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Musculoskeletal Disorders among Nypa Handicraft Workers in Cottage Industries: A Cross-Sectional Study in South Sumatra

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ABSTRACT

Musculoskeletal disorders (MSDs) represent a major occupational health concern among informal workers, particularly traditional Nypa palm handicraft workers who are frequently exposed to repetitive movements and prolonged non-ergonomic working postures. This study aimed to investigate the association between ergonomic and workplace environmental factors and MSDs severity levels among Nypa handicraft workers in traditional home-based industries. An analytical cross-sectional study was conducted among 150 Nypa handicraft workers in Palembang, South Sumatra, Indonesia. MSDs severity was assessed using the Nordic Musculoskeletal Questionnaire (NMQ)/Nordic Body Map (NBM), while work-related factors included working posture, repetitive hand movements, daily working hours, employment duration, and workload. Workplace environmental conditions, including temperature, relative humidity, and illumination, were measured using a thermohygrometer and lux meter. Data were analyzed using chi-square tests and multivariable logistic regression. The results showed that 65.3% of workers experienced mild MSDs and 34.7% experienced moderate MSDs, with the lower back, shoulders, neck, and wrists being the most frequently affected body regions. Bivariate analysis indicated that high-risk working posture was significantly associated with higher MSDs severity levels (OR=2.642; 95% CI: 1.260–5.539; p=0.009). Working ≥8 hours/day was also significantly associated with increased MSDs severity (OR=2.340; 95% CI: 1.130–4.850; p=0.021). Furthermore, abnormal BMI was associated with MSDs severity levels (p=0.016). The findings indicate that non-ergonomic working posture was an important occupational factor associated with MSDs severity among traditional Nypa handicraft workers. Ergonomic interventions, including improved working posture, workstation redesign, adequate rest periods, and workplace environmental management, are recommended to reduce MSDs risk and promote safer working conditions in traditional home-based industries.

Keywords: Musculoskeletal Disorders, Nypa handicraft workers, Cottage industries

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INTRODUCTION

Musculoskeletal disorders (MSDs) are disorders of the muscles, joints, tendons, ligaments, nerves, bones, and related structures that are caused or aggravated by work or the work environment.[1] These disorders have a relevant socio-economic impact on workers' quality of life, increased health costs, reduced productivity, and absenteeism.[2] MSDs are an occupational health problem worldwide. They create a lot of disability, lost productivity, and time off work. Musculoskeletal disorders and low back pain are the leading causes of disability worldwide, affecting 1.71 billion people in over 160 countries.[3] MSDs have several biomechanical risk factors, including repetitive motions, awkward working postures, static loads, and long working hours. [4]

Sustained awkward postures, repetitive motions, forceful exertions, static muscle loading, limited recovery time, and unfavorable workplace environmental conditions such as heat, poor lighting, and limited workspace contribute to MSDs.[5,6] Cottage industries are prone to MSDs because of the high degree of manual work, low mechanization, poor workstation ergonomics, and limited occupational health protection in production processes.

Workers often perform repetitive tasks while sitting or squatting for long periods, increasing biomechanical loading on the neck, shoulders, upper limbs, and lower back. Studies support this, reporting that repetitive work involving prolonged sitting, squatting/kneeling, and awkward postures increases biomechanical

load on the neck, shoulders, upper extremities, and lower back. [9,10] Systematic evidence indicates that workers in textile and handicraft industries consistently exhibit a high prevalence of musculoskeletal symptoms due to occupational ergonomic exposures.[6]

Weaving is a major informal-sector occupation associated with ergonomic risks. Previous studies among handloom and silk weavers have reported a high prevalence of musculoskeletal disorders, particularly in the neck, shoulders, wrists, and lower back, associated with repetitive movements, prolonged static postures, poorly designed seating, heavy workloads, and inadequate rest periods.[11] Previous studies reported an annual work-related musculoskeletal disorder prevalence exceeding 80% among handloom weavers, primarily affecting the lower back, shoulders, neck, and knees, with significant associations with working hours, years of experience, repetitive movements, and manual material handling.[12]

In Indonesia and other coastal areas of Southeast Asia, processing Nypa palm leaves is a traditional economic activity.[13] Nypa products can be used for roofing, house walls, artisanal crafts, and household necessities.[14] The prevalence of musculoskeletal symptoms among handicraft workers ranges from 38.5% to 100%, primarily affecting the neck, back, knees, and upper extremities.[11] Prolonged ergonomic exposures may increase musculoskeletal strain and impair long-term work ability, highlighting the need for targeted interventions tailored to traditional home-based industries.[15]

