral discs, and increased coughing episodes that may elevate intra-abdominal pressure and mechanical stress on the spine (Ilmiati & Indriani, 2022). In addition, nicotine exposure may affect blood circulation and muscle metabolism, potentially increasing muscle fatigue and discomfort.

The present study conducted among sewing workers in the bag and suitcase industry center also found that the back was one of the body regions most frequently reported as experiencing musculoskeletal complaints. Workers with smoking habits represented a dominant group among those reporting MSD complaints. This condition may be related to reduced physical endurance among smokers due to decreased oxygen availability, impaired carbohydrate metabolism, and increased lactic acid accumulation, which may contribute to muscle fatigue and pain (Ardhi & Renni, 2026). However, the present analysis showed that smoking habits were not statistically associated with MSD complaints (OR = 1.123; 95% CI: 0.235–5.359; $p = 1.000$). This finding indicates that smoking may contribute to the occurrence of musculoskeletal symptoms through physiological mechanisms, but its effect may be influenced by other occupational factors, such as working posture, repetitive movements, duration of work, and individual physical workload.

In addition to smoking habits, physical activity and exercise habits may influence the occurrence of musculoskeletal complaints. Most workers who reported limited exercise activities may perceive their occupational activities as equivalent to physical exercise because their daily tasks involve

Dakwatun Shofia^{1*}, Shofiyah Nur Rosyidah², Ragil Ismi Hartanti², Noeroel Widajati¹

¹Departemen Kesehatan dan Keselamatan Kerja, Fakultas Kesehatan Masyarakat, Universitas Airlangga

²Departemen Kesehatan dan Keselamatan Kerja, Fakultas Kesehatan Masyarakat, Universitas Jember

Corresponding author: *E-mail: dakwatunshofia01@gmail.com

considerable energy expenditure. This perception may occur because sewing workers perform physically demanding activities during the production process. Furthermore, among Indonesian workers, limited participation in regular exercise is often associated with fatigue, lack of time, and low motivation. In the present study, most workers reported occasional exercise habits (1–2 times/week). This may be explained by the working conditions in the Tanggulangin bag and suitcase industry center, where the production process operates six days per week, leaving limited time for structured physical activity. Exercise activities are more commonly performed during weekends or holidays. Adequate recovery time is also an important factor in preventing musculoskeletal complaints, as insufficient rest combined with physical workload may increase muscle fatigue and discomfort. Previous research has suggested that workers who perform high-energy activities without adequate recovery periods may have a higher tendency to experience musculoskeletal complaints (Ajhara et al., 2022).

Low physical fitness levels have also been associated with a higher incidence of MSDs, as insufficient muscle endurance may reduce the body's ability to tolerate occupational demands (Ramayanti & Koesyanto, 2021). In addition, the relationship between exercise habits and sedentary behavior should be considered. Previous findings indicate that MSD prevalence tends to be lower among workers with adequate physical activity levels (>150 minutes/week) and limited sitting time (<4 hours/day). Conversely, prolonged sitting combined with occupational inactivity may increase the likelihood of musculoskeletal symptoms. This condition is relevant to sewing workers in the bag and suitcase industry center, where workers may remain in a seated position continuously for approximately 3–5 hours during sewing activities. However, in the present study, exercise habits were not statistically associated with MSD complaints (OR = 1.885; 95% CI: 0.446–7.969; $p = 0.485$). This finding suggests that exercise habits alone may not sufficiently explain MSD occurrence, as musculoskeletal complaints are influenced by multiple factors, including working posture, repetitive movements, duration of exposure, and ergonomic conditions.

