

Determinants of Musculoskeletal Disorder Among Nurses

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ABSTRACT

Objective

To Identify the predictive determinants and associated factors of Musculoskeletal Disorders (MSDs) among nurses at Rumah Sakit Otak Dr. M. Hatta Bukittinggi.

Methods

This study employed a quantitative analytical approach with a cross-sectional design. Respondents were 110 nurses who were selected via proportional random sampling using a lottery methods. Data were collected using the validated Nordic Body Map (NBM) and NASA-TLX workload questionnaires. Bivariate analysis applied the Chi-Square test and variable with $p < 0.25$ were entered into a backward logistic regression for multivariate modelling, controlling for confounding variables.

Results

More than a half of the respondents (55.53%) experienced moderate MSDs. There is a significant associations between MSDs and age ($p=0.000$), gender ($p=0.014$), years of service ($p=0.001$), Body Mass Index (BMI) ($p=0.000$), and workload ($p=0.046$). Furthermore, age is the most dominant factor associated with MSDs ($\text{Exp(B)}=10.156$).

Conclusion

Age, BMI, and workloads are critical factors for occupational MSDs. Implementing targeted ergonomic protocols and tailored physical support for older clinical staff is essential to mitigate injury risks and ensure high-quality health service.



Background

Musculoskeletal disorders (MSDs) represent a leading cause of disability worldwide, affecting approximately 1.71 billions people and imposing a substantial burden on healthcare systems (Liu *et al.*, 2025). In Indonesia, MSDs affect 40.5% of the general workforce and reach symptoms-based prevalence of 24.7% among healthcare professionals (EL-Matary, Syahlan, & Baharuddin, 2026). Nursing is widely recognized as a high risk profession due to strenuous physical demands such as patient lifting, mobilization and monotonous working postures. Consequently the annual of MSDs among nurses reaches 73.8% predominantly affecting the lower back, neck and shoulders (Putri & Suwandi, 2018). The prevalence MSDs reaching 82.5% in Surabaya due to prolonging standing (Anggarani, 2022), 66% in Jakarta (Putu, Mustriwati, Atmaja, 2020) and showing significant escalation following night shifts in ICU settings (Putu, Mustriwati, Atmaja, 2020).

The presence of MSDs among nurses severely compromises the delivery of comprehensive and high quality nursing care. Pain and restricted physical mobility directly impede a nurse's ability to conduct through patient assessments, which poses a substantial risk of inaccurate data collection, flawed nursing diagnoses and ineffective intervention planning (Maliki *et al.*, 2024). Furthermore, physical discomfort and fatigue impair cognitive concentration during data analysis, thereby increasing the risk of clinical errors and reducing the accuracy of evaluating patients responses (Maliki *et al.*, 2024). These physical constraints limit the swift execution of essential nursing procedures, leading to delayed responses to patient needs, diminished patient comfort and a negative shifts in the patient's perception of healthcare service quality (Supardi, Winarti, & Suprajatno, 2022).

Beyond physical impairment, MSDs produce a multifaceted impact on nursing by affecting both psychological well-being and organizational functioning. The chronic pain and discomfort experienced by nurses with MSDs amplify mental workload, increasing the risk of occupational stress and burnout and ultimately reducing overall performance (Rahmawati, Pawestri, & Putra, 2024). From organizational perspective, MSDs significantly diminish work efficiency and lead to substantial work time loss due to absenteeism (Yanti *et al.*, 2024). This intersection of high mental workload and physical strain underscores the urgent need for hospital management to implement strategic, systemic adjustments to optimize the working conditions and roles of nursing staff (Yanti *et al.*, 2024).

Fostering a safer, more ergonomic and more productive work environment requires a comprehensive understanding of multi factorial drivers behind MSDs. Literature indicates that repetitive physical activities, non ergonomic postures and heavy lifting remain the primary external triggers (Meisya, 2024). However, the incidence and severity of MSDs are heavily moderated by a combination of individual and occupational factors (Supardi, Winarti, & Suprajatno, 2022). Specifically, nurses who are middle aged (35-65 years), female, has a service length of 5 years, have an BMI and face intense clinical workloads are significantly more predisposed to experiencing severe musculoskeletal (Lin *et al.*, 2020; Rahimna, 2023).