Ergonomic research has primarily focused on posture, repetition, and force, often overlooking environmental factors such as temperature, humidity, ventilation, and lighting, which may increase physiological workload, accelerate fatigue, impair performance, and exacerbate musculoskeletal strain, thereby contributing to MSDs.[16] A study of Nypa handicraft workers in Terjun Village identified ergonomic hazards, inadequate lighting, and heat exposure; 62.9% required further observation, and 60% were classified as having a low risk of MSDs.[17]

Nypa handicraft workers is an important traditional cottage industry in many coastal areas of Southeast Asia, including Indonesia.[18] Palembang is one of the cities in Indonesia that produces crafts from nypa leaves. Palembang, a river-dominated area in South Sumatra, has a long tradition of utilizing nypa palm leaves as raw materials for handicrafts, such as roofing materials, mats, and baskets. This activity represents an important source of income for several local communities. Nevertheless, preliminary observations showed that Nypa handicraft workers commonly work from home. With limited facilities, they use manual production processes, maintain prolonged static postures, and apply ergonomic principles insufficiently, which may increase the risk of musculoskeletal disorders.

While musculoskeletal disorders have been extensively investigated among textile, silk, and handloom workers, limited attention has focused on workers involved in Nypa palm weaving. Existing evidence suggests that traditional handicraft workers face multiple occupational hazards, including repetitive movements, prolonged static postures, and suboptimal workplace conditions. However, the interaction between ergonomic factors and workplace environmental conditions in relation to MSDs severity among Nypa handicraft workers remains poorly understood. Therefore, this study provides important context-specific evidence to support targeted ergonomic improvements and occupational health interventions in traditional home-based industries.[5,6]

Nypa palm weaving is a traditional home-based occupation that plays an important role in supporting coastal communities' livelihoods. However, the manual nature of this activity often requires workers to sit for long periods, perform repetitive hand movements, and adopt awkward postures for extended periods. These occupational demands may increase biomechanical stress and contribute to the development and progression of musculoskeletal disorders (MSDs). Previous studies among handicraft workers have consistently identified poor working posture, repetitive movements, and long working hours as significant factors associated with MSDs.[11] In addition, research on nypa leaf craft workers has highlighted multiple workplace hazards, including ergonomic constraints, inadequate illumination, and excessive heat exposure. Nevertheless, evidence on the combined influence of ergonomic and workplace environmental factors on MSDs severity among Nypa handicraft workers remains limited.[17]

However, the associations of ergonomic and workplace environmental factors with MSDs, particularly when considered together, remain insufficiently characterized in this occupational setting. Therefore, this study aimed to investigate

the association between ergonomic and workplace environmental factors and the severity levels of musculoskeletal disorders (MSDs) among Nypa handicraft workers in traditional home-based industries.

METHODS

This analytical observational study employed a cross-sectional design to investigate the association between environmental and work-related factors and the severity of musculoskeletal disorders (MSDs) among Nypa handicraft workers in traditional cottage industries. Data were collected from May to October 2025 in Palembang, South Sumatra, Indonesia, among workers engaged in Nypa handicraft production in traditional home-based industries.

The sample size was estimated using the single-population-proportion formula described by Lemeshow.[19] Assuming a 95% confidence level, an expected prevalence of work-related musculoskeletal disorders of 85%, based on a previous study among handloom weavers, and an absolute precision of 6%, the estimated sample size was 136.1 participants.[12]

A 10% allowance was added to account for potential non-response or incomplete data, yielding a target sample size of 150 participants. Ultimately, 150 eligible nypa palm weavers were included in the final analysis.

The minimum sample size was calculated using:

$$n = \frac{Z_{1-\alpha/2}^2 P(1-P)}{d^2}$$

Where:

$Z_{1-\alpha/2}$	Z-score corresponding to a 95% confidence level	:1.96
P	Expected prevalence of MSDs	:0.85
$1-P$	Complement of the expected prevalence	:0.15
d	Absolute precision	:0.06

The initial sample size was 126, which increased to 149 after accounting for an anticipated 15% non-response rate. Ultimately, the final analysis included 150 eligible nypa palm weavers.

A total of participants were selected using simple random sampling from eligible nypa palm weaving workers. Eligibility criteria included active involvement in Nypa palm weaving for ≥6 months, being aged ≥18 years, and providing written informed consent. Workers were excluded if they reported previous traumatic musculoskeletal injuries, congenital musculoskeletal conditions, or chronic diseases affecting mobility and work performance. Participants with incomplete questionnaire responses or missing observational assessment data were excluded from the final analysis.

