

RISK FACTORS FOR MUSCULOSKELETAL COMPLAINTS AMONG NURSES AT AZ-ZAHRA GENERAL HOSPITAL, KALIREJO, CENTRAL LAMPUNG

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ABSTRAK

Keluhan muskuloskeletal merupakan masalah kesehatan kerja yang sering dialami perawat karena pekerjaannya melibatkan aktivitas fisik, postur kerja tidak ergonomis, dan jam kerja yang panjang. Penelitian ini bertujuan menganalisis hubungan usia, jenis kelamin, dan lama kerja per hari dengan keluhan muskuloskeletal pada perawat di Rumah Sakit Umum Az-Zahra Kalirejo, Lampung Tengah. Penelitian kuantitatif dengan desain cross-sectional ini melibatkan seluruh 68 perawat melalui total sampling. Data dikumpulkan dengan kuesioner karakteristik responden dan Nordic Body Map, lalu dianalisis menggunakan uji Chi-Square dan Prevalence Ratio (PR). Sebanyak 22 perawat (32,4%) mengalami keluhan muskuloskeletal. Usia ($p=0,765$; $PR=1,125$; IK 95% 0,534–2,368) dan jenis kelamin ($p=0,712$; $PR=0,877$; IK 95% 0,434–1,770) tidak berhubungan dengan keluhan muskuloskeletal. Lama kerja per hari berhubungan signifikan dengan keluhan muskuloskeletal ($p<0,001$): keluhan dialami 44,9% perawat yang bekerja lebih dari 8 jam per hari, sedangkan tidak ada perawat dengan lama kerja ≤ 8 jam per hari yang mengalami keluhan. Lama kerja per hari perlu diperhatikan dalam pencegahan keluhan muskuloskeletal melalui pengaturan jadwal kerja, waktu istirahat yang memadai, dan penerapan prinsip ergonomi, meskipun desain cross-sectional belum dapat menunjukkan hubungan sebab-akibat.

ABSTRACT

Musculoskeletal complaints are a common occupational health problem among nurses because their work involves physical activity, non-ergonomic postures, and long working hours. This study aimed to analyze the association of age, gender, and daily working hours with musculoskeletal complaints among nurses at Az-Zahra Kalirejo General Hospital, Central Lampung. This quantitative cross-sectional study involved all 68 nurses through total sampling. Data were collected using a respondent characteristics questionnaire and the Nordic Body Map, then analyzed using the Chi-Square test and Prevalence Ratio (PR). Twenty-two nurses (32.4%) experienced musculoskeletal complaints. Age ($p=0.765$; $PR=1.125$; 95% CI 0.534–2.368) and gender ($p=0.712$; $PR=0.877$; 95% CI 0.434–1.770) were not associated with musculoskeletal complaints. Daily working hours were significantly associated with musculoskeletal complaints ($p<0.001$): complaints were reported by 44.9% of nurses working more than 8 hours per day, whereas none of the nurses working ≤ 8 hours per day reported complaints. Daily working hours should be considered in preventing musculoskeletal complaints through work scheduling, adequate rest breaks, and ergonomic practices, although the cross-sectional design cannot establish a causal relationship.



INTRODUCTION

Musculoskeletal disorders (MSDs) are common occupational health issues across various worker groups, manifesting as pain, stiffness, limited range of motion, and reduced work capacity affecting muscles, tendons, ligaments, joints, bones, and other musculoskeletal structures (Liu et al., 2022). Globally, the burden of MSDs is substantial; in 2020–2021, they were estimated to affect approximately 1.63–1.69 billion people worldwide, while in Southeast Asia, the number of prevalent cases was estimated at around 124.7 million in 2021. Lower back pain and neck pain are major contributors to the burden of musculoskeletal disability (Gill et al., 2023).

In Indonesia, musculoskeletal complaints remain an occupational health issue requiring attention. Prevalence rates stand at approximately 11.9% based on diagnoses by healthcare professionals and 24.7% based on symptoms or diagnoses. Furthermore, a significant prevalence of moderate-to-severe MSD symptoms has been reported among the working population, including those in the formal and informal sectors as well as healthcare services (Surya & Handayani, 2025). Various studies in Indonesia indicate that these complaints are particularly prevalent in specific occupational groups affecting, for instance, approximately 75% of nurses and caregivers and 80% of street vendors, with high rates also observed among farmers and production workers thereby establishing MSDs as a widespread and persistent occupational health burden across diverse types of employment (Maznah, 2025).