Working posture was assessed through direct observation using the Rapid Entire Body Assessment (REBA) method. The sewing process in the bag and suitcase industry center is characterized by prolonged static postures, repetitive movements, and limited postural variation. Furthermore, non-ergonomic workstation designs may force workers to maintain awkward postures during production activities. These conditions can increase muscle tension, mechanical loading, and the risk of musculoskeletal discomfort. Previous studies have demonstrated that inappropriate working postures in small-scale industries are associated with an increased occurrence of MSD complaints. A study among jumbo bag sewing workers identified several ergonomic hazards, including prolonged sitting in non-ergonomic positions, repetitive movements involving the hands and feet, and frequent twisting and bending postures, which contributed to increased musculoskeletal risk (Bariroh, Amrullah, & Resmi, 2024). Similarly, the present study found that workers with high-risk working postures based on REBA assessment showed a higher tendency for MSD complaints compared with those with medium-risk postures (OR = 1.500; 95% CI: 0.367–6.137; $p = 0.724$). Although this association was not statistically significant, the finding indicates that ergonomic risks related to sewing posture remain an important concern, particularly considering the repetitive and prolonged nature of sewing activities.

The occurrence of MSD complaints among sewing workers may be related to the specific characteristics of sewing activities, which require prolonged static postures, repetitive movements, particularly involving the hands and wrists, and non-ergonomic working positions, such as forward bending and sitting without adequate support (Manurung & Lubis, 2025). In the sewing process, workers perform several sequential activities, including retrieving cut materials, positioning them on the sewing machine, and performing stitching activities. These tasks often require workers to adopt awkward postures due to limited workspace and workstation design constraints.

During material handling activities, workers frequently reach sideways, backward, or downward to retrieve and place sewing materials. Such movements may increase mechanical stress on the upper

Dakwatun Shofia^{1*}, Shofiyah Nur Rosydah², Ragil Ismi Hartanti², Noeroel Widajati¹

¹Departemen Kesehatan dan Keselamatan Kerja, Fakultas Kesehatan Masyarakat, Universitas Airlangga

²Departemen Kesehatan dan Keselamatan Kerja, Fakultas Kesehatan Masyarakat, Universitas Jember

Corresponding author: *E-mail: dakwatunshofia01@gmail.com

DOI: <https://doi.org/10.33024/minh.v9i5.3904>

extremities, neck, shoulders, and lower back. During the sewing process, workers tend to maintain a forward-flexed posture to achieve visual accuracy when observing stitching lines, trimming threads, and ensuring fabric alignment. These prolonged visual and precision requirements expose workers to ergonomic risks involving the arms, neck, trunk, and lower limbs (Occupational Safety and Health Administration, 2026).

The working posture adopted by sewing workers is influenced by individual anthropometric characteristics and workstation design. Observations at the Tanggulangin bag and suitcase industry center showed that workers performed repetitive movements, including frequent activation of the sewing machine pedal (approximately 50–80 times per minute) and continuous back-and-forth hand movements during stitching. Furthermore, the chairs and tables used by workers did not fully meet ergonomic requirements, as most chairs lacked backrests or armrests, and table heights were not adjusted according to individual anthropometric characteristics. Similar findings have been reported among tailoring workers, where sewing activities require continuous adjustments in posture and viewing angles to achieve precision, resulting in increased ergonomic risks (Rmadi, Sellami, Feki, Hammami, Masmoudi, & Hajjaji, 2024).

Although the present study found that workers with high-risk working postures had a higher tendency for MSD complaints compared with those with medium-risk postures (OR = 1.500), this association was not statistically significant. Nevertheless, the observed ergonomic conditions indicate that working posture remains an important occupational health concern because prolonged static postures and repetitive movements may contribute to cumulative muscle fatigue and discomfort.

Environmental factors assessed in this study included vibration intensity generated by sewing machines. Exposure to vibrating tools may affect the upper extremities, particularly the hands and arms, through mechanical stress and potential alterations in vascular, neurological, and musculoskeletal functions. The vibration measurements obtained from two axes (X-axis and Y-axis) showed that all sewing machines produced vibration intensities $\leq 5 \text{ m/s}^2$.

