Revista Brasileira de Pesquisa em Ciências da Saúde

ORIGINAL ARTICLE

Associated factors with musculoskeletal pain in nursing professionals: a cross-sectional study

Fatores associados à dor musculoesquelética em profissionais de enfermagem: um estudo transversal

Eduardo Gallas Leivas[a*], Leandro Alberto Calazans Nogueira[a]

[a] Rehabilitation Science Postgraduation Program - Augusto Motta University Centre (UNISUAM), Rio de Janeiro, Brazil.

* Correspondence: eduardoleivas@souunisuam.com.br

ABSTRACT

Objectives: To analyze the prevalence and the factors associated with musculoskeletal complaints (i.e., pain and discomfort) in nurse technicians and assistants. **Methods:** This is a study comprising 61 records of female workers from a private company database. Twelve personal, occupational, clinical, and psychosocial covariates were evaluated. The study's outcomes were musculoskeletal complaints in nine body regions during the last 12 months. The multivariable analysis model evaluated the independent relationship between the potential exposure factors and the musculoskeletal complaints. **Results:** The prevalence of musculoskeletal complaints was 86.9% in one body region and 73.8% in more than one body region. The body regions with the highest prevalence were the lower back, shoulder, upper back, and neck. The adjusted logistic regression model revealed an association between musculoskeletal neck complaints and no breaks at work, shoulders complaints and overweight or obesity, wrists/hands complaints and workday > 8 hours, upper back complaints and feeling frequent tiredness, and between hips/thighs complaints and mental stress. **Conclusions:** An elevated prevalence of musculoskeletal complaints was evidenced in the participants. Personal, occupational, clinical, and psychosocial characteristics were associated with musculoskeletal complaints during the last 12 months in female nurse technicians and nurse assistants.

RESUMO

Objetivos: Analisar a prevalência e os fatores associados às queixas musculoesqueléticas (ou seja, dor e desconforto) em técnicos e auxiliares de enfermagem. **Métodos:** Trata-se de um estudo composto por 61 registros de trabalhadoras de um banco de dados de uma empresa privada. Doze covariáveis pessoais, ocupacionais, clínicas e psicossociais foram avaliadas. Os resultados do estudo foram queixas musculoesqueléticas em nove regiões do corpo durante os últimos 12 meses. O modelo de análise multivariável avaliou a relação independente entre os potenciais fatores de exposição e as queixas musculoesqueléticas. **Resultados:** A prevalência de queixas musculoesqueléticas foi de 86,9% em uma região do corpo e 73,8% em mais de uma região do corpo. As regiões do corpo com as maiores prevalências foram a região lombar, ombro, parte superior das costas e pescoço. O modelo de regressão logística ajustado revelou associação entre queixas musculoesqueléticas no pescoço e ausência de pausas no trabalho, queixas nos ombros e sobrepeso ou obesidade, queixas nos punhos/mãos e jornada de trabalho > 8 horas, queixas na região lombar e sensação de cansaço frequente e entre queixas nos quadris/coxas e estresse mental. **Conclusões:** Evidenciou-se elevada prevalência de queixas musculoesqueléticas nos participantes. Características pessoais, ocupacionais, clínicas e psicossociais foram associadas às queixas musculoesqueléticas nos últimos 12 meses em técnicas e auxiliares de enfermagem.

ARTICLE HISTORY
Submitted: 08 April 2023
Approved: 04 April 2023
Published: 16 September 2024

KEYWORDS
cross-section study; epidemiology; musculoskeletal complaints; nurses; risk factors

Introduction

In 2017 there were approximately 1.3 billion cases of musculoskeletal disorders globally, causing 138.7 million disability-adjusted life years and 121.3 thousand deaths (1). Musculoskeletal disorders have a multifactorial aetiology as personal characteristics and psychosocial conditions beyond the physical load (2). Musculoskeletal disorders have been associated with occupational exposure in several professions (3-7), including health professionals (8-10). Investigating musculoskeletal complaints in specific health professionals, such as the nursing workforce, is essential to understanding which factors influence these workers' illnesses and proposing preventive measures.