Nurses constitute a group of healthcare workers at high risk of developing musculoskeletal complaints because their work involves extensive physical activity, such as lifting, transferring, and repositioning patients; maintaining awkward or stooped postures; standing for prolonged periods; and performing repetitive movements during daily care activities (Krishnanmoorthy et al., 2025). These activities increase the biomechanical load on the body and are most frequently associated with complaints involving the lower back, neck, shoulders, and wrists or hands, the areas reported to be the most commonly affected among nurses (Sun et al., 2023). Sustained physical workloads including maintaining static postures, bending or twisting, and a lack of rest breaks, tend to cause prolonged muscle contraction and muscle fatigue, ultimately increasing the likelihood of musculoskeletal disorders among nurses (Mohammed et al., 2024).

Musculoskeletal complaints among nurses are influenced by both individual and occupational factors; age and gender are frequently associated with an increase in such complaints, while the most consistent work-related factors include longer tenure, awkward or stooped working postures, repetitive movements, and activities involving lifting or transferring patients (Wang et al., 2024). Advancing age tends to increase risk due to the associated decline in muscle mass, muscle function, and the structural resilience of components such as intervertebral discs, although not all studies have found a significant link between age and these complaints across all nursing settings (Shomy et al., 2026). Meanwhile, long tenure and high levels of daily occupational exposure tend to prolong the accumulation of biomechanical loads and muscle fatigue, particularly when accompanied by prolonged standing, bending or twisting of the torso, and repetitive lifting of loads or patients (Tang et al., 2022).

Musculoskeletal complaints among nurses have a tangible impact on health and work performance; persistent pain can impair quality of life, reduce physical capability and work efficiency, and lead to activity limitations, absenteeism, and changes in duties or employment, ultimately potentially compromising the quality and safety of patient care (Krishnan et al., 2021). Therefore, identifying risk factors among nurses specifically physical workload, awkward postures, repetitive movements, patient lifting, long working hours, fatigue, and unsafe work environments is crucial for developing preventive measures, ergonomic improvements, and occupational health risk controls (Widiyanto et al., 2022).

A preliminary survey conducted at Az-Zahra Kalirejo General Hospital in Central Lampung revealed that, out of ten workers interviewed, seven (70%) had experienced musculoskeletal complaints within the past week. These complaints were primarily reported in the lower back, neck, shoulders, and wrists. The majority of workers reporting complaints were aged 35 to 50, with women predominating. Furthermore, some worked more than eight hours a day and engaged in activities such as prolonged standing, bending, and lifting or transferring patients.

Previous studies have identified various factors associated with musculoskeletal complaints among other worker groups, such as port laborers and warehouse porters (Jatmika et al., 2022; Indah et al., 2025). However, research specifically analyzing age, gender, and daily working hours as risk factors for musculoskeletal complaints among nurses at Az-Zahra Kalirejo General Hospital in Central Lampung remains limited. Since working conditions, nursing staff characteristics, and service patterns vary across hospitals, findings from other locations do not necessarily reflect the situation at this specific hospital. This gap forms the basis of the present study. The study's novelty lies in its focused analysis

of three risk factors, namely age, gender, and daily working hours, among the nursing population at Az-Zahra Kalirejo General Hospital, based on conditions as they stood in 2026.

Given the high proportion of complaints identified in the pre-survey, along with individual and occupational factors that potentially increase risk, further research is needed to understand the relationship between these factors and musculoskeletal complaints among nurses. The study findings are expected to serve as a basis for hospitals to develop occupational health programs, organize work schedules, and implement preventive measures against musculoskeletal disorders among nursing staff. This study aims to determine the risk factors, specifically age, gender, and daily working hours, associated with the occurrence of musculoskeletal complaints among nurses at Az-Zahra Kalirejo General Hospital, Central Lampung, in 2026.

METHODS

This study employed a quantitative approach with an analytical survey design and a *cross-sectional* method. The research was conducted from July 13 to 17, 2026, at Az-Zahra Kalirejo General Hospital in Central Lampung, covering the Emergency Department, ICU, inpatient wards, and outpatient clinics. The study population consisted of all 68 nurses working at the hospital. The minimum sample size calculated with the Slovin formula at a 5% margin of error was 59 respondents, but because the population was small and all nurses could be reached, total sampling was used. Inclusion criteria were nurses actively working at the hospital during the study period, willing to participate and sign informed consent, and able to complete the questionnaire independently. Nurses who were on leave, sick, or not on duty during data collection, who declined to participate, or who returned incomplete questionnaires were excluded. All 68 nurses met the criteria and were included as respondents. The independent variables were age, gender, and daily working hours, and the dependent variable was musculoskeletal complaints.

