

**RESEARCH ARTICLE****Work-related musculoskeletal disorders (MSDs) among sack sewing workers in Duduk Sampeyan District, Gresik: a cross-sectional study****Rizka Dyah Pitaloka, Ana Islamiyah Syamila*, Adistha Eka Noveyani**

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*Corresponding author, email: ana.islamiyah@unej.ac.id**ARTICLE INFO****ABSTRACT****Keywords:**

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Musculoskeletal disorders (MSDs) are work-related injuries affecting muscles, joints, nerves, and other tissues and are common among sewing workers who adopt ergonomically unfavourable postures. This cross-sectional descriptive study of all 39 sack-sewing workers in the production section of Duduk Sampeyan District used interviews and workplace observations, with MSD symptoms assessed using the Nordic Body Map, posture risk assessed using the Rapid Entire Body Assessment (REBA), and Cardiovascular Load (%CVL) to evaluate workstation vertical alignment. The left leg was the most frequent pain site. Workers with more than five years' employment were significantly more likely to report MSDs than those with five years or less ($RR = 5.8, p < 0.001$). Although REBA scores were predominantly in the medium-to-high risk categories, the posture category was not statistically associated with MSDs in this sample. Recommended interventions include adjusting the sewing table height to worker anthropometry, introducing leg-focused stretching during breaks, and establishing an occupational health post in Duduk Sampeyan to reduce the risk of MSDs.

1. Introduction

Musculoskeletal disorders (MSDs) cause damage to tissues, muscles, joints, ligaments, tendons, nerves, bones, and blood vessels and are frequently associated with ergonomically unfavourable working attitudes, such as prolonged static loading and repetitive tasks (Aisyah *et al.*, 2023). MSDs account for a large share of occupational disease and injury burden, contributing 42%–58% of all work-related illness and 40% of occupational health expenditures globally (Mairani *et al.*, 2023). In Indonesia, data from 2018 reported high proportions of complaints across body regions—lower neck (80%), shoulders (20%), back (40%), waist/back (40%), and calves (80%) (Purandima *et al.*, 2023). The

Labour Force Survey (LFS) 2021 indicated 470,000 workers experienced MSDs related to current or prior employment (Irhamna *et al.*, 2023).

If not properly managed, MSDs can progress to irreversible impairments that limit movement and coordination, reduce concentration, increase fatigue, lower productivity, and raise the risk of accidents and occupational disease, with significant consequences for both employers and workers (Aisyah *et al.*, 2023). Informal-sector workers are particularly vulnerable because they often lack legal protections and must bear medical costs that escalate when complaints become chronic.

The World Health Organisation identifies multiple MSD determinants, including individual

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factors (age, sex, smoking, work period, physical fitness) and occupational factors (awkward postures, workload) (Aisyah *et al.*, 2023; Irawati *et al.*, 2020). Field conditions, however, may reveal additional contextual contributors to MSD risk.

Locally, musculoskeletal complaints—particularly low back pain—rank highly in Gresik Regency's outpatient data, with 53,154 cases among the top ten diseases in 2023; diseases of the musculoskeletal and connective tissue system ranked ninth with 546 visits (Badan Pusat Statistik, 2024). Sewing work, which involves intensive muscle use, long hours, repetitive movements, and non-ergonomic postures, is associated with a high prevalence of MSDs: 57.1% among clothing tailors in Indonesia, second only to influenza in overall prevalence (Alfiani *et al.*, 2023).

In Duduk Sampeyan District (Gresik Regency), several sack-sewing enterprises (UD Anugerah, UD HJN 1, CV HJN 2) produce jumbo bags using a standing sewing posture. Workers typically operate in two shifts of approximately 8–10 hours with a one-hour break, performing repetitive tasks that concentrate the load on specific body parts. Observations and preliminary interviews indicate patterns such as reliance on the left foot for weight-bearing while the right foot operates the pedal, which causes leg pain, and repetitive left-hand adjustments, which cause shoulder pain. Uniform sewing-table heights require taller workers to sustain trunk flexion. In a preliminary survey, 12 of 21 workers reported frequent shoulder and calf pain; the remaining 9 reported back and hand discomfort. The absence of an Occupational Health Post for promotive and preventive services likely delays early detection and management of MSDs.