Musculoskeletal disorders are common health concerns among nursing workers (11-13) and affect the nursing workforce (14, 15). The annual prevalence rate of musculoskeletal complaints in at least one body region reaches 90% (16). The back, neck, shoulder, wrist and hand, and ankle and foot are the most frequent complaints in the last 12 months (12, 16, 17). This population's musculoskeletal disorders have also been associated with occupational or non-occupational factors. For instance, psychosocial factors and mental health problems (18), age, exercise habits, department type (19), years of experience, nurse-to-patient ratios, chronic occupational fatigue (20), and burnout (21) are associated with musculoskeletal pain in nurses. Thus, knowing the extra-labour risk factors contributing to musculoskeletal pain or discomfort is crucial for developing prevention strategies.

Despite several existing studies, most of them assessed musculoskeletal complaints in a specific region of the body. Still, few factors associated with musculoskeletal complaints were verified in the same survey and mostly do not specify the type of nursing workers (i.e., nurses, nurse assistants or nurse technicians). First, nurse technicians and nurse assistants have different workloads and socioeconomic conditions than nurses. The effects of these factors may have a different impact on the health of these professionals. We found only one study for this specific population (17). Knowing the factors that specifically impact the health of nursing assistants and technicians can help in more specific preventive health actions for these professionals.

Besides, analysing musculoskeletal complaints in different body regions demonstrates an encircling clinical profile of these professionals. Therefore, this study aimed to verify the factors associated with musculoskeletal disorders (i.e., pain and discomfort) in nurse technicians and nurse assistants. Secondarily, analyse the prevalence of musculoskeletal pain and discomfort. We hypothesized that physical overload and personal and psychosocial characteristics are associated with musculoskeletal disorders, as well as a high prevalence rate among these professionals.

Methods

Study Design

This is an epidemiological retrospective cross-sectional observational study using a database conducted according to REporting of studies Conducted using Observational Routinely-collected Data (RECORD) (22) approved by the Institutional Faculdade Inspirar Research Ethics Committee (number: 33691520.0.0000.5221), following the Declaration of Helsinki for research in humans. The consent form was waived by the Ethics Committee because the investigation was a data analysis.

Study Participants

We ascertained data from female nurse technicians and nurse assistants aged between 19 and 65 years from a database of a private company specialized in physiotherapy, ergonomics and occupational health. The ergonomic evaluation was carried out in hospitals and clinics in Paraná, Brazil, between June 2019 and March 2020. In Brazil, nursing teams comprise registered nurses, nurse technicians, and nurse assistants. Nurses are responsible for coordinating the nursing workforce. Nurse technicians and nurse assistants execute activities with patients and are exposed to a greater physical workload. Data from participants with current occupations of fewer than 12 months were excluded.

Procedures

The database contained information from an Ergonomic Census questionnaire used to assess of work exposures and musculoskeletal symptoms. The Ergonomic Census questionnaire encompasses personal, occupational, clinical, and psychosocial information, and the Portuguese version of the Nordic Musculoskeletal Questionnaire (NMQ) (23, 24). A team of physical therapists trained in ergonomics received a 2-hour training on applying the Ergonomic Census questionnaire to collect data. The requested information was self-reported individually by each nursing professional. The completion of all questionnaires was supervised by an examiner for clarification in case of uncertainties and lasted approximately 5 to 20 minutes per participant.

Outcome Measures

The study's outcome was musculoskeletal pain or discomfort in the last 12 months. Workers filled in questions regarding the musculoskeletal pain or discomfort based on the NMQ “Have you at any time during the last 12 months had trouble (ache, pain, discomfort) in neck/shoulders/elbows/writs or hands/upper back/low back/hips or thighs/knees/ankles or feet?” The answers are given according to a dichotomous response (yes/no).

Personal and occupational information

Participants answered personal information such as age, sex, mass (Kg), height (m) and daily housework. Occupational information regarding the period in the current occupation, manual lifting or carrying, pulling and pushing loads, trunk bent forward or twisted posture (awkward posture), repetitive movements or posture arm(s) at or above shoulder (hands over shoulder level), computer use, no breaks, workday ≥ 8hours and night work were assessed.