These findings indicate that the vibration exposure from sewing machines remained below the applicable occupational exposure limit based on the Regulation of the Minister of Manpower of the Republic of Indonesia Number 5 of 2018 concerning Occupational Safety and Health in the Workplace Environment. Therefore, the machines were considered to produce vibration levels within acceptable limits for an 8-hour daily exposure period (Ministry of Manpower of the Republic of Indonesia, 2018).

Although vibration intensity was within acceptable limits, workers' hands remained in direct contact with the sewing machine table during operation, allowing vibration transmission to the upper extremities. Long-term exposure to hand-transmitted vibration may contribute to fatigue and discomfort involving muscles, tendons, nerves, and blood vessels. Repeated vibration exposure may increase muscle fatigue and accelerate the development of upper-extremity musculoskeletal complaints (Mootz & Akhavian, 2025).

However, in the present study, the relationship between vibration intensity and MSD complaints could not be statistically analyzed because all measured vibration levels were within the same category (homogeneous exposure). This finding is consistent with previous research reporting no significant relationship between vibration exposure and MSD complaints among workers (Kurniawan & Muzakir, 2024). Nevertheless, continuous monitoring of vibration exposure remains important because prolonged occupational exposure may contribute to musculoskeletal problems, particularly when combined with other ergonomic risk factors such as awkward postures and repetitive movements.

Musculoskeletal complaints were assessed through interviews with respondents using the Nordic Body Map (NBM) questionnaire. The most frequently reported MSD complaints among sewing artisans in the bag and suitcase industry center were located in the lower back, neck, and waist region. This finding is consistent with a survey conducted by the European Agency for Safety and Health at Work (EU-OSHA), which reported that musculoskeletal complaints among workers commonly occur in the neck, lower back, and upper musculoskeletal regions (Isusi, 2020). Similarly, a systematic review reported that low

Dakwatun Shofia^{1*}, Shofiyah Nur Rosydah², Ragil Ismi Hartanti², Noeroel Widajati¹

¹Departemen Kesehatan dan Keselamatan Kerja, Fakultas Kesehatan Masyarakat, Universitas Airlangga

²Departemen Kesehatan dan Keselamatan Kerja, Fakultas Kesehatan Masyarakat, Universitas Jember

Corresponding author: *E-mail: dakwatunshofia01@gmail.com

back pain and neck pain were among the most frequently identified MSD complaints across occupational studies (Gebrye, Mbada, Apeagyei, & Fatoye, 2025).

Previous research among sewing operators also found that the highest levels of MSD complaints were reported in the waist, right calf, buttocks, and back. These complaints were associated with prolonged operation of sewing machines and sitting on chairs without adequate back support. An increase in subjective discomfort during a two-hour working period suggests that prolonged sitting may progressively increase musculoskeletal discomfort, even among healthy workers (Muslimah, Permatasari, Nugroho, Suranto, Pratiwi, & Nandiroh, 2024).

In the present study, lower back and waist complaints were the most dominant symptoms reported by workers. These complaints may occur because sewing activities require workers to maintain static sitting positions for extended periods, which can increase mechanical loading on spinal structures and contribute to muscle fatigue. In addition, the use of chairs without backrests may reduce lumbar support and encourage workers to adopt forward-flexed postures. Neck complaints may also result from poor ergonomic postures, particularly prolonged head and neck flexion while workers maintain visual concentration on stitching accuracy.

To reduce the risk of MSD complaints, workers are recommended to perform regular stretching exercises during work breaks. Stretching activities performed once or twice daily may help maintain muscle flexibility, reduce muscle stiffness, and prevent discomfort associated with prolonged static postures (Ministry of Health of the Republic of Indonesia, 2018).

STUDY LIMITATIONS

This study has several limitations that should be considered when interpreting the findings. First, some photographs used for working posture assessment were taken from suboptimal angles due to limited workspace, restricted distance, and obstacles from machines and surrounding objects. These conditions may have affected the accuracy of posture evaluation using the REBA method.