Most studies of sewing workers focus on seated tasks; research on standing sack-sewing workers is scarce (Nooryana, 2021; Nisa *et al.*, 2025). Although MSD research on standing workers exists for occupations such as batik craftsmen, farmers, office workers, and goods transporters, sack-sewing workers have not been specifically studied (Nisa *et al.*, 2025; Sya'bana & Herwanto, 2023; Azzahra *et al.*, 2025; Yovi & Fauzi, 2021).

Given these gaps, this study aims to describe individual and occupational risk factors for MSDs among sack-sewing workers in Duduk Sampeyan District, Gresik Regency.

2. Materials and Methods

Ethics

The study was approved by the Faculty of Public Health, University of Jember (Ethics Approval No. 480/KEPK/FKM-UNEJ/III/2024). Informed consent was

obtained from all participants prior to data collection.

Study design and setting

This cross-sectional, observational descriptive study with a quantitative approach was conducted in March 2024 at three sack-sewing workplaces in Duduk Sampeyan District, Gresik Regency (UD Anugerah, UD HJN 1, and CV HJN 2) in the production section.

Participants

All production workers who performed sack sewing were eligible. Workers with other job responsibilities were excluded. Total sampling yielded 39 participants.

Variables

- Individual factors: sex, body mass index (BMI), and work period (years).
- Occupational factors: workload, work duration (hours/shift), and work posture.
- Outcome: self-reported musculoskeletal disorder (MSD) complaints.

Data collection instruments and procedures

Respondent identity form: recorded demographic and job information, reported complaints, and any treatments.

Nordic Body Map (NBM): used to document MSD complaints by body region and to derive complaint severity scores (Nooryana, 2021). The illustrated format facilitated accurate self-reporting. Workload (%CVL): cardiovascular load (%CVL) was estimated from heart rate measured with a pulse oximeter at two time points: during work (09:00–09:30) and at rest (11:30–12:00). Values were computed using the pre-specified %CVL formula to approximate physiological workload and fatigue risk. Rapid Entire Body Assessment (REBA): applied to assess postural risk for neck, trunk, legs, arms, forearms, and wrists, accounting for force/load and muscle activity (Yovi & Fauzi, 2021). REBA scoring was performed separately for right and left sides because sack-sewing tasks involve asymmetric leg and hand roles (Sya'bana & Herwanto, 2023). Angulus app: used to measure joint angles to support REBA scoring and improve the accuracy of posture assessment.

Data analysis

Descriptive statistics summarised participant characteristics, REBA categories, %CVL, and NBM results. Bivariate analysis used chi-square tests to assess associations between exposures and MSD complaints. Relative risk (RR) estimates were calculated from cross-tabulations to quantify effect size; RR was preferred

to prevalence ratios because of the small population. Statistical significance was determined at $p < 0.05$. (Specify software and exact tests here if required by the target journal.)

3. Results

3.1 Musculoskeletal Disorders Complaints

Table 1 shows that of 39 sack-sewing workers, 23 (59.0%) were classified as low risk for MSDs and 16 (41.0%) as moderate risk; no workers were classified as high or very-high risk.

All workers (100%) reported complaints in the right calf. The five body regions with the highest pain-severity weights (NBM) were: left calf (weight 107),

left foot (106), right calf (105), right foot (88), and left shoulder (85). The complete distribution of complaints by body region and pain severity is shown in Table 2.