Musculoskeletal disorders (MSDs) severity levels were assessed using the Nordic Body Map (NBM) questionnaire. The total NBM score ranged from 28 to 112 and was categorized into four levels of musculoskeletal complaints: low (28–49), moderate (50–70), high (71–91), and very high (92–112). Working posture was evaluated using the Rapid Entire Body Assessment (REBA) method developed by Hignett and McAtamney (2000).[20] REBA is an ergonomic assessment tool designed to evaluate whole-body postural risks by considering body segment positions, applied force or load, coupling quality, and activity characteristics.

The final REBA scores were classified into five risk levels: negligible risk (score 1), low risk (scores 2–3), medium risk (scores 4–7), high risk (scores 8–10), and very high risk (scores 11–15). Higher REBA scores indicate greater ergonomic exposure and a greater need for prompt corrective actions. The Nordic Body Map questionnaire has been widely used to identify the distribution and severity of musculoskeletal complaints among workers, while the REBA method has been validated as a practical tool for assessing ergonomic risks in various occupational settings.

We assessed workplace environmental conditions, including illumination, air temperature, and relative humidity, through direct measurements at the Nypa weaving workstations during the data collection period. We measured illumination intensity in lux (lx), air temperature in degrees Celsius (°C), and relative humidity in percentage (%), using calibrated instruments. Each environmental parameter was measured once during the observation visit at the workers' usual working locations. No repeated measurements were conducted across different days or work shifts. The collected environmental data were used to describe workplace conditions and evaluate their associations with MSDs severity levels among Nypa palm handicraft workers. Because environmental measurements used a single-point assessment approach, the results reflect workplace conditions during the measurement

period and may not fully capture daily variations in environmental exposure.

Data were coded, checked, and analyzed using IBM SPSS Statistics. Descriptive analyses summarized participants' sociodemographic characteristics, occupational factors, workplace environmental conditions, and MSDs severity levels. Categorical variables were presented as frequencies and percentages, depending on data distribution. The associations between categorical independent variables and MSDs severity levels were assessed using Pearson's chi-square test or Fisher's exact test when the assumptions for the chi-square test were not met. Statistical significance was set at $p < 0.05$.

Ethical approval for this study was obtained from the Institutional Research Ethics Committee of Poltekkes Kemenkes Palembang (Approval No. 0591/KEPK/Adm2/IV/2025). All participants provided informed consent before data collection, and the study procedures followed applicable ethical standards.

RESULTS

Musculoskeletal Disorders (MSDs) Severity Level, Sociodemographic, and Work-Related Characteristics of Participants

Table 1 presents the distribution of musculoskeletal disorders (MSDs) severity levels, sociodemographic characteristics, and work-related characteristics among Nypa handicraft workers.

Table 1. Sociodemographic, Musculoskeletal Disorders (MSDs) Severity Level and Work-Related Characteristics of Nypa Handicraft Workers

Variables	n	%
MSDs Severity Level		
- Mild (NBM score 28–49)	98	65.3
- Moderate (NBM score 50–70)	52	34.7
Age groups		
- ≥ 45 years	73	48.7
- < 45 years	77	51.3
Gender		
- Male	37	24.7
- Female	113	75.3
Educational Level		
- Low (Elementary–Junior High School)	54	36
- High (Senior High School)	96	64
Working duration		
- ≥ 8 hours/day	107	71.3
- < 8 hours/day	43	28.7
Work Experience		
- ≥ 5 years	105	70
- < 5 years	45	30
Working posture		
- High risk (Score (8–10)	109	72.7
- Medium risk (Score (4–7)	41	27.3
Body Mass Index (BMI)		
- Underweight/Overweight (< 18,5-22.9 kg/m²)	72	48
- Normal weight (<18,5 or ≥ 22.9 kg/m²)	78	52

As shown in Table 1, among the 150 Nypa handicraft workers included in this study, 65.3% had mild MSDs severity, while 34.7% had moderate MSDs severity. The age distribution was relatively balanced, with 51.3% of participants aged <45 years. Most participants were women (75.3%). Regarding sociodemographic and occupational characteristics, most workers had completed high school, worked ≥8 hours per day, had more than five years of work experience, adopted non-ergonomic working postures, and had an

abnormal BMI.

Table 2 presents the physical work environment characteristics among Nypa handicraft workers, including temperature, relative humidity, and illumination levels.