This risk heavily amplified a specialized institutions such as the hospitals. Nurses at the specialized facility consistently manage patients with profound mobility limitations and severe neurological impairments, demanding highly intensive labor during daily patients transfers and specialized mobilization procedures (Nobles *et al.*, 2024). These unique and demanding circumstances underscore the critical necessity for localized empirical research to isolate the precise determinants of occupational strain (Vinstrup *et al.*, 2024).

Rumah Sakit Otak Dr. M. Hatta Bukittinggi was a specialized referral hospital located in Bukittinggi City, West Sumatra Province, Indonesia, providing neurological and neurosurgical services, including inpatient care, emergency care, neurorehabilitation, and surgical services. Nurses working in inpatient wards, the emergency department, and the central operating theatre

are routinely involved in physically demanding activities such as patient handling, transferring and mobilizing dependent patients, prolonged standing, repetitive movements, and maintaining awkward working postures. Neurological patients frequently require intensive nursing care due to functional impairments and limited mobility, potentially increasing nurses' physical workload and risk of MSDs. Considering these workplace characteristics and occupational demands, investigating factors associated with MSDs among nurses in this setting is important for developing evidence-based preventive strategies and improving occupational health outcomes.

To identify the magnitude of this problem within the hospital, a preliminary observation of the 10 nurses who completed a screening questionnaire, seven reported musculoskeletal complaints, primarily involving the neck, wrists, buttocks, lower back, knees, and shoulders, while three reported no complaints. The reported symptoms were predominantly observed among female nurses, particularly those in the middle-adult age group, with at least five years of service and a Body Mass Index (BMI) above the normal range. These preliminary findings suggested that MSDs may represent an important occupational health concern in this hospital. However, study that systematically investigated the prevalence of MSDs and their associated risk factors among nurses is still limited. Therefore, the present study was conducted to provide baseline evidence for developing evidence-based ergonomic interventions and occupational health strategies to reduce the burden of MSDs among nurses. This study aim to analyze the predictive factors with MSDs among nurse at Rumah Sakit Otak Dr. M. Hatta Bukittinggi.

Methods

This study employed a quantitative analytical approach with a cross-sectional design, conducted at Dr. M. Hatta Brain Hospital Bukittinggi from June to July 2025. The research population comprised 152 nurses working in inpatient wards, the emergency department, and the central operating theatre. A minimum sample size of 110 respondents was determined using the Slovin formula with a 5% margin of error and selected through proportional random sampling to ensure representation from each work unit (Creswell & Creswell, 2023).

Inclusion criteria included active nurses in the specified units who consented to participate, while exclusion criteria involved nurses on leave or those with a prior medical diagnosis of chronic disease or musculoskeletal injuries. Nurses who were on any form of leave during the data collection period (e.g., annual leave, maternity leave, or sick leave) were excluded from the study because they were not actively involved in clinical duties and therefore did not have current exposure to workplace conditions relevant to the study variables. In addition, nurses with a prior medical diagnosis of chronic disease or musculoskeletal injuries were excluded to minimize potential confounding factors that could influence the occurrence of MSDs independently of workplace-related exposures.

Data were collected using three instruments. First, a demographic questionnaire was used to record age, gender, and length of service. BMI was calculated based on self-reported body weight and height provided by respondents using the standard formula (weight in kilograms divided by height in meters squared, kg/m^2) and was categorized into five groups: severely underweight ($<17 \text{ kg/m}^2$), underweight ($17\text{--}<18.5 \text{ kg/m}^2$), normal ($18.5\text{--}25 \text{ kg/m}^2$), overweight ($>25\text{--}27 \text{ kg/m}^2$), and obese ($>27 \text{ kg/m}^2$). These categories were adopted from established BMI classification criteria commonly used in Indonesia and Asian populations to classify nutritional status and health risk profiles. The categorization was applied to allow more detailed assessment of the potential association between different nutritional status categories and MSDs (Hartati & Isaura, 2023).