Exposure factors - clinical and psychosocial

Information concerning potential exposure factors was collected from the Ergonomic Census database. Clinical information regarding current smokers, daily alcohol, sedentary lifestyle (no regular physical activity), sleep time < 6 hours, sleep disorders, and feeling frequent tiredness were assessed in the questionnaire. Body mass index was calculated. Also, psychosocial information regarding monotonous work, mental stress, anxiety, and dissatisfaction with life was evaluated.

Data Analysis

The study variables were answered by a dichotomous response (yes/no), except for the period in the current occupation (“up to 1 year”, “up to 5 years”, or “more than 5 years”), mental stress (scoring from “0” – nothing – to “10” – totally), anxiety (scoring from “0” – nothing – to “10” – totally). Previous studies established a cut-off point of 5 for the anxiety symptoms (25) and 7 for perceived stress (26). Body mass index (BMI $\geq$ 24.9 Kg/m2) was dichotomized.

Statistical Analysis

A convenience sample was formed with the total data in the database. Continuous variables were presented as mean and standard deviation (SD), and categorical variables were presented in absolute values and proportions (%). Missing data were removed from the analysis. Chi-square test was used to compare the categorical variables. Potential exposure factors for musculoskeletal pain were included in a univariate regression analysis, but variables with floor and ceiling effects less than 15% (27) were excluded from this analysis. Multivariable models were elaborated for each site of musculoskeletal pain during the last 12 months (dependent variables) and the exposure variables

(independent variables). Variables with p < 0.1 in the univariate analysis were included in the multivariable analysis and adjusted to determine which independent variable best explained the association with the dependent variables. The results were presented with the logistic regression analysis, Odds Ratio (OR), its 95% confidence interval (95%CI), and the percentage (%) of variance explained (Nagelkerke R2) for each of the multivariable analyses. A significance level of less than 5% (p < 0.05) was considered for all analyses. The statistical analysis was performed using JASP version 0.12.1.0.

Results

Ninety-five records of female nurse technicians or nurse assistants from 9 clinics and hospitals were included. Thirty-nine records with less than 12 months of current occupation were excluded. A total of 61 questionnaires were included in the study.

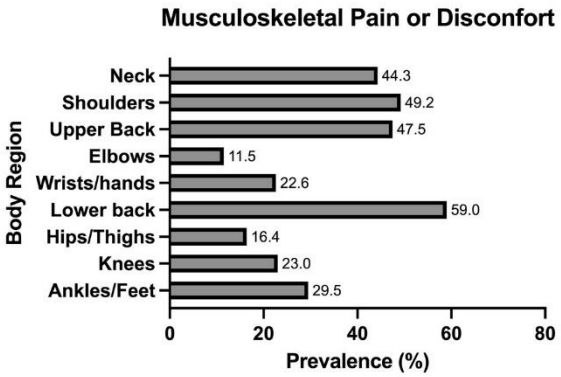
Overall, the mean age was 37.1 (10.3) years. The sample showed frequent computer use (96.7%), repetitive movements (96.7%), pulling or pushing loads (91.8%), manual lifting or carrying (90.2%), trunk bent or twisted (83.6%), and hands over shoulder level (72.1%). A small prevalence of current smokers (3.3%) and daily alcohol (4.9%) was observed. Characteristics of the sample included are shown in **Table 1**.