Data were collected using a respondent characteristics questionnaire and the *Nordic Body Map* (NBM), which identifies complaints such as pain, soreness, tingling, stiffness, or discomfort experienced after work activities in 28 body parts. Each body part was rated on a four-level scale ranging from no complaint to severe complaint, and the total NBM score was categorized as “no musculoskeletal complaints” (scores 0–20) or “presence of musculoskeletal complaints” (scores 21–84). The NBM was used without modification, so its validity and reliability were not re-tested in this study. Age was categorized as “at-risk” (≥ 35 years) or “not at-risk” (< 35 years), gender as male or female, and daily working hours

as >8 hours or ≤8 hours per day. The researcher distributed the questionnaires after explaining the study's objectives and procedures, and respondents completed them independently after signing informed consent, with the researcher clarifying questions when needed. Respondents' names were replaced with codes to maintain confidentiality.

The collected data underwent editing, coding, entry, and cleaning processes before being analyzed using IBM SPSS Statistics version 24. Univariate analysis was used to describe the frequency distribution and percentage of each study variable. Subsequently, bivariate analysis was performed using the Chi-Square test to determine the relationship between age, gender, and working hours and the occurrence of musculoskeletal complaints. The level of statistical significance was set at $\alpha=0.05$ with a 95% confidence level. A p-value <0.05 was interpreted as indicating a statistically significant association between the independent variable and musculoskeletal complaints. The prevalence of complaints in each group was also assessed using the Prevalence Ratio (PR) and 95% confidence interval (CI).

RESULTS AND DISCUSSION

Table 1. Respondent characteristics (n=68)

Characteristics	n	%
Age		
<35 years	51	75.0
≥35 years	17	25.0
Gender		
Male	30	44.1
Female	38	55.9
Work Duration		
>8 hours	49	72.1
≤8 hours	19	27.9
Musculoskeletal Complaints		
None	46	67.6
Any	22	32.4

Based on the study results involving 68 nurses, the majority of respondents were under 35 years of age (n=51; 75.0%), female (n=38; 55.9%), and worked more than 8 hours per day (n=49; 72.1%). Twenty-two respondents (32.4%) reported musculoskeletal complaints, while 46 (67.6%) did not. These findings indicate that, although the majority of nurses did not experience musculoskeletal complaints, the proportion of those who did remains considerable. The prevalence of nurses working more than 8 hours daily also suggests relatively high occupational exposure; therefore, the factor of work duration warrants attention in further analysis regarding the incidence of musculoskeletal complaints (**Table 1**).

Table 2. Risk factors for musculoskeletal complaints among nurses (n=68)

Variable	Musculoskeletal Complaints				p-value	PR	95% CI Lower-Upper
	Complaint		No Complaints				
	n	%	n	%			
Age							
≥35 years	6	35.3	11	64.7	0.765	1.125	0.534–2.368
<35 years	16	31.4	35	68.6			
Gender							
Male	9	30.0	21	70.0	0.712	0.877	0.434–1.770
Female	13	34.2	25	65.8			
Work Duration							
>8 hours	22	44.9	27	55.1	<0.001	1.815	1.410–2.337
≤8 hours	0	0.0	19	100.0			

*Chi-Square test. PR for age and gender compares the prevalence of complaints in the first category with that in the second. For work duration, no complaints occurred among nurses working ≤8 hours; the PR shown is the ratio of the prevalence of no complaints among nurses working ≤8 hours to that among nurses working >8 hours.

Age and gender showed no significant association with musculoskeletal complaints among nurses. Complaints were more frequent among respondents aged ≥35 years (35.3%) than among those aged <35 years (31.4%), but the association was not statistically significant (p=0.765; PR=1.125; 95% CI 0.534–2.368). The prevalence of complaints was also higher among females (34.2%) than males (30.0%), yet the difference was not significant (p=0.712; PR=0.877; 95% CI 0.434–1.770). In contrast, duration of work showed a significant association with musculoskeletal complaints (p<0.001). Complaints were reported by 44.9% of nurses working >8 hours per day, whereas no complaints were found among nurses working ≤8 hours per day. Because of this zero cell, the PR for having complaints could not be estimated; the PR of 1.815 (95% CI 1.410–2.337) refers to the prevalence of having no complaints among nurses working ≤8 hours relative to those working >8 hours (**Table 2**).

