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# Ergonomics and Psychosocial Predictors of Work-Related Musculoskeletal Disorders among Nursing Professionals

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**Abstract:**
Work-related musculoskeletal disorders (WMSDs) are common occupational health issues among nurses resulting from the combined effects of physically demanding tasks and psychosocial pressures. These conditions lead to reduced productivity, increased absenteeism, and strain on healthcare systems. This study aimed to determine the prevalence of WMSDs among nurses in a teaching hospital and to examine demographic, ergonomic, and psychosocial factors associated with their occurrence. A cross-sectional survey was conducted among 45 registered nurses recruited from various wards of a tertiary teaching hospital. Data were collected using a structured self-administered questionnaire, which included the Nordic Musculoskeletal Questionnaire (NMQ) and measures of demographic, ergonomic, and psychosocial variables. Descriptive statistics were applied to summarize characteristics and prevalence, while binary logistic regression was used to identify significant predictors. More than half of the respondents reported WMSDs in the past 12 months, with the ankles/feet (35.6%), neck (33.3%), and lower back (31.1%) most frequently affected. Significant predictors included female (AOR = 6.48, 95% CI: 1.07–39.23), being married (AOR = 5.11, 95% CI: 1.07–24.40), having children (AOR = 5.58, 95% CI: 1.20–25.83), heavy lifting without assistance (AOR = 6.36, 95% CI: 1.31–32.80), high workload (AOR = 5.01, 95% CI: 1.17–21.42), and low supervisory support (AOR = 4.72, 95% CI: 1.04–21.36).In conclusion, WMSDs among nurses are influenced by overlapping personal, ergonomic, and psychosocial risks. Integrated prevention strategies combining ergonomic interventions, such as assistive devices and safe patient-handling, with organizational measures, including workload management, adequate staffing, and supportive supervision, are essential to safeguard nurses' health and maintain healthcare system resilience. This study contributes novel evidence by integrating both ergonomic and psychosocial predictors within a single framework, providing context-specific insights for developing holistic WMSD prevention strategies among Malaysian nurses.

**Keywords:** Work-related musculoskeletal disorders; Nurses; Ergonomic risk factors; Psychosocial predictors; Occupational health

## 1. INTRODUCTION

Work-related musculoskeletal disorders (WMSDs) are a primary occupational health concern worldwide, especially in healthcare. Nurses are highly vulnerable due to patient handling, prolonged standing, awkward posture and repetitive tasks (1). These physical risks are intensified by psychosocial factors such as a heavy workload, limited rest, and low organizational support (2, 3). Together, these stressors not only harm individual health but also lead to absenteeism, reduced productivity, long-term disability, and significant economic and operational costs for healthcare systems (4, 5). Recent studies report consistently high rates of WMSDs among nurses worldwide. Zaitoon *et al.* (6) found that over 80% of nurses in Palestine experienced lifetime low back pain. At the same time, Gorce and Jacquier-Bret highlighted the influence of years of service and work experience on musculoskeletal strain in Asia (7). Ergonomic factors, such as the Movement and Assistant of Hospital Patient (MAPO) index, also show a high patient-handling risk among nurses. For example, 76.6% of nurses in Botswana reported low back pain associated with manual lifting tasks (8). Similarly, Vinstrup *et al.* (9) used electromyography to confirm significant lumbar strain during patient transfers. These findings support the biomechanical load theory, which links cumulative physical demands to long-term musculoskeletal decline.

Beyond ergonomic risks, psychosocial and organizational factors also contribute to WMSD development. Kim and Jeong (10) found that nurses on permanent shifts handling heavy loads were nearly three times more likely to report upper-limb pain, while rotating shift nurses faced over three times higher risk of fatigue, particularly with awkward postures and



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repetitive tasks. These findings align with the Job Demand–Control–Support (JDCS) model, which highlights the combined effects of high job demands and low social support on workers' health. Although many studies have documented the high prevalence of WMSDs among nurses, few have examined ergonomic and psychosocial predictors together (11).