Second, the assessment of smoking habits was limited to the frequency of cigarette consumption and did not include other important smoking

characteristics, such as smoking duration, cumulative exposure, or pack-years. Therefore, the relationship between smoking exposure and MSD complaints may not have been fully captured.

Third, vibration exposure was assessed based only on measurements from sewing machines and did not include direct measurement of vibration transmitted to workers' hands and arms due to equipment limitations. Consequently, the actual individual exposure to hand-transmitted vibration may differ from the measured machine vibration intensity.

Finally, potential measurement bias may have occurred in vibration assessment because data collection was limited by available measurement tools and workplace conditions. Future studies should consider more comprehensive vibration exposure assessment, including direct measurement of hand-arm vibration exposure, longer observation periods, and larger sample sizes to improve the accuracy and generalizability of findings.

CONCLUSION

Most respondents were aged ≥ 30 years, female, non-smokers, and had a working duration of less than three years. More than half of the respondents reported no regular exercise habits and were exposed to high-risk working postures based on the REBA assessment. Furthermore, vibration measurements of sewing machines showed that all recorded exposure levels were below the applicable Threshold Limit Value (TLV), with vibration intensity $\leq 5 \text{ m/s}^2$.

Most respondents experienced low-level musculoskeletal disorder (MSD) complaints based on the Nordic Body Map assessment. Although smoking habits and high-risk working postures showed a tendency toward increased MSD complaints, no statistically significant associations were identified. In addition, the odds ratio for vibration exposure could not be calculated because all measured vibration levels were homogeneous and classified within the same exposure category.

RECOMMENDATIONS

To reduce the risk of MSD complaints among sewing artisans, ergonomic intervention programs are recommended. Workplace stretching sessions may be implemented every two hours during working periods, such as in the morning and afternoon, for

Dakwatun Shofia^{1*}, Shofiyah Nur Rosyidah², Ragil Ismi Hartanti², Noeroel Widajati¹

¹Departemen Kesehatan dan Keselamatan Kerja, Fakultas Kesehatan Masyarakat, Universitas Airlangga

²Departemen Kesehatan dan Keselamatan Kerja, Fakultas Kesehatan Masyarakat, Universitas Jember

Corresponding author: *E-mail: dakwatunshofia01@gmail.com

approximately 15 minutes to reduce muscle fatigue and maintain flexibility. Furthermore, employers should provide ergonomic facilities, including chairs with adequate back and arm support and work tables adjusted according to workers' anthropometric characteristics.

The bag and suitcase industry center is also encouraged to provide occupational health education regarding the risks associated with smoking, ergonomic working techniques, proper work procedures, and strategies for preventing MSDs. These efforts may contribute to improving workers' comfort, reducing ergonomic risks, and supporting occupational health in the informal manufacturing sector.