The study results indicate that 22 out of 68 nurses (32.4%) experienced musculoskeletal complaints. Although the majority of respondents did not report such issues, this proportion warrants attention, as nearly one-third of the nurses reported musculoskeletal system disorders. Musculoskeletal complaints among nurses are associated with physical work demands, such as prolonged standing, walking, bending or twisting the torso, maintaining static postures, and lifting, moving, or assisting with patient mobilization. These factors are frequently cited as primary exposures that increase the risk of pain, particularly in the lower back and extremities (Kim & Jeong, 2024). Repeated exposure to these activities tends to increase the biomechanical load on muscles and joints during work, especially during manual patient handling, awkward postures, and patient transfer or repositioning tasks (Johnson et al., 2023).

Analysis results show no significant association between age and musculoskeletal complaints among the nurses ($p=0.765$). A Prevalence Ratio (PR) of 1.125 (95% CI: 0.534–2.368) indicates that nurses aged ≥ 35 years had a complaint prevalence 1.125 times that of nurses aged <35 years; however, this association was not statistically significant. Theoretically, advancing age can be accompanied by a decline in tissue elasticity, muscle strength, and the body's recovery capacity (Maharani et al., 2026). Nevertheless, the findings of this study suggest that age is not the primary determinant of musculoskeletal complaints among the study respondents.

The absence of an association between age and musculoskeletal complaints may be influenced by sample characteristics, specifically the predominance of the <35 age group, which constituted 75.0% of all respondents. Furthermore, musculoskeletal complaints are multifactorial in nature and can be influenced by factors such as work posture, physical activity, workload, repetitive movements, and ergonomic conditions. These findings align with the study by Yundelfa et al. (2025), which showed no association between age and MSD complaints among nurses at XY Hospital in Padang ($p=0.500$). However, these results differ from the study by Dwiseptianto and Wahyuningsih (2022), which found a relationship between age and musculoskeletal complaints among informal sector workers at the Tirta Agung Ice Factory ($p=0.021$). This discrepancy may be attributed to differences in respondent characteristics and the types of work studied.

Regarding the gender variable, statistical analysis showed no significant association with musculoskeletal complaints ($p=0.712$). A Prevalence Ratio (PR) of 0.877 (95% CI: 0.434–1.770) indicates that the difference in complaint prevalence between male and female nurses is not statistically significant. Although physiological differences in muscle mass and physical capacity exist between men and women, both groups face relatively similar nursing work demands. Activities such as prolonged standing, bending, performing repetitive tasks, and assisting with lifting and transferring patients are experienced by all nurses regardless of gender (Wuytack et al., 2023).

These findings suggest that occupational factors likely play a more significant role than gender. Non-ergonomic postures, the frequency of patient lifting, length of service, body mass index, break times, and physical workload may be other factors influencing the occurrence of musculoskeletal complaints. These results align with Mahajan et al. (2023), who studied musculoskeletal disorders among doctors and nursing officers in western Rajasthan, India, and found no significant association between gender and musculoskeletal complaints. This suggests that complaints among healthcare workers are determined not only by biological factors but also by the extent of physical work exposure.

Unlike age and gender, daily working hours showed a significant association with musculoskeletal complaints ($p < 0.001$). Complaints were reported by 44.9% of nurses working more than 8 hours per day, whereas none of the 19 nurses working ≤ 8 hours per day reported complaints. Because of this zero cell, the prevalence ratio for having complaints could not be estimated, and the PR of 1.815 in Table 2 should not be read as a 1.815-fold higher prevalence of complaints. The contrast between the two groups is nonetheless clear and is consistent with the view that longer working hours extend exposure to physical activity, static postures, repetitive movements, and workloads that increase muscle fatigue. This association should still be interpreted with caution because the ≤ 8 -hour group was small and the analysis was limited to bivariate tests.

Extended working hours tend to reduce opportunities for muscle recovery after nursing tasks, so fatigue can accumulate and complaints of pain in the neck, shoulders, back, lower back, and limbs can increase (Amiri, 2022). Wang *et al.* (2024), in a systematic review and meta-analysis of 23 studies involving 21,042 nurses in China, also identified working more than 8 hours per day as a risk factor for musculoskeletal disorders. Other evidence associates working more than 40 hours per week, long shifts, overtime, working on days off, and combinations of shifts of ≥ 12 hours per day and ≥ 40 hours per week with an increased risk of MSDs among nurses (Heidari *et al.*, 2019). Those studies examined a wider range of working-time exposures, whereas the present study compared only two categories of daily working hours, and the absence of complaints among nurses working ≤ 8 hours may partly reflect the small size of that group.