Table 2. Distribution of Physical Work Environment Conditions in the Workplace

Variables	Total	%
Lighting		
- Not standard (≥300 lux)	76	50.7
- Standard (< 300 lux)	74	49.3
Workplace Temperature		
- Not standard (<18 °C or >30°C	92	61.3
- Standard (18–30°C)	58	38.7
Relative Humidity		
- Not standard (<40% or >60%)	80	53.3
- Standard (40–60%)	70	46.7

Physical Work Environment Conditions

As shown in Table 2, workplace environmental conditions among Nypa handicraft workers were assessed based on temperature, relative humidity, and illumination levels. More than half of the observed workplaces did not meet the environmental standards established by the Indonesian Ministry of Health. [21] Temperature was the most frequently observed non-compliant parameter, with 61.3% of workstations exceeding or falling below the recommended range of 18–30°C. Inadequate relative humidity was also identified in 53.3% of workplaces, while 50.7% of workstations had illumination levels below the recommended minimum of ≥300 lux.

The results of the chi-square analysis examining the associations between sociodemographic characteristics, work-related factors, and MSDs severity levels among Nypa handicraft workers are presented in Table 3.

Table 3. Association Between Sociodemographic and Work-Related Characteristics and the Severity of Musculoskeletal Disorders Among Nypa Handicraft Workers

Variables	Mild, n (%)	Moderate, n (%)	OR (95% CI)	*p*-value
Gender				
Male	26 (70.3)	11 (29.7)	1.346 (0.603–3.003)	0.467
Female	72 (63.7)	41 (36.3)		
Educational level				
Low (Elementary–Junior High School)	36 (66.7)	18 (33.3)	1.097 (0.540–2.220)	0.797
High (Senior High School)	62 (64.6)	34 (35.4)		
Working hours				
≥8 hours/day	76 (71.0)	31 (29.0)	2.340 (1.130–4.850)	0.021*
<8 hours/day	22 (51.2)	21 (48.8)		
Work experience				
≥5 years	73 (70.2)	29 (29.8)	2.114 (0.950–4.110)	0.060
<5 years	25 (54.3)	21 (45.7)		
Working posture				
High risk (Score (8–10)	78 (71.6)	31 (28.4)	2.642 (1.260–5.539)	0.009*
Medium risk (Score (4–7)	20 (48.8)	21 (51.2)		

Variables	Mild, n (%)	Moderate, n (%)	OR (95% CI)	*p*-value
Body mass index (BMI)				
Underweight/Overweight (<18.5 or ≥23 kg/m²)	40 (55.6)	32 (44.4)	0.430 (0.220–0.860)	0.016*
Normal weight (18.5–22.9 kg/m²)	58 (74.4)	20 (25.6)		

*=significancy

As shown in Table 3, working hours, working posture, and body mass index (BMI) were significantly associated with MSDs severity levels. Workers who worked ≥8 hours/day had higher odds of experiencing moderate MSDs severity compared with those who worked <8 hours/day (OR = 2.340; 95% CI: 1.130–4.850; p = 0.021). Similarly, workers with high-risk working postures had higher odds of experiencing moderate MSDs severity compared with those with medium-risk postures (OR = 2.642; 95% CI: 1.260–5.539; p = 0.009). Furthermore, workers with normal BMI had lower odds of experiencing moderate MSDs severity compared with those with abnormal BMI (OR = 0.430; 95% CI: 0.220–0.860; p = 0.016). Gender, educational level, and work experience were not significantly associated with MSDs severity levels (p > 0.05).

Table 4 presents the results of the chi-square analysis examining the association between workplace environmental conditions and MSDs severity levels.

Table 4. Association Between Physical Work Environment Conditions and Musculoskeletal Disorders (MSDs) Severity Level

Physical work environment	Mild, n (%)	Moderate, n (%)	OR (95% CI)	*p*-value
Lighting				
Standard	44 (59.5)	30 (40.5)		
Not standard	54 (71.1)	22 (28.9)	1.674 (0.849–3.300)	0.136
Workplace temperature				
Standard	41 (70.7)	17 (29.3)		
Not standard	57 (62.0)	35 (38.0)	0.675 (0.334–1.366)	0.274
Relative humidity				
Standard	46 (65.7)	24 (34.3)		
Not standard	52 (65.0)	28 (35.0)	0.969 (0.494–1.902)	0.927

As shown in Table 4, no statistically significant associations were observed between workplace environmental conditions and MSDs severity levels. Lighting conditions were not significantly associated with MSDs severity levels (OR = 1.674; 95% CI: 0.849–3.300; p = 0.136). Similarly, workplace temperature (OR = 0.675; 95% CI: 0.334–1.366; p = 0.274) and relative humidity (OR = 0.969; 95% CI: 0.494–1.902; p = 0.927) were not significantly associated with MSDs severity levels.