REFERENCES

- Ajhara, S., Novianus, C., & Muzakir, H. (2022). Faktor-faktor yang Berhubungan dengan Keluhan Musculoskeletal Disorders (MSDs) pada Pekerja Bagian Sewing di PT. X pada Tahun 2022. *Jurnal Fisioterapi Dan Kesehatan Indonesia*, 2(2), 150–162.
- Ardhi, M. N., & Renni. (2026). Hubungan Usia , Masa Kerja , dan Kebiasaan Merokok dengan Kejadian Musculoskeletal Disorders. *Detector: Jurnal Inovasi Riset Ilmu Kesehatan*, 4(1).
- Arini, S. Y., & Haqi, D. N. (2021). Risk Analysis of Musculoskeletal Disorders (MSDs) Complaints on Batik Crafters Under The Assistance of Ademos Indonesia. *Indian Journal of Forensic Medicine & Toxicology*, 15(2), 3471–3477.
- Balaka, M. Y., Rumbia, W. A., & Ernawati, E. (2022). Studi Karakteristik Pekerja Sektor Informal Pada Masa Pandemi Covid 19 Di Kota Kendari. *Jurnal Progres Ekonomi Pembangunan (JPEP)*, 7(2), 178-179.
- Bariroh, S. R., Amrullah, H. N., & Resmi, F. (2024). Analisis Postur Kerja Berdasarkan SNI 9011:2021 dan Rancangan Perbaikan Stasiun Kerja pada Operator Mesin Jahit Jumbo Bag. *8 Th Conference on Safety Engineering and It's Application*, 2581.
- Centers for Disease Control and Prevention. (2021). *About Ergonomics and Work-Related Musculoskeletal Disorders | Ergonomics | CDC*. National Institute for Occupational Safety and Health (NIOSH). Accessed from: <https://www.cdc.gov/niosh/ergonomics/about/index.html>
- Chellappa, V., Victor Rajesh, R., & Prakash, J. (2025). Work-related musculoskeletal disorders (MSDs) among workers in the brass-metal industry. *Work*, 80(2), 711–719.
- Dattani, N. (2025). Prevalence of Work-related Musculoskeletal Discomfort among Sewing Machine Operators. *Journal Of Emerging Technologies And Innovative Research (JETIR)*, 12(1), 300–304.
- Edison, E., Ginanjar, R., & Supriyanto, S. (2021). Resiko Ergonomi dengan Gejala MSDs pada Karyawan Pabrik Midper. *Promotor*, 4(3), 208.
- Gebrye, T., Mbada, C., Apeagyei, P., & Fatoye, F. (2025). Prevalence of musculoskeletal disorders among garment workers: A systematic review and meta-analysis. *BMJ Open*, 15(1).
- Government of Indonesia. (2019). Peraturan Presiden Republik Indonesia Nomor 7 Tahun 2019 Tentang Penyakit Akibat Kerja. In *Www.Hukumonline.Com/Pusatdata* (pp. 1–102). Accessed from: <https://peraturan.bpk.go.id/Home/Details/101622/perpres-no-7-tahun-2019>
- Gowtham, S., Eshwar, A., Thozhanenjan, I., & Vittal, P. (2025). Prevalence of Musculoskeletal Disorders and Associated Risk Factors Among Leather Factory Workers in Chengalpattu District, Tamil Nadu, India: A Cross-Sectional Study. *Cureus*, 17(11).
- Hignett, S., & McAtamney, L. (2000). Rapid Entire Body Assessment (REBA). *Applied Ergonomics*, 31(2), 201–205.

Dakwatun Shofia^{1*}, Shofiyah Nur Rosyidah², Ragil Ismi Hartanti², Noeroel Widajati¹

¹Departemen Kesehatan dan Keselamatan Kerja, Fakultas Kesehatan Masyarakat, Universitas Airlangga

²Departemen Kesehatan dan Keselamatan Kerja, Fakultas Kesehatan Masyarakat, Universitas Jember

