Risk Factors for Musculoskeletal Complaints in Nurses in Hospitals

Annisa Dipinta Hening Cahyaningratri[1], Indri Hapsari Susilowati[1]
[1]Faculty of Public Health, Universitas Indonesia, Depok, Indonesia
Correspondence: **Annisa Dipinta Hening Cahyaningratri**: Kampus UI Depok, Indonesia; annisadipinta12@gmail.com

ABSTRACT
Musculoskeletal complaints are a common occupational health problem experienced by nurses in hospital settings, primarily resulting from patient-handling activities such as lifting, transferring, and maintaining static or awkward postures for prolonged periods. These conditions have been reported with a very high prevalence and may lead to chronic pain, disability, and increased work absenteeism. The aim of this study was to analyze and identify the risk factors contributing to musculoskeletal complaints among hospital nurses. This study employed a systematic review design by searching the electronic databases *ScienceDirect* and *PubMed* using the keywords "risk factors", "musculoskeletal complaints", and "hospital nurses". The inclusion criteria consisted of English-language articles published between 2020 and 2025, free-access, and full-text availability. The study selection process followed the PRISMA protocol, resulting in 15 eligible articles. The review identified 18 risk factors associated with musculoskeletal complaints among hospital nurses: sex, BMI, age, marital status, education level, smoking habits, exercise habits, length of employment, lack of assistance and non-use of assistive devices, working posture, work unit, work shift, employment status, workload, lack of training, job stress, low social support, and fatigue. The most frequently reported musculoskeletal complaints were located in the lower back, neck, and shoulders. These findings highlight the need for preventive measures such as ergonomics-related training, stretching exercises, workload regulation, adequate rest periods, and the promotion of healthy lifestyle behaviors.
Keywords: risk factors; musculoskeletal complaints; hospital nurses

INTRODUCTION
Muscle pain or injury caused by sudden or repetitive movements, pressure, vibration, or improper body posture is known as a musculoskeletal complaint. This condition involves disturbances of connective tissues and the musculoskeletal system [1]. Work-related musculoskeletal complaints have become a serious occupational health issue among hospital staff, particularly nurses. These complaints are categorized as one of the most common work-related injuries. Based on the nature of their work, nurses are among the occupational groups with a high prevalence of work-related musculoskeletal complaints [2]. A high prevalence of work-related musculoskeletal disorders has been reported among nurses, leading to chronic pain, disability, and absenteeism [3].

The primary factors contributing to musculoskeletal complaints among hospital nurses are tasks involving patient handling, such as lifting, transferring, and repositioning patients [4]. Previous studies have reported a high prevalence of musculoskeletal disorders in the study population, with 89% of nurses reporting pain in at least one body region and 97% reporting pain lasting more than one year [5]. The 12-month prevalence of work-related musculoskeletal disorders was 92%, with neck pain (79%) identified as the most common complaint, followed by lower back pain (67%). Furthermore, 95% of respondents perceived working in the same position continuously and for prolonged periods as the main risk factor contributing to WMSDs [6]. These high prevalence rates indicate that musculoskeletal complaints among nurses constitute a significant occupational health problem that warrants serious attention, as they may affect worker health, productivity, and the quality of healthcare services in hospitals.

Considering the magnitude of the problem and the impact caused by various risk factors of musculoskeletal complaints among hospital nurses, this literature review aims to analyze and identify the most influential risk factors contributing to musculoskeletal complaints. This study not only provides theoretical knowledge and a deeper understanding of the risk factors but also offers practical solutions that can be implemented in hospital settings to create a healthier and more productive work environment.

METHODS
This study employed a systematic review method based on data-driven research published within the last five years. The systematic review followed the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines [ ]. Data analysis and synthesis were conducted to generate a comprehensive understanding of musculoskeletal complaints among hospital nurses. In this process, the PICO framework (Participant, Intervention, Comparison, Outcome) was used to guide the focus of the analysis on the essential components of each study. Accordingly, this review provides a structured and systematic overview of research on musculoskeletal complaints among hospital nurses.