Length of Service was categorized into two groups (≤ 5 years and >5 years) to differentiate shorter and longer occupational exposure periods. The cut-off point was selected to distinguish nurses with relatively limited work exposure from those with prolonged cumulative exposure

to occupational risk factors. Longer employment duration may increase exposure to repetitive activities, prolonged standing, physical workload, and awkward working postures, which are recognized contributors to MSDs (Weale *et al.*, 2022).

Second, the Nordic Body Map (NBM), developed by Kuorinka *et al.* (1987) was used to assess musculoskeletal complaints across 28 body regions. Each item was rated on a 4-point Likert scale ranging from “no pain” (1) to “very painful” (4). The total score ranges from 28 to 112 and is categorized into low (28–49), medium (50–70), high (71–91), and very high (92–112). The categorization was based on the scoring interpretation of the NBM questionnaire, which is commonly used to classify the severity level of musculoskeletal complaints according to the total score obtained by respondents. The NBM demonstrated acceptable validity, with item validity coefficients ranging from 0.632 to 0.982, indicating that all items met the acceptable validity criteria and reliability with a reported Cronbach’s alpha of 0.810 (Kuorinka *et al.*, 1987). The Indonesian version of the questionnaire had previously undergone validity and reliability testing, with item validity coefficients ranging from 0.387 to 0.792 indicating that all items met the acceptable validity criteria and a reliability coefficient of 0.919 (Dewi, 2020).

Third, the NASA Task Load Index (NASA-TLX), developed by Hart and Staveland (1988), was used to measure subjective workload. The instrument consists of six items representing six dimensions: mental demand, physical demand, temporal demand, performance, effort, and frustration level. The instrument was completed in two stages: (1) paired comparisons to determine the relative weight of each dimension and (2) rating each dimension on a scale from 0 to 100 (Hart & Staveland, 1988). The instrument was completed in two stages: (1) paired comparisons to determine the relative weight of each dimension, and (2) rating each dimension on a scale from 0 to 100. The final workload score was calculated by multiplying each rating by its corresponding weight, summing the weighted scores, and dividing by 15. The resulting score was categorized as low (0–9), medium (10–29), somewhat high (30–49), high (50–79), and very high (80–100). The NASA-TLX has demonstrated good validity with a reported value of 0.873 to 0.976 and reliability with a reported Cronbach’s alpha of 0.814 (Hart & Staveland, 1988). The Indonesian-language questionnaire had previously undergone validity and reliability testing, with a validity value of 0.779 to 0.873 and a reliability coefficient of 0.833 (Prawatya *et al.*, 2023).

Data analysis included univariate analysis for frequency distributions, bivariate analysis using the Chi-square test, and multivariable logistic regression analysis. Variables with a p-value < 0.25 in the bivariate analysis were selected as candidates for inclusion in the multivariable model using the backward likelihood ratio (Backward LR) method. Prior to model building, multicollinearity among independent variables was assessed using Variance Inflation Factor (VIF) and tolerance statistics. No evidence of multicollinearity was observed. Model fitness was evaluated using the Hosmer–Lemeshow goodness-of-fit test. Statistical significance was established at $p < 0.05$, and results were reported as odds ratios (ORs) with 95% confidence intervals (CIs). This study obtained ethical clearance from the Research Ethics Committee of Dr. M. Hatta Brain Hospital Bukittinggi with approval No: 003843/KEP.RSOMHBUKITTINGGI/2025. All procedures adhered to ethical principles, including informed consent, confidentiality, and voluntary participation.

Results

Based on Table 1, the data reveal that the majority of respondents (60.00%) are in the middle-adulthood category (35–65 years). Regarding gender, nearly all participants are female (87.30%), and a significant majority have a Length of Services more than or equal to five years (71.80%). Furthermore, most respondents possess a normal BMI (59.16%), while nearly all report experiencing a high workload (77.30%). In terms of severity, the MSDs reported by respondents are classified only into mild (44.50%) and moderate (55.50%) categories. These findings indicate that the majority of nurses experience moderate-level MSDs.