Corresponding author: *E-mail: dakwatunshofia01@gmail.com

- Ilmiati, N. (2020). *Faktor Resiko Kejadian Muskuloskeletal Disorder (MSDs) pada Pengrajin Gerabah di Kasongan Yogyakarta Tahun 2020*.
- Ilmiati, N., & Indriani, I. (2022). Faktor resiko kejadian muskuloskeletal disorder (MSDS) pada pengrajin gerabah di kasongan Yogyakarta tahun 2020. *Journal Physical Therapy UNISA*, 1(2), 55–63.
- International Labour Organization. (2013). *The prevention of occupational diseases*. International Labour Office. Accessed from: <https://www.ilo.org/publications/prevention-occupational-diseases>
- International Organization for Standardization (ISO). (2001). *ISO 5349-1:2001 Mechanical vibration—Measurement and evaluation of human exposure to hand-transmitted vibration—Part 1: General requirements*.
- Isusi, I. (2020). Work-Related Musculoskeletal Disorders – Facts and Figures (Syntesis of 10 National Reports). In *European Agency for Safety and Health at Work*.
- Januarta, M. I., & Yasin, M. (2025). Analisis Industri Umkm Terhadap Penyerapan Tenaga Kerja Di Kabupaten Sidoarjo (Studi Kasus): Industri Kerajinan Kulit Di Tanggulangin. *Maisyatuna*, 6(2), 1–12.
- Kanniappan, V., & Palani, V. (2020). Prevalence of Musculoskeletal Disorders among Sewing Machine Workers in a Leather Industry. *Journal of Lifestyle Medicine*, 10(2), 121–125.
- Khan, E. H., Ahmed, M., Jhilky, M. T. A., Galib, S. M., Tanim, B., & Banu, H. B. (2025). Prevalence of Musculoskeletal Symptoms among Female Garment Workers in Dhaka, Bangladesh. *Mugda Medical College Journal*, 8(1), 36–42.
- Kuorinka, I., Jonsson, B., Kilbom, Å., Vinterberg, H., Biering-Sørensen, F., Andersson, G., & Jørgensen, K. (1987). Standardised Nordic Questionnaires for the Analysis of Musculoskeletal Symptoms. *Applied Ergonomics*, 18(3), 233–237.
- Kurniawan, E. A., & Muzakir, H. (2024). Faktor-faktor yang berhubungan dengan MSDs pada penjahit di PT. Andria Fesyen Indonesia Tekstile. *Science: Indonesian Journal of Science*, 1(3), 890-895.
- Kusuma, N. P. D. P., Adnyani, H. P., Mathar, M. A. K., & Karmila, D. (2024). Hubungan Antara Masa Kerja dan Durasi Kerja Dengan Keluhan Musculoskeletal Disorder (MSDs) Pada Pengrajin Tenun. *Journals Of Ners Community*, 13(2), 252–260.
- Manurung, K. N., & Lubis, A. M. (2025). Hubungan Postur Kerja dan Gerakan Repetitif dengan Keluhan Musculoskeletal Disorders pada Penjahit Pakaian di Pusat Industri Kecil Menteng Medan Tahun 2025 The Relationship of Work Posture and Repetitive Movements with Complaints of Musculoskeletal Disord. *Jurnal Geografi, Lingkungan & Kesehatan*, 3(2), 114–123.
- Ministry of Manpower of the Republic of Indonesia. (2018). *Peraturan Menteri Ketenagakerjaan Republik Indonesia Nomor 5 Tahun 2018 Tentang Keselamatan Dan Kesehatan Kerja Lingkungan Kerja*. Accesed from: https://jdih.kemnaker.go.id/asset/data_puu/Perm-en_5_2018.pdf
- Ministry of Health of the Republic of Indonesia. (2018). *Pentingnya Peregangan Tubuh di Sela-sela Waktu Kerja*. Direktorat Promosi Kesehatan & Pemberdayaan Masyarakat. Accessed from: <https://ayosehat.kemkes.go.id/pentingnya-peregangan-tubuh-di-sela-sela-waktu-kerja>
- Mootz, J., & Akhavian, R. (2025). Advancing Accessible Hand-Arm Vibration Safety Monitoring: ISO-Compliance with Wearable Sensors and Transfer Functions. *Electrical Engineering and Systems Science*, 1, 1–10.
- Muslimah, E., Permatasari, D. U., Nugroho, M. T., Suranto, S., Pratiwi, I., & Nandiroh, S. (2024). Ergonomic Assessment of Sewing Machine Operators to Minimize Musculoskeletal Disorders. *SHS Web of Conferences*, 189, 01022.