DISCUSSION

The present study found that Nypa handicraft workers experienced mild to moderate levels of musculoskeletal disorders (MSDs), with mild MSDs being the predominant category. This finding indicates that musculoskeletal symptoms are already prevalent among traditional Nypa handicraft workers, although symptom severity varies across individuals. MSDs among these workers may stem from the nature of Nypa weaving activities, which involve repetitive hand movements, prolonged static sitting, and sustained upper-limb postures that may increase biomechanical loading on the musculoskeletal system.

These findings align with a systematic

review and meta-analysis of 7,322 weavers from low- and middle-income countries, which reported a pooled prevalence of work-related MSDs of 72.2%, highlighting the substantial burden of MSDs among workers in weaving-related occupations. Similar occupational demands, including repetitive movements, prolonged sitting, and constrained working postures, have been identified as important contributors to MSD development among handicraft workers. [22] Previous research among Nypa leaf craftsmen in Terjun Village, Medan Marelan District, also reported a high occurrence of low back pain accompanied by functional limitations, further supporting the vulnerability of Nypa handicraft workers to musculoskeletal problems.[13]

The present study found that working ≥8 hours per day was significantly associated with higher MSDs severity levels among Nypa handicraft workers. Previous studies reported similar findings, indicating that prolonged working hours increase the risk of musculoskeletal symptoms among workers exposed to sustained physical demands.[23] These findings align with previous research showing that long working hours, combined with non-neutral working postures, repetitive movements, and inadequate ergonomic support, are key occupational risk factors for MSDs.[24] Therefore, reducing excessive working hours and implementing appropriate rest periods, including microbreaks, may represent important strategies for preventing MSDs among informal sector workers.

In this study, most Nypa handicraft workers had more than five years of work experience; however, employment duration was not significantly associated with MSDs severity levels. This finding suggests that prolonged work experience alone may not be a sufficient predictor of MSD severity among Nypa handicraft workers. Instead, the occurrence and severity of MSDs may be influenced by the cumulative interaction of multiple occupational exposures, including working posture, repetitive movements, workload, work organization, and recovery time.

Previous studies among handicraft and informal-sector workers have reported that long employment duration, extended working hours, repetitive tasks, sustained awkward postures, and insufficient rest periods contribute to increased musculoskeletal symptoms due to repeated biomechanical loading over time.[25] Although longer employment duration may reflect greater cumulative exposure, the lack of a significant association in this study may reflect variation in individual adaptation, workload patterns, ergonomic practices, or exposure intensity among workers.[26]

The present study demonstrated that a substantial proportion of Nypa handicraft workers adopted high-risk working postures, which were significantly associated with higher MSDs severity levels. This finding suggests that prolonged non-neutral postures during weaving activities may increase biomechanical stress on the musculoskeletal system. Similar findings have been reported among traditional weavers in West Sulawesi, where higher Rapid Entire Body Assessment (REBA) scores were associated with greater severity of musculoskeletal complaints.[27]

Previous research among Nypa craftsmen in Medan Marelan District also reported a significant association between working posture and low back pain, indicating that prolonged static sitting and bending positions during handicraft activities may increase mechanical loading on the lumbar region.[13] Furthermore, studies among workers performing repetitive manual tasks have shown that awkward working postures are strongly related to musculoskeletal complaints due to increased muscle tension, reduced blood circulation, and cumulative tissue strain.[28]

The findings are also consistent with previous ergonomic assessments of weaving activities, which reported low to very high ergonomic risk levels associated with prolonged sitting, trunk flexion, and repetitive upper-limb movements.[29] A systematic review further highlighted that elevated REBA scores reflect greater biomechanical demands and are associated with an increased risk of MSDs among workers engaged in manual and repetitive occupations, including weaving activities.[30] Therefore, improving ergonomic conditions among Nypa handicraft workers should prioritize reducing awkward postures through workstation redesign, adjusting working height, providing appropriate seating support, and implementing periodic rest breaks to minimize cumulative musculoskeletal loading.

In this study, gender, education level, and work experience were not significantly associated with MSDs severity levels. This finding suggests that, within this study population, individual sociodemographic characteristics may contribute less to explaining variation in MSDs severity than occupational exposures. The results highlight the potential importance of workplace-related

ergonomic factors, such as working posture, repetitive movements, and work duration, in influencing MSDs severity among Nypa handicraft workers.