The literature search was conducted using the *ScienceDirect* and *PubMed* databases. The data extracted for this study were related to the analysis of risk factors for musculoskeletal complaints among hospital nurses, using the keywords "risk factors, musculoskeletal complaints, hospital nurses." From the electronic databases, 553 articles were identified from ScienceDirect and 107 articles from PubMed, resulting in a total of 660 articles.

The inclusion criteria consisted of: titles and abstracts relevant to the research topic, hospital nurses as study participants, articles published between 2020–2025, English-language publications, free-access availability, and full-text articles. The exclusion criteria included: titles, abstracts, or full texts not relevant to the research topic; systematic review articles; books; book series; proceedings; and conference papers. Based on these criteria, 15 articles were selected for review. This study utilized secondary data derived from previously published scientific articles; therefore, it did not involve direct participation of human subjects.

The summary of PICO was: 1) participant: hospital nurses; 2) intervention: risk factors of musculoskeletal complaints among hospital nurses 3) comarison: n/a; 4) outcome: specific risk factors of musculoskeletal complaints.

RESULTS
This study analyzed 15 articles that examined factors associated with musculoskeletal complaints among hospital nurses. Based on the literature review, the contributing factors can be grouped into three main categories: individual factors, occupational factors, and psychological

factors. The individual factors identified include sex, age, body mass index (BMI), marital status, education level, smoking habits, and exercise habits. The occupational factors consist of length of employment, lack of assistance or non-use of assistive devices during work, non-ergonomic working postures, work unit, shift system, employment status, workload, and the absence of job-related training. Meanwhile, the psychological factors reported in several studies include job stress, low social support in the workplace, and work-related fatigue. Among all these factors, the analysis indicates that the most consistently reported factors associated with musculoskeletal complaints among nurses are sex, length of employment, working posture, age, and BMI.

Table 1. Musculoskeletal complaints among nurses

Individual factors	Occupational factors	Psychological factors
1. Sex [1,11,12,13,17,18,20,30] 2. Body Mass Index (BMI) [3,5,9,13,19] 3. Age [1,3,5,6,8,9,10,13,14,16,17,18,19,20,30] 4. Marital status [14,19] 5. Education level [14,19] 6. Smoking habits [14,19] 7. Exercise habits [14,19]	1. Length of employment [1,3,5,6,7,8,9,10,11,12,13,14,16,17,18,19,20,30] 2. Lifting tasks and non-use of assistive devices [3,5,6,8,9,10,11,12,13,14,16,17,18,19,20,30] 3. Working posture [3,5,6,8,9,10,11,12,13,14,16,17,18,19,20,30] 4. Work shift system [3,5,6,8,9,10,11,12,13,14,16,17,18,19,20,30] 5. Work unit [3,5,6,8,9,10,11,12,13,14,16,17,18,19,20,30] 6. Workload [3,5,6,8,9,10,11,12,13,14,16,17,18,19,20,30] 7. Lack of stretching activities [14,19]	1. Job stress [9] 2. Low social support [9] 3. Fatigue [9]

In addition to identifying risk factors, the analysis of the 15 articles also shows that musculoskeletal complaints among nurses occur in various body regions. The affected body areas reported include the lower back, neck, shoulders, upper back, wrists/hands, ankles/feet, knees, hips/thighs, elbows, and lower legs. Based on the frequency of reporting across the analyzed studies, the most commonly affected body region is the lower back, followed by the neck and shoulders. This indicates that the upper body and back areas are the most vulnerable to musculoskeletal complaints among hospital nurses.

The factors associated with musculoskeletal complaints among nurses are presented in Table 1, and the affected body areas are presented in Table 2.