3.2 Associations between risk factors and MSD complaints

Table 3 shows associations between individual factors and MSDs. 22 workers (56.4%) were female. Moderate-risk MSDs were observed in 12/22 females (54.5%) and 4/17 males (23.5%). The association between sex and MSD category was not statistically significant ($p = 0.09$; $RR = 0.42$, 95% CI 0.16–1.10). Regarding BMI, most workers (31; 79.5%) were in the low-risk BMI category. No significant association was

Table 1. Distribution based on MSD occurrence

MSDs Category	Total number (n)	Percentage (%)
Low risk	23	59,0
Moderate risk	16	41,0
High risk	0	0
Very high risk	0	0
Total	39	100.0

Table 2. Distribution based on MSDs complaints on the body

Body part	Pain description			Total Workers		Weight based on Pain Severity Level Complaints
	Mild pain	Pain	Severe pain	Total number	Percentage (%)	
Upper neck	12	4	0	16	41,0	36
Lower neck	13	10	1	24	61,5	60
Left shoulder	5	21	3	29	74,3	85
Right shoulder	5	21	2	28	71,7	81
Left upper arm	4	2	2	8	20,5	22
Back	5	7	0	12	30,7	31
Right upper arm	4	2	1	7	17,9	18
Waist	4	8	3	15	38,4	44
Buttocks	0	1	0	1	2,5	3
Hip	0	0	0	0	0	0
Left elbow	1	0	0	1	2,5	2
Right elbow	1	0	0	1	2,5	2
Left forearm	8	5	0	13	33,3	31
Right forearm	8	5	0	13	33,3	31
Left wrist	9	9	1	19	48,7	49
Right wrist	9	9	1	19	48,7	49
Left hand	11	3	2	16	41,0	39
Right hand	11	4	1	16	41,0	38
Left thigh	2	2	1	5	12,8	14
Right thigh	3	1	1	5	12,8	13
Left knee	1	6	0	7	17,9	20
Right knee	1	6	0	7	17,9	20
Left calf	11	23	4	38	97,4	107
Right calf	14	23	2	39	100	105
Left ankle	11	10	2	23	58,9	60
Right ankle	14	7	1	22	56,4	53
Left foot	8	26	3	37	94,8	106
Right foot	20	16	0	36	92,3	88

*Bold: top five highest rankings

Table 3. The associations between individual factors and MSDs

Individual Factors	MSDs Category				Total		p-value	RR	CI
	Moderate risk		Low risk						
	n	%	n	%	n	%			
Gender									
• Male	4	23,5	13	76,5	17	100	0,09	0,42	0,16 - 1,10
• Female	12	54,5	10	45,5	22	100			
Body Mass Indeks (BMI)									
• Low risk	12	38,7	19	61,3	31	100	0,69	1,31	0,56 – 2,94
• High risk	4	50	4	50	8	100			
Work period									
• ≤ 5 years	3	13,6	19	86,4	22	100	0,00	5,84	1,89 – 16,5
• > 5 years	13	76,5	4	23,5	17	100			

* Significant < 0,05

Table 4. The associations between job-related factors and MSDs

Job-related factor	MSDs Category				Total		p-value	RR	CI
	Moderate risk		Low risk						
	n	%	n	%	n	%			
Workload									
• Light	12	35,3	22	64,7	34	100	0,13	2,28	1,20 – 4,26
• Moderate	4	80	1	20	5	100			
Work duration									
• ≤ 8 hours	11	45,8	13	54,2	24	100	0,66	0,73	0,31 – 1,68
• > 8 hours	5	33,3	10	66,7	15	100			
Work posture									
• Moderate risk	13	50	13	50	26	100	0,16	0,46	0,15 – 1,33
• High risk	3	23,1	10	76,9	13	100			

* Chi-square tests were used for bivariate analysis, and RR estimates were obtained from cross-tabulations. Significant associations were considered at $p < 0.05$.

found between BMI category and MSDs ($p = 0.69$; $RR = 1.31$, 95% CI 0.56–2.94). The work period shows that 22 workers (56.4%) had ≤5 years' service, and 17 (43.6%) had >5 years' service. Workers with >5 years' work period had a significantly higher tendency for moderate-risk MSDs compared with those with ≤5 years (13/17 vs 3/22; $p < 0.001$). Relative risk was 5.84 (95% CI 1.89–16.5), indicating that workers with >5 years of service were approximately 5.8 times more likely to report moderate-risk MSDs.

