Original Article

Acute Care Nurses' Musculoskeletal Disorders: A Cross-Sectional Study

Gulten Sucu Dag, PhD, RN
Associate Professor, Eastern Mediterranean University, Faculty of Health Sciences, Nursing Department, Famagusta, North Cyprus, Mersin 10, Turkey

Fatma Cebeci, PhD, RN
Professor, Akdeniz University, Faculty of Nursing, 07058 Campus/ Antalya, Turkey

Ebru Karazeybek, PhD, RN
Assistant Professor, Akdeniz University, Faculty of Nursing, 07058 Campus/ Antalya, Turkey

Arzu Tat Catal, MSN, RN
Research Assistant, Akdeniz University, Faculty of Nursing, 07058 Campus, Antalya, Turkey

Correspondence: Ebru Karazeybek, PhD, RN, Assistant Professor, Akdeniz University, Faculty of Nursing, 07058 Campus/ Antalya, Turkey E- mail: ekarazeybek@gmail.com

The name and the postal address of the place where the work was carried out: Antalya, Turkey, Akdeniz University, Faculty of Nursing, 07058 Campus/ Antalya, Turkey

Abstract

Background: Nurses worldwide are among the high-risk occupational groups in terms of musculoskeletal disorders.
Aim: The aim of this study was to determine the musculoskeletal disorders and the factors affecting them in nurses working in acute care settings.
Methods: This cross-sectional, descriptive study was conducted with 754 nurses working in hospitals in a province. The data were collected between March and October 2016 with a "Personal Information Form" and "The Turkish version of the Standardized Nordic Questionnaire for Analysis of Musculoskeletal Symptoms".
Results: The general prevalence of musculoskeletal disorders was reported as 64.1%. The body regions with the most musculoskeletal disorders were reported to be the upper back, low back, neck, and shoulders, respectively. Statistically significant differences in low back pain were found according to gender; in neck pain according to age, gender, and working duration as a nurse, and in shoulder pain according to age, gender, body mass index, and working duration as a nurse.
Conclusions: This study revealed that musculoskeletal disorders are common among nurses and that they constitute an important occupational problem. Institutional policies need to be developed for early diagnosis and appropriate rehabilitation of musculoskeletal disorders.

Keywords: Acute care settings, musculoskeletal disorders, nursing, rehabilitation

Introduction

Musculoskeletal Disorders (MSDs) are among the leading causes of workforce loss in many countries, and are regarded as the most important factor affecting loss of production. Factors regarded as the main reasons for musculoskeletal disorders, such as the necessity of working long hours on one's feet, bending down, lifting heavy weights, repetitive tasks, static posture, heavy workload and responsibility, and inadequate organization of work, are inseparable parts of the nursing profession (Long, Bogossian, & Johnston, 2013; Souza & Alexandre, 2012). For this reason, nurses are among the high-risk occupational groups for MSDs (Thinkhamrop et al., 2017). Epidemiological studies reveal that a large percentage of nurses working in hospitals are affected by musculoskeletal disorders. Globally, the prevalence of MSDs among nurses ranges between 33-88% (Long et al., 2013; Soylar & Ozer, 2018; Thinkhamrop et al., 2017). In an article in which results of studies made in developing countries were reviewed, the rate of MSDs in employees in general was 37%,

whereas it reached as high as 92% in the nursing profession (Thinkhamrop et al., 2017).

In Turkey, the number of studies examining the prevalence and causative factors of MSDs in nurses working in hospitals is limited. Frequently, it is seen that studies including specific clinical settings are carried out and that general prevalence and factors affecting MSDs are evaluated more limitedly. In a study conducted in Turkey, prevalence of MSDs among nurses working in a hospital was between 79.5-90% (Pinar, 2010). In a study carried out by Tezel (2005), it was determined that 65% of nurses experienced back pain and 54% experienced shoulder pain. In Sezgin and Esin's (2015) study conducted with 323 intensive care nurses, it was revealed that nurses most often suffered from foot, upper back and low back pain. There are also research results indicating that nurses working in operating theatres mostly experienced upper back, low back and neck pain, that this situation affected their home and work lives, that they used medication, and that they changed their places of work (Kandemir et al., 2019). Nurses, who are in a difficult occupational group in a physical sense, are in a group which is at high risk of developing musculoskeletal disorders due to the fact that their musculoskeletal systems are subjected to a wide variety of risk factors. Due to MSDs, nurses may feel unable to work or feel the need to change jobs or take early retirement (Soylar & Ozer, 2018; Thinkhamrop et al., 2017). By leading to reduction in or barriers to an individual's work capacity, physical impairment places a burden on employers and society. MSDs are a global problem that leads to significant health problems and socio-economic consequences (Luhmann et al., 2006). Determining the distribution of MSDs among nurses is important in terms of taking precautions against these risks. In order to prevent situations that may lead to loss of work for nurses and to protect the health of employees, it is necessary to predetermine the factors that can create these problems by means of MSD frequency and secondary prevention approaches (Khasnabis, Heinicke Motsch, & Achu, 2010).