Table 2. Body areas affected by musculoskeletal complaints

No.	Body area	Percentage
1	Lower back [7,8,9,10,11,12,13,14,15,16,17,18,19,20]	26
2	Neck [7,9,10,12,15,14,16,17,18,19,20]	15
3	Shoulders [7,9,10,12,13,14,11,17,20]	15
4	Upper back [9,10,12,14,19]	9
5	Wrists/hands [7,10,12]	5
6	Ankles/feet [9,12,13,14,18,20]	9
7	Knees [7,12,18,19]	7
8	Hips/thighs [7,12]	4
9	Elbows [12,16]	5
10	Lower legs [14]	2
11	Waist [17]	2

Table 3. The results of synthesis (research in musculoskeletal complaints)

Author, year, source	Objective	Study design	Variables	Key findings	Body areas
Dhas et al. (2022). Prevalence of work-related musculoskeletal disorders among pediatric long-term ventilatory care unit nurses. Journal of Pediatric Nursing (Q1) [7].	To determine the prevalence of musculoskeletal disorders among nurses working in PLTVC units.	Cross-sectional; Sample: 127 nurses.	Education level, nationality, age, years of PLTVC experience, sex, job title, years of nursing service, years in PLTVC unit, MSD prevalence.	Significant differences were found between years of PLTVC experience and multisite pain reports.	Lower back, neck, shoulders, upper back, wrists/hands, ankles/feet, knees, hips/thighs, elbows.
Banga et al. (2024). Prevalence of low back pain and associated factors among nurses in public hospitals of Hawassa City. Heliyon (Q1) [8].	To assess the prevalence of low back pain and associated factors among nurses.	Cross-sectional; Sample: 398 nurses.	Age, sex, BMI, work unit, marital status, work experience, salary, education, safety training, exercise program, smoking, alcohol use, comfort, coworker assistance, assistive device use, staffing, sleep disturbance, job stress, job satisfaction, LBP prevalence.	Significant factors: female sex, BMI >25 kg/m², lack of coworker assistance, and non-use of assistive devices.	Low back pain.
Yang et al. (2020). Risk Factors for work-related musculoskeletal disorders among ICU nurses in China. Asian Nursing Research (Q1) [9].	To identify risk factors for WMSDs among ICU nurses and examine relationships among physical, psychosocial, and	Cross-sectional; Sample: 984 nurses.	Age, ICU work, hospital type, sex, marital status, job title, education, exercise, risk perception, safety climate, job stress.	Strong correlations between physical factors (patient-handling frequency, physical workload) and WMSDs.	Lower back, neck, shoulders.