Table 1. Frequency Distribution of Age, Gender, Length Of Services, BMI, Workload, and MSDs (n=110)

Respondents Characteristics	<i>f</i>	%
Age		
Early Adulthood (20-34)	44	40.00
Middle Adulthood (35-65)	66	60.00
Gender		
Male	14	12.70
Female	96	87.30
Length of Services		
<5 Years	31	28.20
≥5 years	79	71.80
BMI		
Severely Underweight (<17)	0	0
Underweight (17- <18,5)	0	0
Normal (18,5- 25)	65	59.10
Overweight (>25- 27)	22	20.00
Obese (>27)	23	20.90
Workload		
Low (0-9)	0	0
Moderate (10-29)	25	22.70
Moderately High (30-49)	0	0
High (50-79)	85	77.30
Very High (80-100)	0	0
MSDs		
Mild (28-49)	49	44.50
Moderate (50-70)	61	55.50
High (71-91)	0	0
Very High (92-112)	0	0

Table 2 shows that age, gender, length of service, BMI, and workload were significantly associated with MSDs among nurses ($p < 0.05$). Middle-aged nurses (35–65 years) were more likely to experience moderate MSDs complaints (74.13%) compared with early-adult nurses (20–34 years), who predominantly reported mild complaints (72.75%) ($p < 0.001$). Female nurses showed a higher prevalence of moderate MSDs complaints (60.38%) than male nurses (21.34%) ($p = 0.014$). Nurses with a length of service of ≥ 5 years were more likely to experience moderate complaints (65.8%), whereas those with < 5 years of service predominantly reported mild complaints (71.09%) ($p = 0.001$). Regarding BMI, most obese nurses experienced moderate MSDs complaints (87.0%), while nurses with normal BMI more frequently reported mild complaints (61.58%) ($p < 0.001$). Furthermore, nurses with a high workload had a greater proportion of moderate MSDs complaints (61.17%) compared with those with a moderate workload (38.83%) ($p = 0.046$).

In the initial multivariate stage, a bivariate selection process was conducted, which identified five variables meeting the criteria $p < 0,25$ inclusion in the multivariate mode, age ($p = 0,000$), gender ($p = 0,014$), Length Of Services ($p = 0,001$), BMI ($p = 0,000$), and workload ($p = 0,046$). In

Table 2. Bivariate Analysis of Factors Associated with MSDs among Nurses at Rumah Sakit Otak DR. Drs. M. Hatta Bukittinggi

Variable	Category	MSDs Mild (%)	MSDs Moderate n (%)	Total n (%)	p-value
Age	Early Adulthood (20-34)	32 (72.75)	12 (27.25)	44 (100)	<0.001
	Middle Adulthood (35-65)	17 (25.87)	49 (74.13)	66 (100)	
Gender	Male	11 (78.66)	3 (21.34)	14 (100)	0.014
	Female	38 (39.62)	58 (60.38)	96 (100)	
Length of Services	< 5 years	22 (71.09)	9 (28.91)	31 (100)	0.001
	≥ 5 years	27 (34.27)	52 (65.73)	79 (100)	
BMI	Normal	40 (61.58)	25 (38.42)	65 (100)	<0.001
	Overweight	6 (27.31)	16 (72.69)	22 (100)	
	Obese	3 (13.04)	20 (86.96)	23 (100)	
Workload	Moderate	16 (64.02)	9 (35.98)	25 (100)	0.046
	high	33 (38.83)	52 (61.17)	85 (100)	

Table 3. Final Multivariate Model of Factors Associated with MSDs

Independent Variable	Unstandardized Coefficient (B)	p-value	Exp (B)
Age	2.318	0.000	10.156
BMI	1.375	0.000	3.956
Workload	1.252	0.036	3496

the first modeling stage, two variables were found to have $p > 0,05$ which is gender ($p = 0,207$) and workload ($p = 0,830$), were subsequently excluded from the model. The three remaining influential variables included age ($p = 0,002$; $\text{Exp}(B) = 10,028$), BMI ($p = 0,000$; $\text{Exp}(B) = 3,916$), and workload ($p = 0,047$; $\text{Exp}(B) = 3,357$). Subsequently, in the second modeling stage, the analysis revealed that all remaining variables were statistically significant with $p < 0,05$, which is age ($p = 0,000$; $\text{Exp}(B) = 8,969$), BMI ($p = 0,000$; $\text{Exp}(B) = 3,880$), and workload ($p = 0,047$; $\text{Exp}(B) = 3,327$), no further variables were removed from the model.