In Malaysia and Southeast Asia, there is limited integrated evidence exploring how physical workload interacts with psychosocial stressors such as low supervisory support, job demand, and organizational pressures. A local study reported that supervisor support significantly influenced nurses' musculoskeletal health, underscoring the need for multidimensional frameworks (12). However, no previous Malaysian research has concurrently analyzed ergonomic and psychosocial predictors within a single model. This study therefore fills this gap by integrating both factors to better understand their combined effects on WMSDs among nurses, offering new context-specific insights for prevention and policy development.

This study addresses the research gap by examining the prevalence of WMSDs among nurses and identifying both ergonomic and psychosocial predictors. It considers demographic factors, physical work characteristics, and psychosocial demands that influence musculoskeletal discomfort in a teaching hospital. By using a multidimensional approach, the study provides evidence to support integrated ergonomic and organizational strategies to reduce WMSDs and promote sustainable occupational health in nursing.

## 2. MATERIAL AND METHODS

### 2.1 Study Design

This study used a cross-sectional design to examine the prevalence of WMSDs and their ergonomic and psychosocial predictors among nurses. This design was appropriate as it allowed simultaneous assessment of exposures and health outcomes within a defined population at a specific point in time.

### 2.2 Study Settings and Population

The study was conducted at a tertiary teaching hospital in Kelantan, Malaysia, involving registered nurses working across various wards. Eligible participants were nurses with at least one year of clinical experience and currently engaged in ward-based duties. Nurses who were pregnant, had systemic or musculoskeletal conditions, or had previous musculoskeletal injuries were excluded to minimise confounding.

Although the target sample size was 66, the final number of respondents was 45, yielding a response rate of 81.8%. Several nurses were unavailable during the data collection period due to shift rotation, annual leave, or workload constraints, which limited participation despite multiple reminders. Nonetheless, the achieved sample size exceeded the minimum required (n = 42) based on a priori power analysis for logistic regression ($\alpha = 0.05$, power = 0.80, and medium effect size). Therefore, the final sample was considered adequate to ensure sufficient statistical power and representativeness across hospital wards.

### 2.3 Sampling Method

A stratified sampling was used to ensure proportional representation across hospital wards, followed by convenience sampling of eligible and consenting nurses. Using Kish's formula (1965) with prevalence estimates from previous studies, the minimum required sample was 55. Allowing for a 10% non-response rate, the final target sample size was set at 66.

### 2.4 Instrument

Data were collected using a structured, self-administered questionnaire. The instrument consisted of two parts:

i. Demographic, Ergonomic, and Psychosocial Factors: A set of self-developed items adapted from previous studies, covering sociodemographic data (age, gender, marital status, education, body mass index), work characteristics (manual handling, patient transfer, posture, repetitive tasks), and psychosocial factors (workload, job dissatisfaction, support from colleagues and supervisors).
ii. Work-Related Musculoskeletal Disorders: The Nordic Musculoskeletal Questionnaire (NMQ), a validated tool widely used in occupational health research, was adopted to assess the prevalence of musculoskeletal symptoms across nine anatomical regions (neck, shoulders, elbows, wrists/hands, upper back, lower back, hips/thighs, knees, and ankles/feet) over the previous 12 months.

A pilot study involving 20 nurses was conducted to assess reliability, yielding a Cronbach's alpha of 0.71, which indicated acceptable internal consistency.In addition, the questionnaire was reviewed by a panel of three occupational health and ergonomics experts to establish content and construct validity, ensuring the clarity, relevance, and comprehensiveness of each item before data collection.

### 2.5 Data Analysis

Data were coded and analyzed using Statistical Package for the Social Sciences (SPSS) version 27.0. Descriptive statistics (frequencies, percentages, means, and standard deviations) summarised demographics, WMSD prevalence, and risk factors. The outcome variable, the presence of WMSDs, was coded dichotomously ('Yes' if any symptom was reported in the past 12 months across any of the nine body regions; otherwise 'No'). Binary logistic regression was applied to identify

predictors while controlling for confounders, with adjusted odds ratios (AOR) and 95% confidence intervals (CI) reported. Statistical significance was set at $p<0.05$.

### 2.6 Ethical Considerations

Ethical approval was obtained from the Human Research Ethics Committee of Universiti Sains Malaysia (USM/JEPeM/151110517) with additional permission from the hospital administration. Participants were informed of the study objectives, assured of voluntary participation, and provided written consent. Confidentiality and anonymity were maintained, and all procedures followed the Declaration of Helsinki.