Dakwatun Shofia^{1*}, Shofiyah Nur Rosyidah², Ragil Ismi Hartanti², Noeroel Widajati¹

¹Departemen Kesehatan dan Keselamatan Kerja, Fakultas Kesehatan Masyarakat, Universitas Airlangga

²Departemen Kesehatan dan Keselamatan Kerja, Fakultas Kesehatan Masyarakat, Universitas Jember

Corresponding author: *E-mail: dakwatunshofia01@gmail.com

DOI: <https://doi.org/10.33024/minh.v9i5.3904>

- Nurshabrina, P. A., Andarini, D., Idris, H., & Anggraeni, R. (2023). Faktor Risiko yang Mempengaruhi Penyakit Musculoskeletal Disorders (MSDs) pada Pekerja. *Jurnal Lentera Kesehatan Masyarakat*, 2(3), 163–174.
- Occupational Safety and Health Administration. (2026). *eTools : Sewing and Related Procedures - Sewing Station Design | Occupational Safety and Health Administration*. Occupational Safety and Health Administration. Accessed from: <https://www.osha.gov/etools/sewing/station-design>
- Olutende, M., Kweyui, I. W., Wanzala, M., & Mse, E. (2022). Risk Factors for Work-Related Musculoskeletal Disorders among Nurses in Kakamega County Kenya. *OALib*, 09(04), 1–14.
- Ramayanti, A. ., & Koesyanto, H. (2021). Faktor-Faktor yang Berhubungan dengan Keluhan Musculoskeletal Disorders pada Pekerja Konveksi. *Indonesian Journal of Public Health and Nutrition*, 1(1), 472–478.
- Rmadi, N., Sellami, I., Feki, A., Hammami, K. J., Masmoudi, M. L., & Hajjaji, M. (2024). Exploring multisite musculoskeletal symptoms among sewing machine operators in a tunisian leather and footwear industry using decision tree models. *Clinical Epidemiology and Global Health*, 27(April), 101575.
- Salsabila, N. N., Indraswari, N., & Sujatmiko, B. (2022). Gambaran Kebiasaan Merokok Di Indonesia Berdasarkan Indonesia Family Life Survey 5 (Ifs 5). *Jurnal Ekonomi Kesehatan Indonesia*, 7(1), 13.
- Setyanto, N. W., Efranto, R., Lukodono, R. P., & Dirawidya, A. (2015). Ergonomics Analysis in the Scarfing Process by OWAS, NIOSH and Nordic Body Map's Method at Slab Steel Plant's Division. *International Journal of Innovative Research in Science, Engineering and Technology* , 4(3), 1086–1093.
- Sholeha, N., & Sunaro, M. (2022). Gambaran Keluhan Musculoskeletal Disorders (Msds) Pada Pekerja UD. X Tahun 2021. *Jurnal Kesehatan Masyarakat*, 10(1), 70–74.
- Siregar, P. A., Marpaung, W., & Jariah, A. (2021). *Analisis Risiko Kejadian Nyeri Otot Pada Perempuan Pengupas Kepiting*. Merdeka Kreasi.
- Statistics Indonesia. (2026). Keadaan Ketenagakerjaan Indonesia Februari 2026. In *Berita Statistik Indonesia* (Vol. 05, Issue 28). Accessed from: http://www.bps.go.id/brs_file/tenaker-15mei07.pdf
- U.S. Bureau of Labor Statistics. (2024). *Injuries, Illnesses, and Fatalities Factsheets : U.S. Bureau of Labor Statistics*. U.S. Bureau Of Labor Statistics. <https://www.bls.gov/iif/factsheets/>
- World Health Organization. (2022). *Musculoskeletal health*. World Health Organization. <https://www.who.int/news-room/factsheets/detail/musculoskeletal-conditions>
- World Medical Association. (2013). *Declaration of Helsinki: Ethical Principles for Medical Research Involving Human Subjects*. *JAMA*, 310(20), 2191–2194.

Dakwatun Shofia^{1*}, Shofiyah Nur Rosyidah², Ragil Ismi Hartanti², Noeroel Widajati¹

¹Departemen Kesehatan dan Keselamatan Kerja, Fakultas Kesehatan Masyarakat, Universitas Airlangga

²Departemen Kesehatan dan Keselamatan Kerja, Fakultas Kesehatan Masyarakat, Universitas Jember

Corresponding author: *E-mail: dakwatunshofia01@gmail.com

DOI: <https://doi.org/10.33024/minh.v9i5.3904>