Based on the modeling in Table 3, the final model identifies three significant variables: age ($p = 0,000$; $\text{Exp}(B) = 10,156$), BMI ($p = 0,000$; $\text{Exp}(B) = 3,956$), and workload ($p = 0,036$; $\text{Exp}(B) = 3,496$). The highest $\text{Exp}(B)$ values found in the age variable, indicating that nurses aged 35–65 years have a 10-fold higher risk of experiencing MSDs compared to those aged 20–34 years. Consequently, age is the most dominant factor associated with the incidence of MSDs among nurses at Rumah Sakit Otak DR. Drs. M. Hatta Bukittinggi in 2025.

Discussion

This study found that 55.53% of nurses experienced moderate MSDs, indicating that MSDs remain a considerable occupational health problem among nurses at Dr. M. Hatta Brain Hospital Bukittinggi. Nursing activities frequently involve repetitive movements, prolonged standing, awkward body postures, and manual patient handling, all of which increase biomechanical stress on the musculoskeletal system (Tamboosi, Tamboosi, & Tamboosi, 2025). In neurological care

settings, the physical demands can be greater because patients frequently require assistance with mobility, repositioning, transferring, and activities of daily living (Vinstrup *et al.*, 2024). Such work conditions may contribute substantially to the development of musculoskeletal complaints. Such conditions may substantially contribute to musculoskeletal complaints among nurses. This finding corroborates previous evidence that identifies nurses as one of the occupations most susceptible to MSDs, largely owing to prolonged exposure to physical demands and unfavorable ergonomic conditions (Sepehrian, Hasjin, & Farahmandnia, 2024).

The present study demonstrated a significant association between age and MSDs ($p=0.000$), and age emerged as the strongest predictor in both bivariate and multivariate analyses. Nurses in the middle-adult age group had approximately ten times greater odds of experiencing MSDs than younger nurses. This finding is consistent with previous studies reporting that increasing age is associated with progressive declines in muscle and joint elasticity, reduced regenerative capacity, lower muscle strength, and degenerative changes in connective tissues (Nobles *et al.*, 2024). Further explained that age-related reductions in muscle mass, bone strength, and tissue resilience increase vulnerability to work-related musculoskeletal injuries. As individuals age, cumulative physiological deterioration may reduce the ability to tolerate prolonged physical demands, making older nurses more susceptible to musculoskeletal complaints. In neurological nursing settings, these age-related changes may be more evident because nurses frequently manage patients requiring intensive physical assistance (Nayak, Das, & Swain, 2026).

The findings also showed a significant association between gender and MSDs ($p=0.014$) in the bivariate analysis. Female nurses were more likely to experience musculoskeletal complaints than male nurses. This finding corroborates previous evidence indicating that sex-related physiological differences, including lower muscle mass, diminished physical strength, and hormonal influences, may contribute to the greater susceptibility of female workers to musculoskeletal disorders (Mwebaze *et al.*, 2025). Female nurses may also experience greater physical strain during repetitive patient-care activities because of differences in body composition and biomechanical capacity (Hudson *et al.*, 2023). However, gender was not retained as an independent predictor in the multivariate model, suggesting that its influence may overlap with other factors such as age, BMI, and workload.

A significant association was also found between years of service and MSDs ($p=0.001$). Nurses with longer work experience were more likely to experience MSDs. This finding may be explained by prolonged cumulative exposure to occupational stressors, including repetitive physical activities, awkward postures, and manual handling tasks. Previous studies have shown that long-term exposure to physical demands can gradually increase biomechanical stress and accelerate musculoskeletal deterioration (Amiri, 2022). Similarly, Aulianingrum (2022) reported that prolonged occupational exposure may increase susceptibility to MSDs over time. However, years of service did not remain significant in the multivariate analysis, possibly because its effect overlaps with age-related physiological changes and cumulative occupational exposure.