## 3. RESULTS AND DISCUSSION

### 3.1 Sociodemographic Characteristics

A total of 45 nurses participated in the study with a response rate of 81.8% (Table 1). The mean age was 32.2 years, and the average BMI was 26.3 kg/m², within the overweight range. Participants had an average of 9.4 years of employment, reflecting substantial work experience. Most were female (88.9%, n=40), married (71.1%, n=32), and over half (55.6%,n=25) had children. The majority (80.0%, n=36) worked in shifts, while 20.0% (n=9) had regular office hours. Nearly all (95.6%, n=43) undertook routine housework in addition to their professional duties. Regarding lifestyle, 20.0% (n= 9) exercised regularly, 55.6% (n=25) occasionally, and 24.4% (n=11) never exercised. Most respondents were non-smokers (95.6%, n=43) with only 4.4% (n=2) reporting a history of smoking.

### 3.2 Prevalence of Work-Related Musculoskeletal Disorders

More than half of the nurses reported experiencing WMSDs in the past 12 months, with the ankles/feet, neck, and lower back being most affected, followed by the upper back and shoulders (Figure 1). A global meta-analysis estimated the prevalence of WMSD among nurses at 77.2%, with the most common locations being the lower back (59.5%), neck (53.0%), and shoulders (46.8%) (5). Similarly, a meta-analysis of Asian nurses reported an even higher prevalence of 84.3%, with the same anatomical patterns (7). Prolonged standing has been highlighted as a key risk factor for ankle and foot disorders, with prevalence ranging from 21.2% to 55.3% across countries (13). In contrast, in Ethiopian hospitals, lower back pain remains the most prevalent complaint among nurses (14). These findings suggest that while the lower back is consistently vulnerable, the higher rates of ankle and foot discomfort among Malaysian nurses likely reflect cumulative biomechanical strain from prolonged standing, walking, and patient handling within local organizational and cultural contexts.

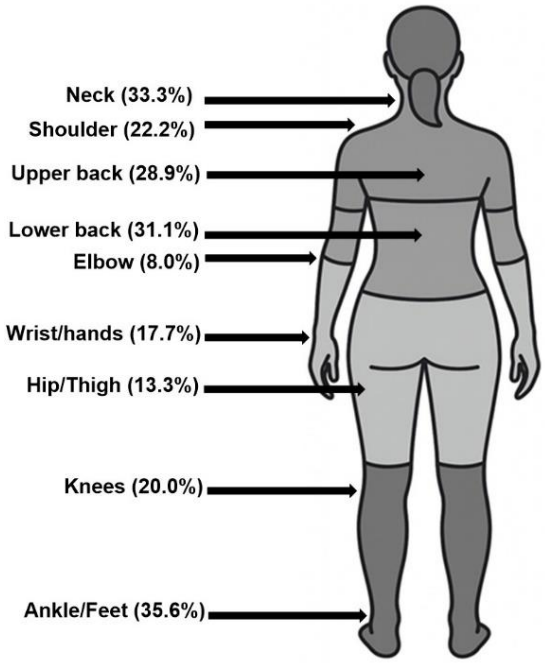


Figure 1. Prevalence of work-related musculoskeletal disorders by body region.

The high prevalence of ankle–foot discomfort observed in this study is in contrast with the previous findings where lower back pain is often reported as a musculoskeletal symptom. For instance, Sisala *et al.* (15) identified the lower back as the most affected region among nurses and midwives, reflecting the strain of static postures and physically demanding tasks. Similarly, a meta-analysis by Gorce and Jacquier-Bret among Asian nurses reported lower back pain at 58.5%, followed by the neck (45.9%) and shoulders (40.9%), confirming the dominance of back-related complaints in many settings

(7). However, in Malaysia, the higher prevalence of ankle–foot issues may be related to the prolonged standing and walking typical of nursing workflows. Matuszewska *et al.* (16) noted that extended weight-bearing and locomotion exert significant biomechanical stress on the lower limbs, making ankle and foot problems an emerging occupational health concern. These findings highlight that WMSD patterns vary by context and are shaped by organizational culture, hospital layout, staffing, and ergonomic resources. Preventive strategies should therefore be tailored to local conditions, addressing both spinal strain and the rising burden of lower limb discomfort among nurses.