The associations between job-related factors and MSDs are shown in Table 4. Most workers (34; 87.2%) were classified as having a light workload. The association between workload category and MSDs was not statistically significant ($p = 0.13$; $RR = 2.28$, 95% CI 1.20–4.26). 24 workers (61.5%) worked ≤8 hours/day, and 15 (38.5%) worked >8 hours/day. No significant association was observed between daily work duration and MSD category ($p = 0.66$; $RR = 0.73$, 95% CI 0.31–1.68). Most workers (26; 66.7%) were rated as moderate risk by REBA, with 13 (33.3%) in the high-risk category. REBA category was not significantly associated with MSD category ($p = 0.16$; $RR = 0.46$, 95% CI 0.15–1.33).

4. Discussion

4.1 Musculoskeletal Disorders Complaints

Awkward postures and prolonged static loading increase the risk of MSD. In this study, 59.0% of sack-sewing workers were classified as low risk and 41.0% as moderate risk, a distribution comparable to findings of mostly mild complaints among garment workers (Alvionisa *et al.*, 2023). Nordic Body Map mapping showed that complaints were concentrated in the lower limbs and specific upper-body sites rather than being widespread; the highest pain-severity weights were in the left calf, left foot, right calf, right foot, and left shoulder (Table 2).

The pattern of leg complaints plausibly reflects task biomechanics: standing sewing with an asymmetric load—left foot as the static support and right foot operating the pedal—likely increases the sustained load on the left leg and foot. Repetitive left-hand adjustments of the sack likely explain higher left-shoulder scores. Taller workers (>160 cm) using uniformly low table heights adopted forward-flexed trunk and neck postures, which may contribute to neck and shoulder discomfort; static neck flexion maintained for extended periods

is associated with an increased risk of MSDs (Fitri *et al.*, 2023). NBM effectively identified symptomatic regions and severity, but has limited capacity to quantify localised biomechanical loading of extremities; targeted assessments could better characterise foot/calf disorders.

4.2 The associations between risk factors and musculoskeletal disorders

4.2.1 The associations between individual factors and MSDs

Females comprised 56.4% of the sample. Although a larger proportion of women reported moderate-risk MSDs (54.5% vs 23.5% in men), sex was not statistically associated with MSD category ($p = 0.09$). This concurs with studies reporting no clear sex–MSD association in similar settings (Aswin & Hidayati, 2023; Indah *et al.*, 2023), notwithstanding physiological/hormonal differences that can affect pain perception (Hartanto *et al.*, 2022).

Most workers had BMI in the low-risk range (79.5%), and BMI was not associated with MSD category ($p = 0.69$). While elevated BMI has been associated with increased mechanical joint load and with MSDs in other studies, our sample and prior informal-sector research did not show a significant association (Alfiani *et al.*, 2023; Tjahayuningtyas, 2019). The small number of overweight/obese workers who reported more complaints suggests BMI may be relevant in larger samples (Rahmawati, 2021; Dyana *et al.*, 2023).

Work period (tenure) showed a strong association: workers with >5 years' service had a significantly higher likelihood of moderate-risk MSDs ($RR = 5.84$, $p < 0.001$). This aligns with exposure-accumulation models and prior findings linking longer employment to greater MSD prevalence (Irawati *et al.*, 2020; Alfiani *et al.*, 2023). Repeated exposure to static postures and repetitive movements over time likely explains this relationship (Rahayu *et al.*, 2020; Indah *et al.*, 2023).

4.2.2 The associations between job-related factors and MSDs

The work period in this study is treated as an individual factor because, in informal employment, tenure is not contract-bound and workers can change jobs at will. Longer tenure increases cumulative exposure to workplace hazards (Aswin & Hidayati, 2023), and MSD risk typically rises with greater cumulative exposure (Rahmawati, 2020). Most sack-sewing workers in this study had ≤5 years' service (56.4%), similar to findings among weaving craftsmen in Palembang (Yosineba *et al.*, 2020). Nevertheless, some workers reported over 10 years' experience.