Author, year, source	Objective	Study design	Variables	Key findings	Body areas
	organizational factors.				
Koyuncu et al. (2024). Impact of work-related musculoskeletal pain on routine tasks among operating room nurses. Pain Management Nursing (Q1) [10].	To determine work-related musculoskeletal pain and its impact on routine tasks.	Cross-sectional; Sample: 105 nurses.	Age, sex, education, OR work hours, surgical participation, BMI, nursing experience, OR experience, weekly hours, standing duration, surgical nurse role, circulating nurse role.	Significant factors: age, BMI, OR experience, surgical nurse role.	Neck, lower back, upper back, hands/wrists, shoulders.
Tuna et al. (2021). Musculoskeletal discomfort and professional quality of life among nurses. Pain Management Nursing (Q1) [11].	To assess musculoskeletal discomfort and its associations.	Cross-sectional, descriptive, correlative; Sample: 333 nurses.	Age, sex, marital status, job position, professional tenure, organizational tenure, unit, shift.	Younger nurses, males, executive positions, and less experience had higher discomfort scores.	Lower back.
Teixeira et al. (2020). Work-related musculoskeletal disorders and work instability in nursing professionals. Rev Bras Med (Q4) [12].	To analyze the relationship between work instability and WMSDs.	Cross-sectional; Sample: 111 nurses.	Sex, professional category, age, work unit, WMSDs, work instability.	Work instability associated with age and work unit.	Neck, shoulders, upper back, elbows, wrists, lower back, hips/thighs, knees, ankles/feet.
Hosseini et al. (2021). Work-related musculoskeletal symptoms and fatigue among iranian nurses. BMC Musculoskeletal Disorders (Q2) [13].	To determine WMSD prevalence, associated factors, and relationship with fatigue.	Cross-sectional; Sample: 500 nurses.	Age, BMI, work experience, daily hours, sex, marital status, children, smoking, shift work, job type, WMSDs, fatigue.	Fatigue, age, work experience, sex, smoking, shift work, and employment type significantly associated with WMSDs.	Ankles/feet, lower back, knees, shoulders.
Maslon et al. (2024). Workload, stress, body function, and musculoskeletal pain in nurses – pilot study. Int. J. Occup. Med. Environ. Health (Q3) [5].	To examine workload, perceived stress, physical findings, and musculoskeletal pain.	Pilot study; Sample: 42 nurses.	Perceived workload, stress, physical findings, musculoskeletal pain, age, BMI, work experience.	Workload and stress were associated with pain.	Lower back, head.
Krishnan et al. (2021). Prevalence of WMSDs: Psychological and physical risk factors. IJERPH (Q2) [14].	To estimate prevalence and risk factors of WMSDs across anatomical regions.	Cross-sectional; Sample: 300 nurses.	Age, education, marital status, children, work experience, BMI, psychosocial factors, physical factors, WMSDs.	Major risk factors: age, low education, female sex, high BMI, work experience.	Lower back, ankles, neck, shoulders, lower legs, upper back.
Chandralekha et al. (2022). WMSDs and quality of life among staff nurses. Indian J. Occup. Environ. Med. (Q3) [15].	To estimate WMSD prevalence, identify risk factors, and examine associations.	Cross-sectional; Sample: 207 nurses.	Job type, department, repetitive movements, bending, heavy lifting, abnormal posture, working while ill, job satisfaction, training, workplace density, WMSDs.	Risk factors: repetitive movements, prolonged abnormal posture, working while ill.	Lower back, neck, shoulders.
Nemera et al. (2024). Magnitude and factors of wmsds among Ethiopian nurses. BMC Musculoskeletal Disorders (Q2) [16].	To assess magnitude and associated factors of WMSDs.	Cross-sectional; Sample: 406 nurses.	Sex, age, marital status, education, experience, work unit, patient load, hours, shift, training, psychological factors, behavioral factors, WMSDs.	Significant factors: lack of injury-prevention training, marital status, work unit, improper posture, prolonged static work, bending/twisting.	Lower back, neck, elbows.
Latina et al. (2020). Prevalence of MSDs and low back pain among Italian nurses. Acta Biomed (Q3) [17].	To determine prevalence of MSDs and low back pain.	Cross-sectional; Sample: 256 nurses.	Age, education, manual handling training, BMI, years of work, MSD and LBP prevalence.	Female sex increased risk of low back pain.	Waist, neck, shoulders, back.
Tefera et al. (2021). Low back pain among ICU nurses in Ethiopia. PLOS ONE (Q1) [18].	To assess magnitude and associated factors of LBP.	Cross-sectional; Sample: 412 ICU nurses.	Age, sex, ethnicity, religion, education, ICU unit, ICU training, BMI, sleep duration, job stress.	Significant factors: female sex, lack of assistive devices, insufficient ICU	Lower back.

Author, year, source	Objective	Study design	Variables	Key findings	Body areas
				training, lack of exercise, job stress.	
Ouni et al. (2020). Prevalence and risk factors of msds among tunisian nurses. La Tunisie Médicale (Q4) [19].	To evaluate MSD prevalence and associated factors.	Cross-sectional; Sample: 310 nurses.	Age, sex, weight, height, BMI, lifestyle habits, marital status, children, seniority, work system, repetitive tasks, standing, physical effort, awkward posture, heavy lifting.	Significant factors: female sex, single status, high BMI, seniority, repetitive tasks, prolonged standing, heavy effort, awkward posture, low social support, stress.	Lower back, upper back, knees.
Perumal et al. (2023). Prevalence, risk factors, and coping strategies of lbp among nurses in Sabah. Medical Journal of Malaysia (Q3) [20].	To determine LBP prevalence, workplace risk factors, and coping strategies.	Cross-sectional; Sample: 420 nurses.	Age, sex, marital status, BMI, children, education, department, experience, nursing rank.	Sex and years of experience significantly associated with LBP.	Lower back, shoulders, ankles.