### 3.3 Interplay Between Psychosocial and Ergonomics Risk Factors

As shown in Table 1, most respondents reported psychosocial risk factors, with demanding work activities (82.2%, n=37) and high workload (73.3%, n=33) being the most common. In contrast, only 15.6% (n=7) reported work dissatisfaction, suggesting that despite the heavy demands, overall dissatisfaction was relatively infrequent. However, low co-worker support (44.4%, n=20) and low managerial support (33.3%, n=15) were reported by many, indicating significant gaps in workplace social support.

Table 1. Prevalence of psychosocial risk factors among respondents (N=45).

| **Psychosocial Factors** | **(n, %)** |
|---|---|
| Demanding psychosocial work activities | 37 (82.2) |
| High perceived workload | 33 (73.3) |
| Work dissatisfaction | 7 (15.6) |
| Low co-worker support | 20 (44.4) |
| Low managerial support | 15 (33.3) |

These findings align with recent evidence. Barros and Baylina reported that high psychosocial risks, including heavy workloads, emotional strain, and limited organizational support, were strongly associated with WMSDs among nurses before and during the pandemic (17). Similarly, Bellacov *et al.* (18) found that work organization and extended shifts increased musculoskeletal pain, highlighting the combined effects of psychosocial and physical demands. Reviews by Wåhlin *et al.* (19) further emphasise the need to integrate ergonomic and psychosocial assessment as their interaction amplifies cumulative strain. The present study supports this view by demonstrating that WMSDs cannot be attributed solely to physical workload. Psychosocial stressors such as high job demands and low workplace support act synergistically with ergonomic risks, underscoring the need for comprehensive prevention strategies. Interventions that include psychosocial support, participatory ergonomics, and improved work scheduling are vital to safeguard nurses' musculoskeletal health and well-being.

### 3.4 Postural and Repetitive Strain Exposure

Figure 2 shows that nearly all nurses (100%) performed physically demanding tasks, such as walking and transferring patients between a bed and a chair. Similarly, 97.8% (n = 44) reported manual handling, bending, twisting, and standing for more than 30 minutes. Patient repositioning, assisting with toileting, and repetitive postures were also common (95.6%). Postural strain was evident in neck twisting (82.2%, n=37), flexion (71.7%, n = 32), and extension (57.8%, n = 26), while awkward postures, though less frequent (62.2%, n=28), remained significant. These findings are consistent with recent systematic reviews, which report high rates of WMSDs among nurses. A 2024 review found that low back pain (LBP) was the most common complaint, with a prevalence ranging from 32.5% to 87.5%, primarily linked to manual patient handling without the use of lifting aids (8). Similarly, another 2024 study reported high WMSD prevalence among nurses and midwives, again with the lower back most frequently affected (15). Ergonomic evaluations confirm the biomechanical stress involved in nursing tasks. Motion sensor analyses of patient-lifting activities revealed that the neck exceeded its load limit by 66%, the shoulder by 49%, and the elbow by 76%, demonstrating substantial strain on these joints (20).