When occupational health risks are in question, it is important to be proactive. Orientation towards prehabilitation by early detection can be evaluated as a proactive approach for managing MSDs. MSD problems experienced by nurses working in all acute care settings threaten their health and lead to workforce losses. Therefore, rehabilitation becomes important, and there is a need to determine the MSDs and the factors affecting this. The findings of this study will contribute to determining the risk factors for MSDs and to the planning of preventive rehabilitation programs in line with the determined risk factors. The aim of this study was to determine the musculoskeletal disorders and the factors affecting them in nurses working in the acute care settings. To achieve this aim, answers to the following questions were sought:

1. What are the musculoskeletal disorders experienced by acute care nurses?

2. Do nurses' sociodemographic and clinical characteristics affect their MDS experience?

Method

Design: The research is of the cross-sectional, descriptive type. The questionnaires were given out to the nurses in each hospital department by the researchers and collected during the same day.

Study universe and sample: The study universe consisted of 1519 nurses working in city center hospitals. The university, state and private hospitals have different working hours and conditions. Working hours can have an effect on musculoskeletal disorders. Therefore, first of all, stratification was performed in order to determine the number of samples to be taken from each institution. The stratified random sampling technique was used for sample selection. For the sampling, nurses were included in the sample group pro rata (1/2) according to the acute care settings the nurses worked in. Nurses selected with the simple random sampling method from each stratum formed the sample group. The research was conducted with 754 nurses.

Data collection: This study was conducted in university, state and private hospitals. The data were collected between March and October 2016 with a self-reporting questionnaire based on a "Personal Information Form" and "The Standardized Nordic Questionnaire for Analysis of Musculoskeletal Symptoms (Turkish Version). **The Personal Information Form**, which was created by the researchers following a review of the related literature (Bernal et al., 2015; Pinar, 2010; Sezgin & Esin, 2015), includes demographic questions about age, gender, marital status, BMI, and tobacco use, etc., and questions related to subjects comprising individual, physical and occupational risk factors. The Turkish validity

and reliability of the "Standardized Nordic Questionnaire for Analysis of Musculoskeletal Symptoms", developed by Kuorinka et al. (1987) was performed by Kahraman et al. (2016) The internal consistency of the Turkish version of the Nordic Musculoskeletal Questionnaire was excellent, with a Cronbach's alpha of 0.89. Cronbach's alpha coefficient of this study was calculated as 0.88. The validity and reliability of the questionnaire for musculoskeletal disorders has been demonstrated in various studies (Abo El Ata et al.,2016; Amin et al.,2014; Bernal et al., 2015; Luan et al., 2018). The Standardized Nordic Questionnaire for Analysis of Musculoskeletal Symptoms provides reliable information about the onset, prevalence and outcome of musculoskeletal pain, and consists of two sections in which the related complaints are identified. The first section assesses whether or not there has been any ache, pain or discomfort in nine body areas (neck, shoulder, upper back, elbow, low back, hand/wrist, thigh, knee, and foot/ankle) within the last 12 months and the last 7 days, and whether or not this has prevented the sufferer from doing his/her work. The second section contains additional questions about disorders related to the neck, shoulders and low back and the type, duration and effects of the disorders during the last 12 months and last 7 days. The questionnaires were given out to the nurses in each hospital department by the researchers and collected during the same day.

Data evaluation: The research data were evaluated using SPSS software (IBM Company, Armonk, NY, USA). Numbers and percentages were used for descriptive variables and for determining musculoskeletal disorders experiences while chi-square test was used for determining factors affecting musculoskeletal disorders. Differences between variables having fewer than five per cell were investigated separately by using Fisher's exact test. Probability values below 0.05 were accepted as statistically significant for all tests. The Cronbach's alpha coefficient of this study was calculated.

Ethical considerations: Permission to conduct the research was obtained from the relevant institutions, approval was obtained from the Clinical Research Ethics Committee (20.01.2016/38), written informed consent was received from the participants and complied with the Declaration of Helsinki.