Characteristic	Value
Personal Information	
Age, years, mean (SD)	37.1 (10.3)
Height, m, mean (SD)	1.63 (0.1)
Weight, Kg, mean (SD)	69.4 (11.7)
Daily Housework, n (%)	30 (49.2)
Occupational Information	
How long current occupation time	
Between 1-5, years, n (%)	28 (45.9)
Above 5, years, n (%)	33 (54.1)
Manual lifting or carrying, n (%)	55 (90.2)
Pulling or pushing loads, n (%)	56 (91.8)
Trunk bent or twisted, n (%)	51 (83.6)
Hands over shoulder level, n (%)	44 (72.1)
Repetitive movements, n (%)	59 (96.7)
Computer use, n (%)	59 (96.7)
No breaks, n (%)	23 (37.7)
Workday ≥ 8 hours, n (%)	33 (54.1)
Night work	23 (37.7)
Clinical Information	
Current smoker, n (%)	2 (3.3)
Daily Alcohol, n (%)	3 (4.9)
Sedentary lifestyle, n (%)	35 (57.4)
Sleep disorders, n (%)	22 (36.1)
Sleep time < 6 hours, n (%)	28 (45.9)
Feeling frequent tiredness, n (%)	36 (59.0)
BMI, Kg/m^2, mean (SD)	26.2 (3.8)
Overweight or obese BMI >24.9, n (%)	34 (55.7)
Psychosocial Information	
Monotonous Works, n (%)	9 (14.8)
Mental stress, 0-10, mean (SD)	5.1 (2.6)
Mental stress, cutoff ≥ 7, n (%)	16 (26.2)
Anxiety, 0-10, mean (SD)	5.6 (2.8)
Anxiety, cutoff ≥ 5, n (%)	40 (65.6)
Dissatisfaction with life, n (%)	8 (13.1)

Continuous variables are expressed in Mean (Standard Deviation) and categorical variables in Frequency (Percent).

Pain or discomfort during the last 12 months in at least one body region was reported by 53 (86.9%) of workers, whereas more than one body region was reported by 45 (73.8%) of workers. The highest musculoskeletal pain or discomfort prevalent during the last 12 months was low back, shoulder, upper back, and neck, respectively (**Figure 1**).

Figure 1. Prevalence of musculoskeletal pain or discomfort during last 12 months (n=61)



A logistic regression was performed to ascertain the effects of potential exposure factors on musculoskeletal pain or discomfort in each body region during the last 12 months. The logistic regression model indicated a protective association between hips/thighs pain or discomfort and overweight or obesity (adjusted OR=0.18; CI=0.03, 0.94; p=0.042). The logistic regression model indicated an association between neck pain or discomfort and no breaks at work (adjusted OR=3.97; CI=1.15, 13.71; p=0.029), shoulders pain or discomfort and overweight or obesity (adjusted OR=4.92; CI=1.49, 16.26; p=0.009), wrists/hands pain or discomfort and workday > 8 hours (adjusted OR=3.86; CI=1.02, 14.68; p=0.047), upper back pain or discomfort and feeling frequent tiredness (adjusted OR=6.73; CI=1.98, 22.87; p=0.002), and between hips/thighs pain or discomfort and mental stress (adjusted OR=5.83; CI=1.15, 29.56; p=0.033). There was no other association between a body region pain discomfort and an exposure factor. The multivariate model that best explained pain or discomfort was developed for the neck in the last 12 months, with a result of 35% (Nagelkerke R2).

The results of logistic regression adjusted of musculoskeletal pain or discomfort in each body region during the last 12 months to each variable and an explanation by the model (Nagelkerk R^2) are presented in **Table 2**.

Table 2. Logistic regression results (n=61) – multivariable analyzes

	Neck	Shoulders	Elbows	Wrists/Hands	Upper back	Low back	Hips/Thighs	Knees	Ankles/Feet
Personal Information									
Daily Housework	0.32 (0.09-1.11)	-	-	-	-	-	-	-	-
Occupational Information									
Hands over shoulder level	-	-	-	-	2.78 (0.75-10.29)	-	-	-	-
No breaks	**3.97 (1.15-13.71)**	2.51 (0.76-8.35)	-	-	-	-	-	-	2.89 (0.93-8.97)
Workday > 8 hours	-	-	-	**3.86 (1.02-14.68)**	-	-	-	-	-
Night work	-	-	-	-	-	-			-
Clinical Information									
No Regular Physical activity	-	-	-	-	-	-	-	-	-
Sleep disorders	1.53 (0.37-6.36)	-	-	-	-	2.11 (0.65-6.88)	-	-	-
Sleep time < 6 hours	-	-	-	-	-	-	-	-	-
Feeling frequent tiredness	-	3.37 (1.00-11.42)	-	4.96 (0.95-26.00)	**6.73 (1.98-22.87)**	2.70 (0.89-8.21)	-	2.63 (0.43-16.16)	-
Overweight or obese BMI >24.9	2.09 (0.60-7.27)	**4.92 (1.49-16.26)**	-	-	-	-	**0.18 (0.03-0.94)**	-	-
Psychosocial Information				-	-	-			
Mental stress, cutoff ≥ 7, n (%)	1.93 (0.44-8.43)	-	-	-	-	-	**5.83 (1.15-29.56)**	3.11 (0.71-13.60)	-
Anxiety, cutoff ≥ 5, n (%)	2.62 (0.61-11.34)	-	-	-	-	-	-	-	-
Nagelkerke R^2 (%)	0.35	0.29	0.09	0.21	0.27	0.13	0.21	0.16	0.08