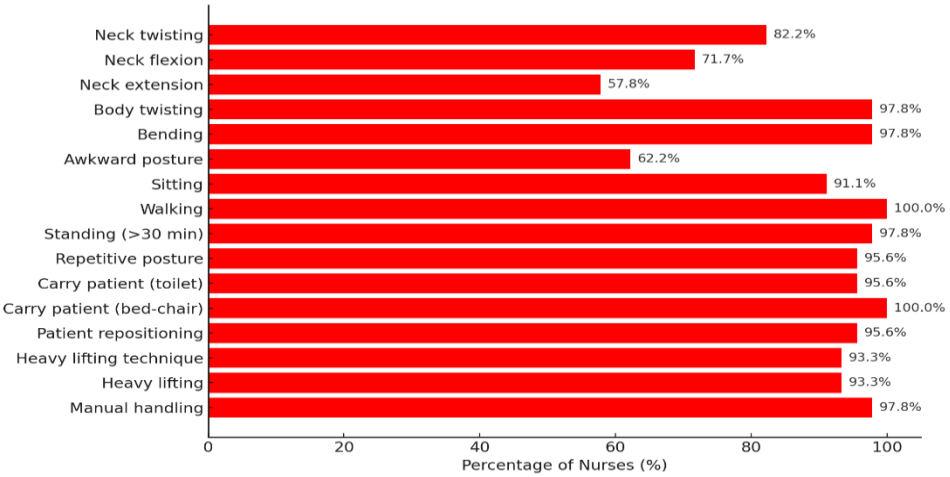


Figure 2. Work characteristics related to ergonomic and postural demand.

These results support the biomechanical load theory, which explains how physical stress applied repeatedly or continuously to the musculoskeletal system leads to micro-damage and eventual injury. According to this theory, muscles, tendons, and ligaments experience cumulative fatigue when exposed to repeated exertion, awkward postures, or prolonged static positions without sufficient recovery time. Over time, these small mechanical stresses accumulate, causing tissue inflammation, pain, and functional impairment. In nursing work, for example, frequent patient lifting, sustained neck flexion during documentation, and prolonged standing can progressively overload specific body regions such as the back, neck, and lower limbs which ultimately increased the risk of work-related musculoskeletal disorders (WMSDs).

### 3.5 Predictors of Work-Related Musculoskeletal Disorders

As shown in Table 2, logistic regression analysis identified several significant predictors of WMSDs. Female nurses were 6.48 times more likely to experience WMSDs than males (95% CI: 1.07–39.23; p = 0.042). Marital status was also significant, with married respondents showing higher odds of WMSDs than single nurses (95% CI: 1.07–24.40; p = 0.041). Similarly, nurses with children were 5.58 times more likely to report WMSDs compared to those without children (95% CI: 1.20–25.83; p = 0.028).

Table 2. Logistic regression analysis of predictors of WMSDs.

| Factors | Crude OR (95% CI) | p-value | AOR (95% CI) | p-value |
|---|---|---|---|---|
| Gender | | | | |
| Female | 7.20 (1.15-45.10) | 0.035* | 6.48 (1.07-39.23) | 0.042* |
| Male | | Reference | | |
| Marital Status | | | | |
| Married | 4.95 (1.12-21.82) | 0.034* | 5.11 (1.07 – 24.40) | 0.041* |
| Single | | Reference | | |
| Having Children | | | | |
| Yes | 5.40 (1.26 – 3.10) | 0.024* | 5.58 (1.20 – 25.83) | 0.028* |
| No | | Reference | | |
| Working hours | | | | |
| Shift | 3.25 (0.95 – 1.12) | 0.062 | 3.48 (0.90 -13.48) | 0.074 |
| Office | | Reference | | |
| Heavy lifting | | | | |
| Self | 6.70 (1.40-32.12) | 0.018* | 6.36 (1.31 – 32.80) | 0.022* |
| With help | | Reference | | |
| Repetitive patient handling | | | | |
| Yes | 4.25 (0.98 –18.44) | 0.056* | 4.43 (0.95 – 20.59) | 0.060 |
| No | | Reference | | |
| High workload | | | | |
| Yes | 5.20 (1.24 – 21.74) | 0.026* | 5.01 (1.17 – 21.42) | 0.030* |
| No | | Reference | | |

| | | | | |
|---|---|---|---|---|
| Low supervisory support | | | | |
| Yes | 4.85 (1.12 – 20.96) | 0.037* | 4.72 (1.04- 21.36) | 0.044* |
| No | Reference | | | |

OR = Odds Ratio; AOR = Adjusted Odds Ratio; CI = Confidence Interval
* Significant at $p<0.05$

Work-related exposures were also significant predictors of WMSDs. Nurses performing heavy lifting without assistance had a markedly higher risk (AOR = 6.36; 95% CI: 1.31–32.80; p = 0.022), while high workload (AOR = 5.01; 95% CI: 1.17–21.42; p = 0.030) and low supervisory support (AOR = 4.72; 95% CI: 1.04–21.36; p = 0.044) were also associated with increased odds. Although repetitive patient handling and shift work did not reach statistical significance, their elevated odds suggest clinical relevance. These results confirm the multifactorial nature of WMSDs, shaped by both demographic and occupational factors. Female nurses were particularly vulnerable, reflecting biological differences and heavier involvement in patient-handling tasks (6, 17). Marital status and childcare responsibilities further increased strain, consistent with Asian studies showing family-related duties exacerbate fatigue and hinder recovery (7, 21).