Similar findings have been reported in previous studies among weaving workers, where ergonomic factors, particularly awkward working postures and prolonged work duration, were identified as more consistent determinants of MSDs compared with demographic characteristics.[23] Nevertheless, MSDs are recognized as multifactorial occupational health outcomes resulting from complex interactions between biomechanical exposures, psychosocial workplace factors, and individual worker characteristics.[31] Therefore, prevention strategies should consider both workplace ergonomic improvements and individual factors to reduce the risk and severity of MSDs among informal sector workers

The present study found that most traditional Nypa handicraft workers were exposed to workplace environmental conditions that were below recommended occupational health standards, particularly in terms of temperature, relative humidity, and illumination. Although these unfavorable environmental conditions may contribute to physical discomfort and increase physiological demands during prolonged, repetitive handicraft activities, they were not significantly associated with MSDs severity levels in the present analysis. This finding suggests that biomechanical factors, such as non-neutral working postures, repetitive movements, and prolonged work duration, may have a greater influence on MSDs severity among Nypa handicraft workers.

Previous studies among weaving and other handicraft workers have reported that inadequate lighting may affect visual comfort, productivity, and perceived work fatigue; however, biomechanical factors, such as awkward postures, repetitive movements, and prolonged static loading, remain major contributors to MSDs development.[12] Furthermore, exposure to excessive temperature and humidity may increase physiological strain by accelerating fatigue. They can reduce physical endurance and affect workers' ability to maintain optimal working postures during prolonged tasks.[32] Therefore, although workplace environmental conditions were not directly associated with MSDs severity in this study, improving thermal comfort and workplace conditions remains important as part of a comprehensive ergonomic intervention strategy for traditional Nypa handicraft workers.

The findings of this study have important practical implications for preventing and reducing MSDs severity among traditional Nypa handicraft workers. Because high-risk working posture was significantly associated with higher MSD severity, ergonomic interventions should prioritize improving workers' posture through workstation redesign, including adjustable seating with adequate back support, appropriate work surface height, and improved seating arrangements. Additional preventive strategies, such as regular microbreaks, ergonomic training, and structured stretching exercises, may reduce biomechanical loading and minimize musculoskeletal discomfort. Previous studies have demonstrated that workplace ergonomic interventions can effectively reduce biomechanical exposure and the risk of work-related MSDs.[23] Therefore, integrating ergonomic improvements with workplace health promotion strategies may contribute to safer working conditions and improved occupational health among Nypa handicraft workers.

This study has several limitations that should be considered when interpreting the findings. First, the cross-sectional design limits the ability to establish temporal relationships and causal inferences between ergonomic factors and MSDs severity levels. Second, the study was conducted among Nypa handicraft workers in a limited geographical area, which may restrict the generalizability of the findings to other traditional home-based industries with different working characteristics. Third, MSDs severity was assessed using a self-reported questionnaire, which may be subject to recall bias and reporting bias. In addition, workplace environmental measurements were obtained at the time of data collection and may not fully represent variations in exposure conditions over longer periods.

Despite these limitations, this study provides valuable preliminary evidence regarding the relationship between ergonomic, occupational, and workplace environmental factors and MSDs severity levels among Nypa handicraft workers. The findings highlight the importance of ergonomic improvement as a feasible intervention strategy in traditional home-based industries. Future studies using longitudinal designs, larger and more diverse populations, objective ergonomic assessment methods, and repeated environmental exposure measurements are recommended to further clarify the determinants and prevention strategies for MSDs among

informal workers.

CONCLUSION

Musculoskeletal disorders (MSDs) represent a major occupational health concern among Nypa handicraft workers in traditional home-based industries. This study identified significant associations between working posture, daily working hours, and body mass index and MSDs severity levels. In contrast, sociodemographic characteristics and workplace environmental conditions were not significantly associated with MSDs severity levels.

These findings highlight the importance of ergonomic interventions that improve working posture, optimize work duration, promote healthy body weight management, and reduce biomechanical stress to prevent MSDs progression and improve occupational health among Nypa handicraft workers.

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CONFLICT OF INTEREST

There are no potential conflicts of interest to declare.