Note: variables are expressed in OR (95% IC. Values in bold represent statistically significant difference (p<0.05)

Discussion

We observed an association between personal, occupational, clinical, and psychosocial characteristics and musculoskeletal pain or discomfort. A high prevalence of musculoskeletal pain or discomfort among nurse technicians and assistants was verified, emphasizing the spine (i.e., low back, upper back and neck) and shoulders. Our findings suggest an association between no breaks and neck complaints, overweight or obesity and shoulders complaints, workday > 8 hours and wrists/hands complaints, feeling frequent tiredness and upper back complaints, and mental stress and hips/thighs complaints in the last 12 months. In contrast, being overweight or obese had a protective association with

hips/thighs complaints during the previous 12 months. These findings highlight the importance of knowledge about the biopsychosocial nature of musculoskeletal pain among nurse technicians and assistants.

The homogeneity of the sample (i.e., nurse assistants or nurse technicians) and a large number of controlled covariates represent the study's strengths. Also, applying floor and ceiling effects eliminated exposure factors prevalent in the sample from the multivariable analysis. Altogether, these elements can minimize confounding bias. Finally, this study analyzed the prevalence of musculoskeletal pain and discomfort in several body regions, while most research explores one or a few body regions. This fact made it possible to identify the body regions with the highest prevalence of pain or discomfort. However, some limitations should be acknowledged. In Brazil, it is common for these professionals to work double shifts, which is not reported

in the questionnaire. Recall bias may occur due to a self-reported questionnaire containing retrospective information. Despite efforts to reduce bias, the study design allows associations to be established, but a cause-effect relationship cannot be inferred.

Occupational factors were associated with wrists/hands or neck complaints. A long workday was associated with wrists/hands pain or discomfort. Recent study has shown a correlation between physical exhaustion at the end of the workday and musculoskeletal pain in nursing (28). A long workday may be associated with a more significant load on the extremities of the upper limbs, especially in manual jobs as nurses. Long periods of hand exertion may reflect upper limb overuse syndrome (29). Likewise, no breaks at work increased the likelihood of reporting neck complaints. Organisational ergonomic breaks reduce neck discomfort in office workers described by studies with low methodological quality (30). A recent study showed that office workers practised breaks and postural changes effectively reduced new neck pain episodes (31). Long exposure to physical and mental stress can cause overload and pain. Pauses are interventions that potentially act on the physiological recovery of workers and consequently reduce these complaints. However, properly determining the frequency and time of breaks needed for this recovery is a challenge in practice.

Clinical aspects also contributed to pain in body sites. For instance, being overweight or obese (BMI > 24.9) was associated with shoulder pain or discomfort. The association between chronic pain, chronic shoulder pain and obesity has been established (32, 33). Among the possible causal mechanisms of pain in obese individuals are mechanical effects on joints, behavioural (i.e., changes in sleep and decreased physical activity that can impact musculoskeletal pain), and physiological (inflammatory theory) (34). In the same way, nurse professionals who felt frequent tiredness were more likely to inform upper back complaints in the current study. Frequently feeling tired had already been associated with low back pain in nurses (35), and our findings revealed this association with upper back pain. Surprisingly, a protective association was obtained between overweight or obese (BMI > 24.9) and hips/thighs pain or discomfort. To our knowledge, there are no biologically plausible explanations for protection between the exposure factor and the outcome. However, some aspects must be analysed. First, despite the homogeneity of the sample and a large number of covariates included in the model, there may be a difference in workload, and a confounding factor may need to be adequately controlled. Secondly, as previously mentioned, there is a lack of causal relationships in an association study. Therefore, overweight or obese people may seek to remain seated longer to reduce loads and lower limb pain accordingly. Thus, the pain and overweight or obesity would lead to a protective behaviour that justifies these findings. Third, BMI is an inaccurate means of classifying body fat estimation and may indicate false health status because certain people with increased muscle mass may have an elevated BMI (36, 37). Ultimately, being overweight or obese may lead to stronger hip muscles or change movement patterns to adapt to joint overloads.