The strong association between heavy lifting and WMSDs supports the biomechanical load theory, which links high-load exertions with tissue fatigue and musculoskeletal damage. Similar findings were reported by Kgakge *et al.* (8) in Botswana, where 76.6% of nurses performing manual transfers experienced low back pain, and by Vinstrup *et al.* (9), who demonstrated spinal muscle strain during transfers using electromyography. Liu *et al.* (22) also confirmed that combined ergonomic stressors significantly increased the risk of WMSD across multiple body regions.

Psychosocial stressors, including high workload and low supervisory support, further interact with ergonomic demands, aligning with the Job Demand–Control–Support (JDCS) model. Kim and Jeong (23) found that nurses with shift schedules and limited recovery time reported greater pain and fatigue, while Oakman *et al.* (24) highlighted how high job demands and poor support increase musculoskeletal risk across occupations. Although repetitive tasks and shift work were not statistically significant in this study, prior systematic reviews have consistently shown their association with musculoskeletal discomfort, suggesting their importance in larger samples (5, 11).

These findings carry critical implications for occupational safety and health policy. Ergonomic strategies should include the use of assistive lifting devices, team-based handling, adequate staffing, and task-specific ergonomic training. Organizational measures must also address psychosocial risks by reducing workload, improving staff-to-patient ratios, and strengthening supervisory support. Enhancing workplace support not only reduces musculoskeletal risk but also improves job satisfaction and retention. Finally, WMSD prevention should be integrated into hospital policies through continuous health surveillance, routine risk assessments, and a supportive workplace culture. Integrated ergonomic and organizational interventions will be more effective than isolated approaches, protecting nurses' well-being, reducing absenteeism, and sustaining high-quality patient care.

This study highlights the high burden of WMSDs among nurses, particularly in the ankles/feet, neck, and lower back. Significant associations were found with ergonomic exposures, such as self-lifting and repetitive patient handling, as well as psychosocial strain, including heavy workload and low supervisory support. These findings confirm the multifactorial nature of WMSDs, shaped by demographic, ergonomic, and organizational factors. In line with international and regional evidence, the results show that risks are influenced not only by physical demands but also by psychosocial and organizational contexts. Therefore, comprehensive interventions that combine ergonomic measures (e.g., assistive devices, safe handling practices) with organizational strategies (e.g., workload management, adequate staffing, supportive leadership) are essential. Addressing these domains together can reduce WMSDs, enhance nurse well-being, improve patient care, and strengthen healthcare system resilience.

## 4. CONCLUSION

This study has several limitations that should be acknowledged. First, its cross-sectional design prevents causal interpretation of the associations identified between ergonomic and psychosocial factors and WMSDs. Second, the relatively small sample size and single-hospital setting may limit generalizability to other healthcare institutions. Third, the data were self-reported, which may introduce recall or response bias despite the use of a validated instrument. Future studies should consider larger, multi-center samples and longitudinal designs to confirm causal pathways and strengthen the evidence base for intervention strategies.

## AUTHORSHIP CONTRIBUTION STATEMENT

Nurul Izzah Abdul Samad: writing – review & editing, visualization. Nurfadzlina Deruis: methodology, data curation, investigation, formal analysis, writing - original draft. Nurhidayah Sabri: writing – review & editing, visualization. Nursuhaili Mohd Amin: writing – review & editing, visualization. Nurul Atikah Che Hasan: writing – review & editing, visualization. Nurul Ainun Hamzah: project administration, supervision, methodology, resources, advanced analysis, writing – final review & editing, validation, funding.

## DATA AVAILABILITY

Data are available on request.

## DECLARATION OF GENERATIVE AI

The use of AI tools to configure image figures is not a part of scientific writing.

## DECLARATION OF COMPETING INTEREST

There is no conflict of interest.

## ACKNOWLEDGMENT

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