DISCUSSION

The findings of this literature review indicate that musculoskeletal complaints commonly experienced by hospital nurses are influenced by a wide range of factors, including sex, BMI, age, marital status, education level, smoking habits, exercise habits, length of employment, lack of assistance and non-use of assistive devices, working posture, work unit, shift work, employment type, workload, lack of training, job stress, low social support, and fatigue. These factors interact and contribute to the development of musculoskeletal complaints among hospital nurses.

The review shows that the most frequently reported factors associated with musculoskeletal complaints are sex, length of employment, working posture, age, and BMI. Several studies found that female nurses tend to be more vulnerable to Work-Related Musculoskeletal Disorders (WRMSDs), partly due to additional responsibilities outside of work—such as childcare and household duties—which reduce rest time and limit opportunities for physical exercise [14]. Women were reported to experience musculoskeletal complaints 2.1 times more frequently than men. However, contrasting evidence also exists, with some studies reporting higher musculoskeletal complaints among male nurses [11]. These findings suggest that sex is an important factor associated with musculoskeletal complaints, although the direction of risk may vary across studies.

Individuals with more than ten years of work experience were found to be more susceptible to lower back pain compared to those with fewer years of experience [13]. This may be attributed to long-term exposure to repetitive and physically demanding tasks, leading to cumulative strain on the musculoskeletal system. Excessive working hours combined with staff shortages further increase the risk of musculoskeletal disorders, hypertension, and depressive symptoms among nurses [14].

Working posture emerged as one of the most prominent risk factors. Improper body mechanics—such as inadequate coordination of muscles and joints during patient handling—can lead to musculoskeletal strain, particularly when nurses do not work in close proximity to the object being lifted. Prolonged incorrect posture, repetitive movements, bending, and twisting during work are significantly associated with musculoskeletal complaints [16]. Non-ergonomic working postures increase musculoskeletal risk because repetitive and prolonged improper positioning places excessive load on muscles and joints.

Age also plays a significant role. Individuals aged ≥41 years reported higher incidence of pain in various body regions within the past 12 months. Age-related changes in cartilage and connective tissues, including thinning and structural degeneration, reduce joint strength and flexibility, increasing the risk of pain, inflammation, and more severe joint damage [10,21].

A significant association was also found between lower back pain and overweight status. Obesity increases mechanical load on the lower back and weakens abdominal muscles, contributing to herniation, disc degeneration, and compression [8].

Other risk factors identified in the literature include lack of assistance and non-use of assistive devices, workload, job stress, work unit, lack of training, and marital status. Nurses who do not use assistive devices during patient handling are 1.77 times more likely to experience lower back pain. This may be due to insufficient retraining or limited availability of equipment such as wheelchairs, lifts, transfer beds, and automated beds, which help reduce spinal injuries. High workload and stress—particularly time pressure—were also reported to contribute to muscle tension and overall physical fatigue. Long working hours and physically demanding patient-handling tasks increase the risk of musculoskeletal complaints [5,8,14].

Among pediatric ICU, adult ICU, head and neck surgery, orthopedics, and neurosurgery units, pediatric ICU showed the highest risk related to worker retention issues. High patient dependency, organizational workload, and occupational risk factors negatively affect worker stability, productivity, job satisfaction, and health, ultimately reducing patient care effectiveness [12]. Marital status and lack of injury-prevention training were also associated with increased musculoskeletal risk. Married nurses may face additional responsibilities outside work, increasing physical fatigue. Nurses without injury-prevention training were found to have a 5.52-fold higher risk of musculoskeletal complaints, suggesting that existing training may be insufficient or that ergonomic principles are not adequately applied in practice [16].

Additional risk factors include shift work, employment type, fatigue, social support, education level, smoking habits, and exercise habits. Nurses in higher organizational positions may experience greater mental workload and stress due to managerial responsibilities, contributing to musculoskeletal complaints, particularly in the neck region. Fatigue resulting from excessive workload and insufficient recovery time further exacerbates musculoskeletal risk. Shift work—especially night shifts or rotating shifts—disrupts sleep patterns, increases physical fatigue, and reduces recovery time, thereby elevating musculoskeletal risk [13].