This study has several limitations. The *cross-sectional* design measured exposure and complaints at the same time, so the findings indicate associations rather than causal relationships. Each factor was analyzed separately with bivariate tests, and work-related factors such as work posture, patient handling, physical workload, body mass index, length of service, and psychosocial factors were not measured and may have confounded the associations. Musculoskeletal complaints were self-reported through the *Nordic Body Map* without clinical examination, which may introduce reporting bias. Daily working hours were categorized only as > 8 and ≤ 8 hours, without information on overtime, shift patterns, or rest breaks. Finally, the study involved the nurses of a single hospital, so the findings may not apply to hospitals with different work units, workloads, and work systems.

CONCLUSIONS

Daily working hours were significantly associated with musculoskeletal complaints among nurses at Az-Zahra Kalirejo General Hospital, whereas age and gender were not.

Complaints were reported by 44.9% of nurses working more than eight hours per day and by none of those working eight hours or less. Because the study was *cross-sectional* and analyzed each factor separately, this association does not establish a causal relationship. Hospitals are advised to review work schedules, provide adequate rest breaks, and strengthen the application of ergonomic principles in nursing activities. Future researchers are encouraged to involve more respondents and locations, use multivariate analysis, and include other factors such as work posture, physical workload, body mass index, length of service, patient lifting activities, rest breaks, and ergonomic conditions.

REFERENCES

- Amiri, S. (2022). Longer working hours and musculoskeletal pain: A meta-analysis. *International Journal of Occupational Safety and Ergonomics*, 29, 1–16. <https://doi.org/10.1080/10803548.2022.2036488>
- Dwiseptianto, R. W., & Wahyuningsih, A. S. (2022). Keluhan muskuloskeletal pada pekerja sektor informal. *Indonesian Journal of Public Health and Nutrition*. <https://doi.org/10.15294/ijphn.v2i1.51232>
- Gill, T. K., Mittinty, M., March, L., Steinmetz, J. D., Culbreth, G. T., Cross, M., Kopec, J. A., Woolf, A. D., Haile, L. M., Hagins, H., Ong, K., Kopansky-Giles, D. R., Dreinhofer, K. E., Betteridge, N., Abbasian, M., Abbasifard, M., Abedi, K., Adesina, M., Aithala, J., . . . Brooks, P. M. (2023). Global, regional, and national burden of other musculoskeletal disorders, 1990–2020, and projections to 2050: A systematic analysis of the Global Burden of Disease Study 2021. *The Lancet Rheumatology*, 5, e670–e682. [https://doi.org/10.1016/S2665-9913\(23\)00232-1](https://doi.org/10.1016/S2665-9913(23)00232-1)
- Heidari, M., Borujeni, M. G., & Rezaei, P. (2019). Work-related musculoskeletal disorders and their associated factors in nurses: A cross-sectional study in Iran. *The Malaysian Journal of Medical Sciences*, 26, 122–130. <https://doi.org/10.21315/mjms2019.26.2.13>
- Indah, W. P., Fachrin, S. A., & Ikhtiar, M. (2025). Faktor yang berhubungan dengan keluhan musculoskeletal disorders (MSDs) pada pekerja buruh angkut di Gudang Bulog Kota Makassar. *Window of Public Health Journal*, 6(5), 839–848.
- Jatmika, L., Fachrin, S. A., & Sididi, M. (2022). Faktor yang berhubungan dengan keluhan MSDs pada pekerja buruh di Pelabuhan Yos Sudarso Tual. *Window of Public Health Journal*, 3(3), 563–574.
- Johnson, K., Swinton, P., Pavlova, A., & Cooper, K. (2023). Manual patient handling in the healthcare setting: A scoping review. *Physiotherapy*, 120, 60–77. <https://doi.org/10.1016/j.physio.2023.06.003>
- Kim, W., & Jeong, B.-Y. (2024). Exposure time to work-related hazards and factors affecting musculoskeletal pain in nurses. *Applied Sciences*. <https://doi.org/10.3390/app14062468>
- Krishnan, K., Raju, G., & Shawkataly, O. (2021). Prevalence of work-related musculoskeletal disorders: Psychological and physical risk factors. *International Journal of Environmental Research and Public Health*, 18. <https://doi.org/10.3390/ijerph18179361>