Work period was significantly associated with

MSDs ($p = 0.00$); workers with >5 years' service had an RR of 5.84, indicating they were approximately 5.8 times more likely to report MSDs than those with ≤5 years' service. This result is consistent with studies linking longer employment to higher prevalence of MSDs (Irawati *et al.*, 2020; Alfiani *et al.*, 2023). Prolonged exposure to repetitive movements and non-ergonomic postures leads to cumulative mechanical stress (Rahayu *et al.*, 2020). In this sample, most workers scored as moderate (66.7%) or high (33.3%) on the REBA, which, combined with long tenure, likely explains the elevated MSD risk among those with >5 years' service. Prolonged static standing, asymmetric foot loading (left foot as support, right foot operating the pedal), repetitive left-hand adjustments, and sustained neck/trunk flexion contribute to progressive musculoskeletal strain (Purandima *et al.*, 2023), consistent with reports that work-related muscle disorders can appear after two years in the same role (Indah *et al.*, 2023).

Workload is classified into physical and mental components (Pridayanti *et al.*, 2023). For these sack-sewing workers, physical workload is the primary MSD-relevant factor. Most workers (87.2%) were categorised as having a light workload. Daily output varied (approximately 8–30 sacks/day, commonly 15–20 sacks), reflecting individual skill and product complexity; similar low-workload distributions were reported among weaving workers (Pridayanti *et al.*, 2023). Physical workload was estimated using %CVL derived from pulse measurements during work (DNK, 09:00–09:30) and rest (DNI, 11:30–12:00); higher muscle activity tends to increase pulse rate (Sanger & Paat, 2023). Data collection limitations—single DNK/DNI measurements, non-standardised rest conditions, and some workers being active before DNI measurement—may have biased %CVL estimates. Consequently, the mean DNK–DNI difference was not significant.

Although workload was not significantly associated with MSDs in Table 4, a larger proportion of workers with moderate workloads reported MSDs (80% vs 35.3% for light workloads), suggesting that workload intensity may interact with posture, repetition, and individual capacity to increase risk. Ergonomic risks (static standing, repetitive movements, asymmetric loading) and differences in skill or production targets likely explain higher complaint rates among those with a moderate workload. Long-term heavy or repetitive workloads impose sustained large muscle contractions and increased strain, particularly when combined with awkward postures (Sanger & Paat, 2023).

Workload in this study showed no significant association with MSD complaints among sack-sewing workers in Duduk Sampeyan District (Table 4). This

aligns with findings from Astuti *et al.* (2019) on predominantly standing waste collectors ($p = 0.081$) and Asnel & Pratiwi (2021) on laundry workers ($p = 0.305$), indicating that workload alone may not determine MSD occurrence (Astuti *et al.*, 2019; Asnel & Pratiwi, 2021). Table 4 shows 35.3% of workers with light workloads and 80% of workers with moderate workloads reported moderate MSDs, suggesting that although most workers have light workloads, complaints concentrate among those with moderate workloads. Differences in skill level, daily production volume, and ergonomic risks—static weight-bearing on the left foot, forward bending of the neck and trunk, and repetitive hand movements—likely explain the greater number of complaints in the moderate-workload group. Supporting this, 3 of 5 workers with a moderate workload had high-risk postures. Prolonged heavy or repetitive workloads lead to sustained, large-scale muscle contractions and increased strain, particularly with awkward postures (Sanger & Paat, 2023).