Psychosocial factors are recognized as major contributors to musculoskeletal disorders. Lack of workplace support is a significant psychosocial risk factor, often due to insufficient assistance, poor communication, and limited cooperation among staff, which increases psychological stress and intensifies physical strain during work activities [19].

Smoking is associated with musculoskeletal disorders because smokers tend to experience slower healing processes due to reduced oxygenation in musculoskeletal tissues [17]. Regular exercise helps maintain normal body weight, indirectly reducing the risk of lower back pain by decreasing mechanical load on the spine [18]. Low education level has also been linked to musculoskeletal disorders, possibly because individuals with lower education may lack basic ergonomic knowledge and skills in the workplace [14,22].

Analysis of the 15 reviewed articles shows that the most frequently reported body areas affected by musculoskeletal complaints are the lower back, neck, and shoulders. These complaints are often caused by prolonged static postures, improper working positions, and bending or twisting during work activities [16].

Control measures

The International Ergonomics Association (IEA) defines ergonomics as the scientific discipline concerned with understanding interactions between humans and other elements of a work system. Its primary goal is to optimize worker well-being and overall system performance. Ergonomics applies theoretical knowledge, principles, data, and scientific methods to design systems that support human health while improving system efficiency [23].

Control measures should include ergonomic training to enhance nurses' understanding of proper working postures and correct use of equipment to avoid awkward positions. Implementing stretching routines can help reduce muscle stiffness. Management should regulate workload and ensure adequate rest periods to prevent muscle fatigue, as well as implement job rotation. Promoting healthy lifestyles, including regular exercise, can further reduce musculoskeletal risk.

Reducing MSD incidence through appropriate preventive measures can lower costs associated with medical care, absenteeism, and productivity loss [24].

CONCLUSION

Musculoskeletal complaints among nurses are influenced by multiple individual, occupational, and psychosocial risk factors. Eighteen key factors were identified, including individual characteristics (sex, BMI, age, marital status, education, smoking, and exercise habits), occupational conditions (length of employment, lack of assistance or assistive devices, working posture, work unit, shift work, employment type, workload, and lack of training), and psychosocial aspects (job stress, low social support, and fatigue). These combined factors place nurses at a high risk of developing musculoskeletal problems.

Preventive measures—such as ergonomics training, stretching routines, workload regulation, adequate rest periods, and healthy lifestyle practices—are essential to reduce this risk. This review strengthens the existing evidence base on musculoskeletal risk factors among hospital nurses and highlights the need for future studies to explore more targeted interventions.

Ethical consideration, competing interest and source of funding

-This literature review did not require ethical approval because it exclusively utilized secondary data derived from previously studies.
-There is no conflict of interest related to this publication.
-Source of funding is authors.