REFERENCES

1. Ding X, Guan Z, Liu N, Bi M, Ji F, Wang H, et al. Prevalence and Risk Factors of Work-Related musculoskeletal Disorders Among Emerging Manufacturing Workers in Beijing, China. Front Med [Internet]. 2023;10. Available from: https://doi.org/10.3389/fmed.2023.1289046
2. Lorenzini M, Kim W, Ajoudani A. An Online Multi-Index Approach to Human Ergonomics Assessment in the Workplace. IEEE Trans human-machine Syst [Internet]. 2022;52(5):812–23. Available from: https://doi.org/10.48550/arXiv.2111.06323
3. WHO. Musculoskeletal Conditions. 2022; Available from: https://www.who.int/news-room/fact-sheets/detail/musculoskeletal-conditions
4. Haftu D, Kerebih H, Terfe A. Prevalence of Work-Related Musculoskeletal Disorders and Its Associated Factors among Traditional Cloth Weavers in Chencha District, Gamo Zone, Ethiopia, an Ergonomic Study. PLoS One [Internet]. 2023;18(11):e0293542. Available from: https://doi.org/10.1371/journal.pone.0293542
5. Motta F, Varrecchia T, Chini G, Ranavolo A, Galli M. The Use of Wearable Systems for Assessing Work-Related Risks Related to the Musculoskeletal System—A Systematic Review [Internet]. Vol. 21, International Journal of Environmental Research and Public Health. 2024. p. 1567. Available from: https://doi.org/10.3390/ijerph21121567
6. Seidu RK, Ofori EA, Eghan B, Fobiri GK, Afriyie AO, Acquaye R. A Systematic Review of Work-Related Health Problems of Factory Workers in the Textile and Fashion Industry. J Occup Health [Internet]. 2024 Jan 1;66(1):uiae007. Available from: https://doi.org/10.1093/joccuh/uiae007
7. Gunderaya G, S.M. Q, Saniya S, Laxmim L, Hasanuddin S. Prevalence of Musculoskeletal Disorders and Postural Risks among Workers in Small Scale Industries – A Case Study. In: Proceedings of the International Conference on Industrial Engineering and Operations Management [Internet]. 2024. Available from: https://doi.org/10.46254/in04.20240202
8. Kataria K, Sharma M, Suri NM, Kant S, Luthra S. Analyzing Musculoskeletal Risk-Severity among Small Scale Casting Workers using Ergonomic Assessment Tools: A Statistical Approach. Work [Internet]. 2022;72:1429–42. Available from: https://doi.org/10.3233/wor-210867
9. Hulshof CTJ, Pega F, Neupane S, Colosio C, Daams JG, Kc P, et al. The Effect of Occupational Exposure to Ergonomic Risk Factors on Osteoarthritis of Hip or Knee and Selected Other Musculoskeletal Diseases: A Systematic Review and Meta-Analysis from the WHO/ILO Joint Estimates of the Work-related Burden of Disease and In. Environ Int [Internet]. 2021;150:106349. Available from: https://doi.org/10.1016/j.envint.2020.106349
10. Tang KHD. The Prevalence, Causes and Prevention of Occupational Musculoskeletal Disorders. Glob Acad J Med Sci [Internet].