Most workers (61.5%) worked ≤ 8 hours per day; the maximum possible working time was 10 hours. Similar patterns of ≤ 8 -hour shifts are reported by Prima *et al.* (2022) and Pridayanti *et al.* (2023). Prolonged standing can cause leg pain, swelling, varicose veins, muscle fatigue, and stiffness, and sustained forward bending reduces muscle perfusion, increasing fatigue and localised pain (Purandima *et al.*, 2023). Typical productivity-rest cycles (4 hours work with short breaks) help limit fatigue; sack-sewing workers commonly follow a 4.5-hour work period, 1-hour break, then 4 hours more, though some undertake up to 2 hours overtime. In this study, work duration did not associate with MSD complaints ($p = 0.66$), consistent with Rahayu *et al.* (2020) ($p = 0.421$). Notably, 45.8% of workers with ≤ 8 hours and 33.3% with > 8 hours reported moderate MSDs, indicating that shorter work duration does not preclude complaints when ergonomic risk is high. Of the 24 workers with ≤ 8 hours, 10 had high-risk postures, supporting the view that exposure quality (posture/repetition) may be more decisive than duration. Active breaks (walking to buy food) may help restore blood flow and reduce stiffness after rest (Mairani *et al.*, 2023).

Work posture must match worker anthropometry to avoid excessive load on bones, nerves, and soft tissues (Azwar, 2020). In this sample, 66.7% had moderate-risk REBA postures. Oktavia *et al.* (2023) reported higher proportions of high-risk postures among tailors (53.6%) in Pamekasan. REBA results in this study showed frequent high leg scores (29 workers, ≥ 3 ; 74.3%), and many workers (38.4%) were ≥ 160 cm tall yet used uniformly low tables, causing trunk and neck flexion. REBA neck scores indicated $> 20^\circ$ flexion for most

workers (94.8%), and 11 workers (28.2%) had trunk bending of $20\text{--}60^\circ$. Repetitive left-hand adjustments and asymmetric foot loading explain elevated left-shoulder and left-foot/calf complaints. Among the 13 workers with high REBA risk, 3 had moderate workloads, suggesting an interaction between posture and workload.

Despite prevalent moderate/high REBA scores, work posture was not statistically associated with MSD complaints ($p = 0.16$). Similar null findings exist in studies of standing tofu producers and garment workers (Tjahayuningtyas, 2019; Lestari & Iلمي, 2022). MSD occurrence depends on individual capacity (muscle endurance, metabolism, motor control) and task dynamics (Irhamna *et al.*, 2023; Abdillahtulkhaer *et al.*, 2022). Static postures and repetitive actions produce sustained muscle contractions that lead to pain (Mairani *et al.*, 2023). In this study, five workers with moderate-risk postures were ≥ 160 cm and therefore stooped, which, combined with repetitive left-hand tasks and asymmetric foot loading, likely contributed to the high NBM weights for the left foot. Individual adaptation and variability in movement strategies may explain why some workers with moderate-risk REBA scores report fewer complaints (Putri *et al.*, 2020).

Ergonomic interventions are needed: adjust table height to worker anthropometry, implement targeted stretching and micro-breaks (especially for legs and shoulders), consider task rotation, and establish an Occupational Health and Safety Post for regular monitoring and early detection. Informal work flexibility (allowing movement during breaks) may offer partial protection (Oktavia *et al.*, 2023), but systematic promotive and preventive programs are recommended to reduce MSD risk and work-related injuries.

Study limitations include potential bias and imprecision in %CVL estimation arising from single, inconsistent pulse measurements, the small sample size, and subjectivity in NBM self-report. Future research should collect repeated pulse measurements under standardised conditions, increase the sample size, and consider objective measures for localised extremity assessment.

5. Conclusions

Most sack-sewing workers were female, had BMI ≤ 25 , and ≤ 5 years' tenure; MSD risk was generally low (59%) but concentrated in the left calf and left foot, with work period > 5 years significantly associated with higher MSD risk (RR = 5.84) while gender, BMI, workload, work duration, and REBA posture were not significant in this sample. Practical recommendations: adjust sewing-table height to worker anthropometry, introduce scheduled micro-breaks with leg and

shoulder stretching, provide cushioning/support at pressure points, implement task rotation, and establish an Occupational Health and Safety Post in Duduk Sampeyan for monitoring and education. Limitations: small sample and single-time %CVL pulse measures—recommend larger, repeated-measure studies to confirm findings.

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