Mental stress was the psychosocial factor linked to hip/thigh pain or discomfort. Patients with pain-related-hip pathology also present psychological comorbidities (i.e., pain catastrophizing, anxiety, depression) (38). In healthcare professionals, including nurses, musculoskeletal pain is associated with psychological stress (39). A recent study showed that high physical demand occupations or women are more likely to experience musculoskeletal pain and high stress (40). As a psychological condition, we believe that mental stress plays a similar role in the hip/thigh complaints of nursing professionals in the current study.

A high prevalence of pain or discomfort was found in more than one body region. A recent study identified a prevalence of 32.0% of musculoskeletal pain in more than one body region (41). These numbers are much lower than those in our sample (73.8%). Another study verified the prevalence of pain in each body region the values found (low back up to 49.5%, shoulders up to 31.0%, upper back up to 34.8%, and neck pain up to 45.3%) (42) are below our findings except neck pain (59.0%, 49.2%, 47.5%, and 44.3%, respectively). However, similar values were found in licensed practical nurses and nurse technicians (57.1%, 52.0%, 50.8%, and 47.8%) (17), although the values for other regions were lower in our study. These data demonstrate a vulnerability to musculoskeletal pain in the population studied and justify improving the understanding of risk factors.

The current study highlighted the clinical relevance of the biopsychosocial nature of musculoskeletal pain in nursing professionals. For future surveys, longitudinal studies comparing musculoskeletal pain or discomfort considering different biopsychosocial variables be important to preventive and clinical actions against these complaints. In addition, for the effectiveness of preventive programs against musculoskeletal pain in this population should be encouraged to include the different aspects due to the biopsychosocial nature of musculoskeletal pain.

Conclusion

In conclusion, personal, occupational, clinical, and psychosocial characteristics were associated with musculoskeletal pain or discomfort during the last 12 months in nurse technicians and nurse assistants. The participants presented an elevated prevalence of musculoskeletal complaints.

Conflict of interests

The authors declare that there is no potential conflict of interest.

Funding

This study was supported by the Fundação Carlos Chagas Filho de Apoio à Pesquisa do Estado do Rio de Janeiro (FAPERJ, No. E-26/211.104/2021) and Coordenação de Aperfeiçoamento de Pessoal (CAPES, Finance Code 001; No. 88881.708719/2022-01, and No. 88887.708718/2022-00).