REFERENCES

1. Tantawy SA, Al Halwachi B, Al Ghanim A, Al Mansoori A, Kamel DM. Work-related musculoskeletal disorders among employees with different tasks: An Ahlia University case study. Physiother Q. 2022;30(4):59–64.
2. Saberipour B, Ghanbari S, Zarea K, Gheibizadeh M, Zahedian M. Investigating prevalence of musculoskeletal disorders among Iranian nurses: A systematic review and meta-analysis. Clin Epidemiol Glob Health. 2019;7(3):513–8.
3. Van Hoof W, O'Sullivan K, Verschueren S, O'Sullivan P, Dankaerts W. Evaluation of absenteeism, pain, and disability in nurses with persistent low back pain following cognitive functional therapy: A case series pilot study with 3-year follow-up. Phys Ther. 2021;101(1):1–13.
4. Januskevicius V. Work-related musculoskeletal disorders among hospital workers. Oshwiki; 2022.
5. Masłoń A, Kamińska M, Kvåle A. Workload, general perceived stress, body function, musculoskeletal pain, and their mutual relationships in nurses: A pilot study. Int J Occup Med Environ Health. 2024;37(3):257–70.
6. Singh I, Kashyap D, Sandilya AK. Prevalence of musculoskeletal disorders among nurses. Int J Nurs Health Sci. 2024;6(2):29–35.
7. Dhas BN, Joseph L, Jose JA, Zeeser JM, Devaraj JP, Chockalingam M. Prevalence of work-related musculoskeletal disorders among pediatric long-term ventilatory care unit nurses: Descriptive cross-sectional study. J Pediatr Nurs. 2023;69:e114–9.
8. Banga D, Samuel T, Yihune M, Bekele G, Molla E, Borie YA, et al. Prevalence of low back pain and associated factors among nurses working in public hospitals of Hawassa city, southern Ethiopia: A cross-sectional study. Heliyon. 2024;10(9):e30300.
9. Yang S, Li L, Wang L, Zeng J, Li Y. Risk factors for work-related musculoskeletal disorders among intensive care unit nurses in China: A structural equation model approach. Asian Nurs Res. 2020;14(4):241–8.
10. Koyuncu A, Kaya K, Kaya O, Yava A. The impact of work-related musculoskeletal pains on routine tasks among operating room nurses: A multicenter cross-sectional study. Pain Manag Nurs. 2024;26(1):e88–96.
11. Tuna R, Eskin Bacaksiz F, Kahraman B. The relationship between musculoskeletal discomfort and professional quality of life among nurses. Pain Manag Nurs. 2022;23(1):62–7.
12. Teixeira EJS, de Souza Petersen R, Marziale MHP. Work-related musculoskeletal disorders and work instability of nursing professionals. Rev Bras Med Trab. 2022;20(2):206–14.
13. Hosseini E, Daneshmandi H, Bashiri A, Sharifian R. Work-related musculoskeletal symptoms among Iranian nurses and their relationship with fatigue: A cross-sectional study. BMC Musculoskelet Disord. 2021;22(1):1–9.
14. Krishnan KS, Raju G, Shawkataly O. Prevalence of work-related musculoskeletal disorders: Psychological and physical risk factors. Int J Environ Res Public Health. 2021;18(17).
15. Chandralekha K, Joseph M, Joseph B. Work-related musculoskeletal disorders and quality of life among staff nurses in a tertiary care hospital of Bangalore. Indian J Occup Environ Med. 2019;23(1):8–13.
16. Nemera A, Eliyas M, Likassa T, Teshome M, Tadesse B, Dugasa YG, et al. Magnitude of work-related musculoskeletal disorders and its associated factors among Ethiopian nurses: A facility based cross-sectional study. BMC Musculoskelet Disord. 2024;25(1):1–10.
17. Latina R, Petruzzo A, Vignally P, Cattaruzza MS, Buratti CV, Mitello L, et al. The prevalence of musculoskeletal disorders and low back pain among Italian nurses: An observational study. Acta Biomed. 2020;91(12-S):1–10.
18. Tefera BZ, Zeleke H, Abate A, Abebe H, Mekonnen Z, Sewale Y. Magnitude and associated factors of low back pain among nurses working

at intensive care unit of public hospitals in Amhara region, Ethiopia. PLoS One. 2021;16(12):1–13.
19. Ouni M, Elghali MA, Abid N, Aroui H, Dabebbi F. Prevalence and risk factors of musculoskeletal disorders among Tunisian nurses. Tunis Med. 2020;98(3):225–31.
20. Perumal AS, Awang Lukman K. The prevalence, risk factors and coping strategies of low back pain among nurses in public hospitals in Kota Kinabalu, Sabah: A cross-sectional study. Med J Malaysia. 2024;79(5):584–90.
21. Villa-Forte A. Effects of aging on the musculoskeletal system. MSD Manual Consumer Version; 2022;1(1):112-118.
22. Demissie B, Bayih ET, Demmelash AA. A systematic review of work-related musculoskeletal disorders and risk factors among computer users. Heliyon. 2024;10(3):e25075.
23. IEA. What is ergonomics (HFE)? International Ergonomics & Human Factors Association; 2024.
24. Kamijantono H, Sebayang MM, Lesmana A. Risk factors and ergonomic influence on musculoskeletal disorders in the work environment. J La Medihealtico. 2024;5(3):660–70.