Results

It was determined that 51.9% of the nurses were between the ages of 29 and 38 years, 93.5% were female, 69.5% were married, and 41.6% had associate degrees. It was also determined that 69.1% of the nurses had a BMI between 18.50 and 24.99, 64.4% were non-smokers, and three-quarters of them did not do regular exercise. Moreover, it was revealed that 32.2% of the nurses worked in university hospitals and that 30.1% of them worked in surgical clinics, while 27.4% of them had worked in clinics for 6-10 years, and 77.1% of them worked between 41-60 hours per week.

The Nordic musculoskeletal symptom analysis revealed that 64.1% of nurses experienced any musculoskeletal disorder in any body region in the past 12 months. Rates according to body area were reported to be as follows: upper back (64.0%), low back (55.7%), neck (38.5%), and shoulders (33.4%) (Table 1). 33.0% of the nurses stated that they had been prevented from doing work due to low back disorders during the previous 12 months. The rate for nurses suffering from upper back pain during the previous 7 days was 19.3% (Table 1).

It was determined that 41.6% of the nurses had received treatment for low back pain, 37.4% had been treated for neck pain, and 36.9% had been treated for shoulder pain during the previous 12 months. It was revealed that 4.9% of the nurses had changed jobs due to lumbar pain (Table 2). Statistically significant differences in low back pain were found according to gender (p=0.001); in neck pain according to age, (p=0.009), gender (p=0.005) and working duration as a nurse (p=0.008); and in shoulder pain according to age (p=0.002), gender (p=0.004), BMI (p=0.008) and working duration as a nurse (p=0.002) (Table 3).

Table 1. Distribution of disorders suffered by nurses according to body areas with reference to Nordic analysis of musculoskeletal symptoms (n:754)

Areas	*Those Suffering During Past 12 Months*		*Those Prevented from Working During Past 12 Months*		*Those Suffering During Past 7 Days*	
	n	***%****	***n***	***%****	***n***	***%****
Low back	420	55.7	249	33.0	143	18.9
Neck	291	38.5	136	18.0	93	12.3
Shoulder	252	33.4	92	12.2	82	10.8
Elbow	74	9.8	36	4.7	19	2.5
Hand/Wrist	186	24.6	111	14.7	55	7.2
Upper back	483	64.0	182	24.1	146	19.3
Thigh	142	18.8	82	10.8	51	6.7
Knee	186	24.6	103	13.6	76	10.0
Foot/Ankle	194	25.7	103	13.6	82	10.8

*Since disorders occurred in more than one area of the body, n was increased. Percentages were taken from total n.

Table 2. Status of treatment and inability to work due to musculoskeletal disorders in acute care nurses (n:754)

	Low Back (n:505)		*Neck (n:345)*		*Shoulder (n:249)*	
	n	***%****	***n***	***%****	***n***	***%****
Total period of discomfort during past 12 months						
0 days (no impediment)	-	-	49	14.2	32	12.9
1-7 days	157	37.3	129	37.3	93	37.6
8-30 days	76	18.1	63	18.2	42	17.0
Over 30 days	139	33.1	70	20.2	61	24.7
Every day	48	11.4	34	9.8	19	7.6
Those receiving treatment due to discomfort during past 12 months	175	41.6	110	37.4	79	36.9
Period of inability to work during past 12 months						
0 days	189	45.0	150	51.0	90	42.2
1-7 days	134	31.9	80	27.2	75	35.2

8-30 days	52	12.3	31	10.5	24	11.2
Over 30 days	45	10.7	33	11.2	24	11.2
Those changing jobs due to their discomfort	25	4.9	6	1.7	3	1.2

Table 3. Comparison of nurses' identifying characteristics with their musculoskeletal disorders