2022;4(2):56–68. Available from: https://doi.org/10.0.141.252/gajms.2022.v04i02.004
11. Das D, Kumar A, Sharma M. A Systematic Review of Work-Related Musculoskeletal Disorders among Handicraft Workers. Int J Occup Saf Ergon [Internet]. 2020 Mar;26(1):55–70. Available from: https://doi.org/10.1080/10803548.2018.1458487
12. Kaboré PA, Schepens B. Work-Related Musculoskeletal Disorders and Risk Factors among Weavers: A cross-Sectional Study. South African J Physiother [Internet]. 2023;79(1):1904. Available from: https://doi.org/10.4102/sajp.v79i1.1904
13. Aprisandi A, Silaban G. Analisis Faktor Penyebab Tingkatan Gangguan Low Back Pain (LBP) pada Pengrajin Daun Nypah di Kelurahan Terjun Kecamatan Medan Marelan. TROPHICO [Internet]. 2023;3(1):1–7. Available from: https://doi.org/10.32734/trophico.v3i1.11338
14. Nasution CVQ, Supristiwendi S, Mahyuddin T, Basriwijaya KMZ. Strategi Pengembangan Usaha Atap Daun Nypah (Nypa fruticans) di Kecamatan Seruway Kabupaten Aceh Tamiang. J Inov Penelit [Internet]. 2022;3(2):4839–44. Available from: https://doi.org/10.47492/jip.v3i2.1747
15. Sofian R. Perbaikan Lingkungan Kerja Guna Meningkatkan produktivitas dan Kesejahteraan Pengrajin atap Daun Nypah Tradisional di Desa Pulau Palas dengan Metode Work Sampling. JUTI UNISI [Internet]. 2019;3(1):9–17. Available from: https://doi.org/10.32520/juti.v3i1.742
16. Bai X, Wicaksono H. How Relevant Are Environmental Factors in The Ergonomic Performance Assessments? Procedia Manuf [Internet]. 2020;52:325–30. Available from: https://doi.org/10.1016/j.promfg.2020.11.054
17. Silaban G, Lubis A. Relationship Between Potential Ergonomic Hazard Factors and Musculoskeletal Disorders in Nypah leaf crafters in Terjun Village, Indonesia. Int J Occup Saf Heal [Internet]. 2025;15(3):262–71. Available from: https://doi.org/10.3126/ijosh.v15i3.78138
18. Hossain M, Islam MA. Utilization of Mangrove Forest Plant: Nypa Palm (Nypa fruticans Wurmb.). Am J Agric For [Internet]. 2015;3:156. Available from: https://doi.org/10.11648/j.ajaf.20150304.16
19. Levy PS, Lemeshow S. Sampling of Populations: Methods and Applications. John Wiley & Sons; 2013.
20. Hignett S, McAtamney L. Rapid entire body assessment (REBA). Appl Ergon [Internet]. 2000;31(2):201–5. Available from: https://doi.org/10.1016/S0003-6870(99)00039-3
21. Permenkes RI. Regulation of the Minister of Health (Permenkes) No. 70 of 2016 concerning Standards and Requirements for Industrial Work Environmental Health [Internet]. Indonesia; 2016. Available from: https://peraturan.bpk.go.id/Details/114490/permenkes-no-70-tahun-2016
22. Koiri P. Occupational Health Problems of the Handloom Workers: A cross Sectional Study of Sualkuchi, Assam, Northeast India. Clin Epidemiol Glob Heal [Internet]. 2020 Dec 1;8(4):1264–71. Available from: https://doi.org/10.1016/j.cegh.2020.04.025
23. Geto AK, Daba C, Desye B, Berihun G, Berhanu L. Prevalence of Work-Related Musculoskeletal Disorder and Its Associated Factors Among Weavers in Low- and Middle-Income Countries: a Systematic Review and Meta-Analysis. BMJ Open. 2025 Aug;15(8):e093124.
24. Zinabu FS, Getie K, Shiferaw KB, Belay GJ, Takele MD, Fentanew M, et al. Work-Related Musculoskeletal Disorders and Associated Factors among Weavers Working in Bahir Dar City, Northwest Ethiopia: Cross-Sectional Study Design. BMC Musculoskelet Disord [Internet]. 2024 May;25(1):419. Available from: https://doi.org/10.1186/s12891-024-07494-y
25. Das D, Singh AK. Risk Factors Associated with Work-Related Musculoskeletal Disorders among Floor-Sitting Precision Handicraft Workers. Int Arch Occup Environ Health [Internet]. 2022 Jul;95(5):1129–45. Available from: https://doi.org/10.1007/s00420-021-01817-5
26. Pramesti N, Arini S. The Correlation between Working Period and Exercise Routines with Musculoskeletal Complaints on Batik Craftsmen. Indones J Occup Saf Heal [Internet]. 2022; Available from: https://doi.org/10.20473/ijosh.v11i2.2022.187-194
27. Mallapiang F, Azriful, Nildawati, Syarfaini, Muis M, Adriansyah. The Relationship of Posture Working with Musculoskeletal

Disorders (MSDs) in the Weaver West Sulawesi Indonesia. Gac Sanit [Internet]. 2021;35:S15–8. Available from: https://doi.org/10.1016/j.gaceta.2020.12.005
28. Putri BA. The Correlation between Age, Years of Service, and Working Postures and the Complaints of Musculoskeletal Disorders. Indones J Occup Saf Heal [Internet]. 2019;8(2):187–96. Available from: https://doi.org/10.20473/ijosh.v8i2.2019.
29. Maria Magdalena MM. Analisis Tingkat Risiko Ergonomi Pada Pekerja Tenun Ikat Di Kelurahan Tuan Kentang Kota Palembang Tahun 2019. J Kesehat Bina Husada [Internet]. 2021;13(04):143–7. Available from: https://doi.org/10.58231/jkbh.v13i04.43
30. Kee D. Systematic Comparison of OWAS, RULA, and REBA Based on a Literature Review [Internet]. Vol. 19, International Journal of Environmental Research and Public Health. 2022. p. 595. Available from: https://doi.org/10.3390/ijerph19010595
31. Yang F, Di N, Guo WW, Ding WB, Jia N, Zhang H, et al. The Prevalence and Risk Factors of Work Related Musculoskeletal Disorders among Electronics Manufacturing Workers: a Cross-Sectional Analytical Study in China. BMC Public Health [Internet]. 2023;23(10):1–11. Available from: https://doi.org/10.1186/s12889-022-14952-6
32. Flouris A, Dinas P, Ioannou L, Nybo L, Havenith G, Kenny G, et al. Workers' Health and Productivity under Occupational Heat Strain: a Systematic Review and Meta-Analysis. Lancet Planet Heal [Internet]. 2018;2 12. Available from: https://doi.org/10.1016/s2542-5196(18)30237-7