BMI showed a significant association with MSDs ($p=0.000$) and remained an independent predictor in the final model. Nurses with higher BMI were more likely to report musculoskeletal complaints than those with normal BMI. This finding supports previous research demonstrating that excessive body weight increases biomechanical loading on joints, the spine, and supporting muscles, thereby elevating the risk of musculoskeletal pain and functional impairment (Putri & Suwandi, 2018). Increased body weight places additional stress on weight-bearing structures such as the lower back, knees, hips, and ankles, which may accelerate tissue degeneration and contribute to chronic pain (Vincent *et al.*, 2012). Furthermore, obesity may reduce physical endurance and mobility, increasing vulnerability to occupational strain and injury (Marras, 2006). Therefore, maintaining a healthy body weight should be considered an important component of occupational health promotion among nurses (Foncubierta-Rodríguez, Poza-Méndez, & Holgado-Herrero,

2024).

The study also identified a significant association between workload and MSDs ($p=0.046$), with workload remaining a significant predictor in the multivariate model. Heavy workloads can increase physical and psychological demands, leading to muscle fatigue, repetitive strain, and prolonged exposure to non-ergonomic working positions (Liu *et al.*, 2025). Excessive workloads may additionally reduce opportunities for adequate rest and recovery during work shifts, thereby worsening musculoskeletal symptoms (Faqih, Febiyani, & Munang, 2025). Previous studies have shown that physically demanding activities such as patient lifting, prolonged standing, bending, and transferring patients substantially increase mechanical stress on muscles and joints. These mechanisms are especially relevant in neurological care settings where patients often require extensive physical assistance. These mechanisms are particularly relevant in neurological care settings, where patients frequently require extensive physical assistance. High workloads combined with staffing shortages and complex nursing interventions may further increase the risk of unsafe body mechanics and repetitive movements (Hawke, 2025). Therefore, effective workload management should be considered an important strategy to reduce MSDs risk and improve nurses' well-being (Kang *et al.*, 2025).

The findings of this study have important implications for nursing management and occupational health practice. Hospital administrators should implement ergonomic interventions to reduce physical strain during patient care activities (Serumena, Suhendi, & Haqa, 2026). Such interventions may include ergonomic training, safe patient-handling protocols, provision of assistive equipment, and routine workplace ergonomic assessments (Serumena, Suhendi, & Haqa, 2026). Workload management strategies, including adequate staffing, balanced shift scheduling, and task redistribution, should also be considered. Furthermore, regular occupational health screening and health promotion programs focusing on weight management and physical fitness may help identify high-risk individuals and reduce the burden of MSDs among nurses (Sontis *et al.*, 2025). These findings highlight the importance of implementing preventive strategies, including workload management, ergonomic interventions, and targeted occupational health programs for high-risk groups, to reduce the burden of MSDs in nursing practice. Overall, this study demonstrates that MSDs among nurses are influenced by a combination of individual and occupational factors, with age, BMI, and workload representing the most important determinants. These findings emphasize the multifactorial nature of MSDs and highlight the importance of ergonomic improvements, workload optimization, and occupational health promotion programs to improve nurse health, safety, and productivity.

Several limitations should be acknowledged. First, the cross-sectional design limits the ability to establish causal relationships between risk factors and MSDs occurrence. Second, the use of self-reported questionnaires may introduce recall bias and subjective interpretation. Third, the study was conducted in a single neurological hospital, which may limit the generalizability of the findings to other healthcare settings. Additionally, several potentially relevant factors, including psychosocial stress, ergonomic assessments, and physical activity outside work, were not evaluated. Future studies using longitudinal designs and involving multiple healthcare institutions are recommended to better understand the long-term effects and causal pathways of occupational risk factors on musculoskeletal health among nurses.

Conclusion

In conclusion, this study found that age, gender, length of service, BMI, and workload were significantly associated with MSDs among nurses at Rumah Sakit Otak DR. Drs. M. Hatta Bukittinggi, with age identified as the strongest predictor. These findings highlight the importance of ergonomic interventions, workload management, and occupational health programs to reduce

MSDs risk and improve nurses' well-being. Hospitals can implement these findings by developing comprehensive MSDs prevention programs, including ergonomic risk assessments, safe patient-handling training, optimized staffing allocation, work rotation systems, routine screening for high-risk nurses, and provision of ergonomic assistive devices. Integrating these strategies into occupational health policies may help create a safer work environment and sustainably improve nurses' health and performance.

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