	Area of Discomfort	*Low Back (n:505)*		*Neck (n:345)*		*Shoulder (n:249)*	
Identifying Characteristics		***n***	***%§***	***n***	***%§***	***n***	***%§***
Age	18-28	151	29.9	90	26.1	62	24.9
	29-38	263	52.1	184	53.3	127	51.0
	39-48	74	14.7	63	18.3	50	20.1
	48-56	17	3.4	8	2.3	10	4.0
	χ^2 / p*	3.477	.324	11.628	**.009**	15.144	**.002**
Gender	Female	483	95.6	332	96.2	242	97.2
	Male	22	4.4	13	3.8	7	2.8
	χ^2 / p	11.549	**.001**	7.804	**.005**	8.319	**.004**
Education level	Health vocational High school	95	18.8	52	15.1	36	14.5
	Associate degree	215	42.6	154	44.6	116	46.6
	Degree and above	195	38.6	139	40.3	97	38.9
	χ^2 / p	1.325	.516	5.002	.082	5.294	.071
Marital status	Married	362	71.7	248	71.9	176	70.7
	Single	143	28.3	97	28.1	73	29.3
	χ^2 / p	3.451	.063	1.711	.191	0.247	.619
BMI	10.00-18.40	21	4.2	11	3.2	5	2.0
	18.50-24.99	346	68.5	237	68.7	167	67.1
	25.00-29.99	106	21.0	76	22.0	55	22.1
	30.00-40.00	32	6.3	21	6.1	22	8.8
	χ^2 / p	1.721	.632	2.257	.521	11.893	**.007**
Smoking habits	Non-smoker	316	62.6	214	62.0	165	66.3
	Smoker	189	37.4	131	38.0	84	33.7
	χ^2 / p	2.364	.124	1.636	.201	0.531	.466
Doing regular exercise	No	395	78.2	271	78.6	196	78.7
	Yes	110	21.8	74	21.4	53	21.3
	χ^2 / p	0.290	.591	0.020	.888	0.001	.976
Working duration as a nurse	0-5 years	102	20.2	65	18.8	49	19.7
	6-10 years	136	26.9	82	23.8	51	20.5
	11-15 years	124	24.6	84	24.3	67	26.9
	16-20 years	83	16.4	65	18.8	41	16.5
	21 years and over	60	11.9	49	14.2	41	16.5
	χ^2 / p	2.054	.726	13.734	**.008**	16.515	**.002**

Hours worked per week	1-40	119	23.6	80	23.2	66	26.5
	41-60	386	76.4	265	76.8	183	73.5
	χ^2 / p	0.492	.483	0.051	.820	2.882	.090
Clinic where employed	Surgical clinics	144	28.5	107	31.0	83	33.3
	Internal clinics	129	25.5	68	19.7	56	22.5
	Intensive care Unit	102	20.2	79	22.9	52	20.9
	Operating theatre	80	15.8	65	18.8	40	16.1
	Emergency services	50	9.9	26	7.5	18	7.2
	χ^2 / p	7.605	.107	9.364	.053	3.307	.508

§Percentages were taken from the n number of the relevant body area

*p<.05 Note BMI = body mass index

Discussion

Musculoskeletal disorders are a serious public health problem globally (Storheim & Zwart, 2014; Thinkhamrop et al., 2017). Healthcare personnel belong to a high-risk occupational group with regard to MSDs (Soylar & Ozer, 2018; Thinkhamrop et al., 2017). In this study, which was conducted with 754 nurses working in clinics in university, state and private hospitals in a city center, it was determined that disorders related to the musculoskeletal system, primarily in the upper and low back, were common among nurses.

In the study, it was seen that over half of the nurses had suffered from upper and low back pain during the previous 12 months, and that this was followed by neck and shoulder pain (Table 1). Although there are studies which, in parallel with our research findings, reveal that nurses mostly experience upper back pain (Gul et al., 2014; Kandemir et al., 2019), in studies conducted nationally and internationally, the majority of studies report that nurses most frequently experience low back pain (Freimann et al., 2013; Gul et al., 2014; Luan et al., 2018; Ovayolu et al., 2014; Ribeiro, Serranheira, & Loureiro, 2017; Wang, Dai, & Ning, 2015). In the literature, although the low back area generally occupies first place among musculoskeletal disorders suffered by nurses, disorders of the other areas are also common, and MSDs are a universal problem in the nursing profession. Due to nurses' exposure to various risk factors in different work conditions, MSDs are an expected result. MSDs can lead to various problems for nurses by having a negative impact on both their professional experiences and their private lives. This and similar studies revealing the rates and importance of MDSs in nurses can be of benefit for creating awareness towards prevention initiatives. There is a need to create and implement prehabilitation plans by displaying a proactive approach towards MSDs. It was reported in studies that nurses with disorders of the musculoskeletal system generally used medication and resorted to medical, surgical and physical treatment methods to alleviate the symptoms (Choobineh et al., 2010), and that 37.8% of them were prevented from working (Luan et al., 2018). There are also nursing studies in which nurses stated that due to disorders of the musculoskeletal system, there had been periods when they were unable to continue working within the previous 12 months (Ribeiro et al., 2017), they wished to change their place of work (Kandemir et al., 2019), and that they could change their jobs in the future (Choobineh et al., 2010).

In the study, it was revealed that almost half of the nurses had received treatment for lumbar pain during the previous 12 months, and that low back complaints were the biggest reason for them to change jobs (Table 2). Nurses suffering from MSDs may work less, retire earlier, become unemployed, or spend more on their health. Consequently, MDSs suffered by nurses can also be accompanied by a significant financial burden. Our results reveal that to

control nurses' musculoskeletal system disorders, there is a need for ergonomic and prehabilitation programs such as therapeutic exercises and posture training. It is considered that with the implementation of these programs, musculoskeletal system disorders can be reduced and that consequently, productivity can be increased. It is thought that in order to reduce demand for job changes, appropriate organization of workload and improvement of work environments can decrease the negative effects of MDSs on nurses.