References

1. Safiri S, Kolahi AA, Cross M, Hill C, Smith E, Carson-Chahhoud K, et al. Prevalence, Deaths, and Disability-Adjusted Life Years Due to Musculoskeletal Disorders for 195 Countries and Territories 1990-2017. Arthritis Rheumatol. 2021;73(4):702-14.
2. da Costa BR, Vieira ER. Risk factors for work-related musculoskeletal disorders: A systematic review of recent longitudinal studies. Am J Ind Med. 2010;53(3):285-323.
3. Mohammadipour F, Pourranjbar M, Naderi S, Rafie F. Work-related Musculoskeletal Disorders in Iranian Office Workers: Prevalence and Risk Factors. J Med Life. 2018;11(4):328-33.
4. Besharati A, Daneshmandi H, Zareh K, Fakherpour A, Zoaktafi M. Work-related musculoskeletal problems and associated factors among office workers. Int J Occup Saf Ergon. 2020;26(3):632-8.
5. Adedoyin AR, Mbada CE, Ajayi OK, Idowu OA, Oghumu SN, Oke KI, et al. Prevalence and pattern of work-related musculoskeletal disorders among Nigerian bricklayers. Work. 2022;72(2):627-35.
6. Ekechukwu END, Useh E, Nna OL, Ekechukwu NI, Obi ON, Aguwa EN, et al. Ergonomic assessment of work-related musculoskeletal disorder and its determinants among commercial mini bus drivers and driver assistants (mini bus conductors) in Nigeria. PLoS One. 2021;16(12):e0260211.
7. Mishra S, Sarkar K. Work-related musculoskeletal disorders and associated risk factors among urban metropolitan hairdressers in India. J Occup Health. 2021;63(1):e12200.
8. Mansoor SN, Al Arabia DH, Rathore FA. Ergonomics and musculoskeletal disorders among health care professionals: Prevention is better than cure. J Pak Med Assoc. 2022;72(6):1243-5.
9. Roll SC, Tung KD, Chang H, Sehremelis TA, Fukumura YE, Randolph S, et al. Prevention and rehabilitation of musculoskeletal disorders in oral health care professionals: A systematic review. J Am Dent Assoc. 2019;150(6):489-502.
10. Anderson S, Stuckey R, Oakman J. Work-related musculoskeletal injuries in prosthetists and orthotists in Australia. Int J Occup Saf Ergon. 2021;27(3):708-13.
11. Yang S, Lu J, Zeng J, Wang L, Li Y. Prevalence and Risk Factors of Work-Related Musculoskeletal Disorders Among Intensive Care Unit Nurses in China. Workplace Health Saf. 2019;67(6):275-87.
12. Westergren E, Ludvigsen MS, Lindberg M. Prevalence of musculoskeletal complaints among haemodialysis nurses - a comparison between Danish and Swedish samples. Int J Occup Saf Ergon. 2021;27(3):896-901.
13. Arvidsson I, Gremark Simonsen J, Dahlqvist C, Axmon A, Karlson B, Björk J, et al. Cross-sectional associations between occupational factors and musculoskeletal pain in women teachers, nurses and sonographers. BMC Musculoskelet Disord. 2016;17:35.
14. Haeffner R, Kalinke LP, Felli VEA, Mantovani MF, Consonni D, Sarquis LMM. Absenteeism due to musculoskeletal disorders in Brazilian workers: thousands days missed at work. Rev Bras Epidemiol. 2018;21:e180003.
15. Fujii T, Matsudaira K. Prevalence of low back pain and factors associated with chronic disabling back pain in Japan. Eur Spine J. 2013;22(2):432-8.
16. Rypicz Ł, Karniej P, Witczak I, Kołcz A. Evaluation of the occurrence of work-related musculoskeletal pain among anesthesiology, intensive care, and surgical nurses: An observational and descriptive study. Nurs Health Sci. 2020;22(4):1056-64.
17. Moreira RF, Sato TO, Foltran FA, Silva LC, Coury HJ. Prevalence of musculoskeletal symptoms in hospital nurse technicians and licensed practical nurses: associations with demographic factors. Braz J Phys Ther. 2014;18(4):323-33.
18. Freimann T, Pääsuke M, Merisalu E. Work-Related Psychosocial Factors and Mental Health Problems Associated with Musculoskeletal Pain in Nurses: A Cross-Sectional Study. Pain Res Manag. 2016;2016:9361016.
19. Lin SC, Lin LL, Liu CJ, Fang CK, Lin MH. Exploring the factors affecting musculoskeletal disorders risk among hospital nurses. PLoS One. 2020;15(4):e0231319.
20. Younan L, Clinton M, Fares S, Jardali FE, Samaha H. The relationship between work-related musculoskeletal disorders, chronic occupational fatigue, and work organization: A multi-hospital cross-sectional study. J Adv Nurs. 2019;75(8):1667-77.
21. Langballe EM, Innstrand ST, Hagtvet KA, Falkum E, Gjerløw Aasland O. The relationship between burnout and musculoskeletal pain in seven Norwegian occupational groups. Work. 2009;32(2):179-88.
22. Benchimol EI, Smeeth L, Guttmann A, Harron K, Moher D, Petersen I, et al. The REporting of studies Conducted using Observational Routinely-collected health Data (RECORD) statement. PLoS Med. 2015;12(10):e1001885.
23. Pinheiro FA, Troccoli BT, Carvalho CV. [Validity of the Nordic Musculoskeletal Questionnaire as morbidity measurement tool]. Rev Saude Publica. 2002;36(3):307-12.
24. de Barros EN, Alexandre NM. Cross-cultural adaptation of the Nordic musculoskeletal questionnaire. Int Nurs Rev. 2003;50(2):101-8.
25. Kent P, Mirkhil S, Keating J, Buchbinder R, Manniche C, Albert HB. The concurrent validity of brief screening questions for anxiety, depression, social isolation, catastrophization, and fear of movement in people with low back pain. Clin J Pain. 2014;30(6):479-89.
26. Vaegter HB, Handberg G, Kent P. Brief Psychological Screening Questions Can be Useful for Ruling Out Psychological Conditions in Patients With Chronic Pain. Clin J Pain. 2018;34(2):113-21.
27. Gulledge CM, Lizzio VA, Smith DG, Guo E, Makhni EC. What Are the Floor and Ceiling Effects of Patient-Reported Outcomes Measurement Information System Computer Adaptive Test Domains in Orthopaedic Patients? A Systematic Review. Arthroscopy. 2020;36(3):901-12.e7.
28. Sigursteinsdóttir H, Skúladóttir H, Agnarsdóttir T, Halldórsdóttir S. Stressful Factors in the Working Environment, Lack of Adequate Sleep, and Musculoskeletal Pain among Nursing Unit Managers. Int J Environ Res Public Health. 2020;17(2).
29. Bird HA. Overuse syndrome in musicians. Clin Rheumatol. 2013;32(4):475-9.
30. Hoe VC, Urquhart DM, Kelsall HL, Zamri EN, Sim MR. Ergonomic interventions for preventing work-related musculoskeletal disorders of the upper limb and neck among office workers.