- Krishnanmoorthy, G., Rampal, S., Karuthan, S. R., Baharudin, F., & Krishna, R. (2025). Effectiveness of participatory ergonomic interventions on work-related musculoskeletal disorders, sick absenteeism, and work performance among nurses: Systematic review. *JMIR Human Factors*, 12. <https://doi.org/10.2196/68522>
- Liu, S.-W., Wang, B., Fan, S., Wang, Y., Zhan, Y., & Ye, D. (2022). Global burden of musculoskeletal disorders and attributable factors in 204 countries and territories: A secondary analysis of the Global Burden of Disease 2019 study. *BMJ Open*, 12. <https://doi.org/10.1136/bmjopen-2022-062183>
- Maharani, A., Sari, S. A., & Ludiana, L. (2026). Implementasi terapi genggam jari bola karet terhadap kekuatan otot ekstremitas atas pasien stroke. *Jurnal Cendikia Muda*, 6(2), 215–225.
- Mahajan, D., Gupta, M. K., Mantri, N., Joshi, N., Gnanasekar, S., Goel, A., Srinivasan, S., Gonade, N. M., Sharma, S., Garg, M., & Bhardwaj, P. (2023). Musculoskeletal disorders among doctors and nursing officers: An occupational hazard of overstrained healthcare delivery system in western Rajasthan, India. *BMC Musculoskeletal Disorders*, 24. <https://doi.org/10.1186/s12891-023-06457-z>
- Maznah, F. Z. (2025). Prevalence of musculoskeletal disorders associated with 3 types of work in Indonesia. *Ranah Research: Journal of Multidisciplinary Research and Development*. <https://doi.org/10.38035/rj.v7i3.1388>
- Mohammed, I. S., Abdulai, M., Ibrahim, M. M., Buasilenu, H., Baako, I., Nyarko, B. A., Wuni, A., & Buunaaisie, C. (2024). Prevalence of workplace-related musculoskeletal disorders among nurses and midwives in a tertiary healthcare facility: A descriptive cross-sectional survey. *Nursing Open*, 11. <https://doi.org/10.1002/nop2.70098>
- Shomy, N. R., Billah, K. A., Chowdhury, S. R., Choudhury, T. A., Maria, S., & Dey, T. (2026). Prevalence of work-related musculoskeletal problems and perceived job risk factors among nurses at tertiary level hospitals in Sylhet. *Jalalabad Medical Journal*. <https://doi.org/10.3329/jmj.v22i2.88054>
- Sun, W.-G., Yin, L., Zhang, T.-Q., Zhang, H., Zhang, R., & Cai, W.-D. (2023). Prevalence of work-related musculoskeletal disorders among nurses: A meta-analysis. *Iranian Journal of Public Health*, 52, 463–475. <https://doi.org/10.18502/ijph.v52i3.12130>
- Surya, H., & Handayani, S. (2025). Individual and ergonomic risk factors for musculoskeletal disorders among health workers in Indonesia: A literature review. *HEARTY*. <https://doi.org/10.32832/heart.v13i2.17541>
- Tang, L., Wang, G., Zhang, W., & Zhou, J. (2022). The prevalence of MSDs and the associated risk factors in nurses of China. *International Journal of Industrial Ergonomics*. <https://doi.org/10.1016/j.ergon.2021.103239>
- Wang, K., Zeng, X., Li, J.-W., Guo, Y.-L., & Wang, Z.-L. (2024). The prevalence and risk factors of work-related musculoskeletal disorders among nurses in China: A systematic review and meta-analysis. *International Journal of Nursing Studies*, 157, 104826. <https://doi.org/10.1016/j.ijnurstu.2024.104826>
- Widiyanto, A., Ellina, A. D., Peristiowati, Y., Atmojo, J. T., & Livana, P. (2022). Risk factor of work-related musculoskeletal disorders among health workers. *International Journal of Health Sciences*. <https://doi.org/10.53730/ijhs.v6ns5.9573>

- Wuytack, F., Evanoff, B., Dale, A., Gilbert, F., Fadel, M., Leclerc, A., & Descatha, A. (2023). Comparing physical work exposures between men and women: Findings from 65,281 workers in France. *Occupational and Environmental Medicine*, 80, 558–563. <https://doi.org/10.1136/oemed-2023-108839>
- Yundelfa, M., Muslim, F., Nengcy, S., Aulia, A. M., Fitri, M., & Efendi, M. (2025). Analisis tingkat risiko dengan keluhan musculoskeletal disorders pada perawat di Rumah Sakit XY Padang. *Menara Ilmu*. <https://doi.org/10.31869/mi.v19i2.6595>