Cochrane Database Syst Rev. 2018;10:CD008570.

31. Waongenngarm P, van der Beek AJ, Akkarakittichoke N, Janwantanakul P. Effects of an active break and postural shift intervention on preventing neck and low-back pain among high-risk office workers: a 3-arm cluster-randomized controlled trial. Scand J Work Environ Health. 2021;47(4):306-17.

32. Li J, Chen J, Qin Q, Zhao D, Dong B, Ren Q, et al. Chronic pain and its association with obesity among older adults in China. Arch Gerontol Geriatr. 2018;76:12-8.

33. Özkuk K, Ateş Z. The effect of obesity on pain and disability in chronic shoulder pain patients. J Back Musculoskelet Rehabil. 2020;33(1):73-9.

34. Chin SH, Huang WL, Akter S, Binks M. Obesity and pain: a systematic review. Int J Obes (Lond). 2020;44(5):969-79.

35. Smedley J, Inskip H, Buckle P, Cooper C, Coggon D. Epidemiological differences between back pain of sudden and gradual onset. J Rheumatol. 2005;32(3):528-32.

36. StatPearls. 2022.

37. Rothman KJ. BMI-related errors in the measurement of obesity. Int J Obes (Lond). 2008;32 Suppl 3:S56-9.

38. Gudmundsson P, Nakonezny PA, Lin J, Owhonda R, Richard H, Wells J. Functional improvement in hip pathology is related to improvement in anxiety, depression, and pain catastrophizing: an intricate link between physical and mental well-being. BMC Musculoskelet Disord. 2021;22(1):133.

39. Hämmig O. Work- and stress-related musculoskeletal and sleep disorders among health professionals: a cross-sectional study in a hospital setting in Switzerland. BMC Musculoskelet Disord. 2020;21(1):319.

40. Vinstrup J, Sundstrup E, Andersen LL. Psychosocial stress and musculoskeletal pain among senior workers from nine occupational groups: Cross-sectional findings from the SeniorWorkingLife study. BMJ Open. 2021;11(3):e043520.

41. Haukka E, Ojajärvi A, Kaila-Kangas L, Leino-Arjas P. Protective determinants of sickness absence among employees with multisite pain-a 7-year follow-up. Pain. 2017;158(2):220-9.

42. Henschke N, Kamper SJ, Maher CG. The epidemiology and economic consequences of pain. Mayo Clin Proc. 2015;90(1):139-47.