Individual risk factors are another important aspect of MDSs. It was revealed in the study that age, gender, number of hours worked per week and BMI had an effect on MSDs. In the study, the rate of incidence of MSDs in nurses in the 29-38 age group was high (Table 3). Although there are other study findings which support the results of our study (Kandemir et al., 2019; Lin et al., 2020), in contrast with our findings, it was reported in some studies that musculoskeletal system disorders were seen more frequently as age advanced (Keriri, 2013; Simsek, Yagci, & Senol, 2017), while in other studies, age had no effect (Nutzi et al., 2015; Rathore, Attique, & Asmaa, 2017). In this study, it is considered that MSD rates were higher because nurses in this age group are in a more active period of their lives.

In the study, although the rate of low back complaints in women was significantly higher than in men (Table 3), this result is considered to be due to the low number of male nurses participating in the research. Similar to this finding, it was also stated in the study by Luan et al. (2018) that the high rates of MSDs reported in nurses were one of the female gender-related factors. Some studies dealing with the subject of MSDs in nursing professionals support the fact that these disorders are dominant in women with scientific evidence, and stress that being a woman and nurse contributes to the rate of low back pain in women being 2.26 times that of men (Munabi et al., 2014; Petersen & Marziale, 2017). The reason for this situation is stated to be related to anthropomorphic differences or the different characteristics of muscle fibers between men and women (Côté, 2012; Petersen & Marziale, 2017). It is possible that males have different risk factors related to MSDs. There is a need for further research in which the effect of gender is evaluated.

In the literature, it is reported that long working hours cause both physical and psycho-social problems, and that they cause an increase in MSDs (Bae & Fabry, 2014; Lin et al., 2020). In the study conducted by Kalkim et al. (2019) it was reported that neck and ankle pain increased in nurses who worked for more than 40 hours. Bae and Fabry (2014) stated that in seven out of nine studies, there was a correlation between working for more than 40 hours per week and MSDs in nurses. In this study, too, it was revealed that 77.1% of nurses worked for between 41-60 hours per week and that long periods of work per week increased shoulder pain (Table 3). The tension, lack of physical activity and inability to set aside enough time for relaxation created by long working hours may have caused these disorders in nurses.

BMI is associated with MSDs in various areas of the body (Viester et al., 2013). In this study, it was revealed that nurses with high BMI had high rates of suffering from shoulder disorders (Table 3). Similar to our study findings, Singh et al. (2012) and Lin et al. (2020) revealed that there was a significant relationship between BMI and development of MSDs in nurses. The high rates of shoulder discomfort in nurses with high BMI can be the subject of a separate study.

It is stated in the literature that BMI, tobacco use, doing regular physical activity, and organizational factors dependent on the hospital had an impact on disorders of the musculoskeletal system (Attar, 2014; Soylar & Ozer, 2018). In line with these findings, considering the high rates of detection of MSDs in nurses and the danger caused by MSDs to employee safety, a proactive approach is essential. To protect nurses' physical and mental health and to prevent workforce losses, guiding them towards rehabilitation by early identification of the symptoms that appear is imperative.

Limitations: This study has some limitations. The fact that the research is a descriptive study and that the data are based on participants' statements can be regarded as important limitations. Furthermore, another limitation is the possibility that memory lapses might have occurred while remembering MSD symptoms in the responses to the questions related to complaints that occurred during the previous 12 months in the questionnaire used to gather the study data. It cannot be generalized to nurses other than the hospitals where the research was conducted.

Conclusion: The right to possess the highest possible physical and mental health standards, in short, "the right to health", "is a basic human right protected by international law". There are a great many risk factors that can affect the health of almost all occupational groups, but amongst these, nurses are one of the groups at greatest risk. In our study, too, high rates of pain, especially of upper back, low back, neck and shoulder pain, related to the musculoskeletal system were determined in nurses. Preventive activities are needed to increase awareness for preventing MDSs in nurses. Since the percentage of nurses who did regular exercise was low in our study, in the name of musculoskeletal and spinal health, it can be recommended that nurses do regular exercise and that they be given support in this matter. It is important to establish institutional policies for the prevention, reduction and rehabilitation of employees by determining musculoskeletal system disorders and risk factors. Moreover, it is recommended that data of studies to be conducted on this subject in the future should be collected from data recorded in hospital systems.

Acknowledgments: The authors would like to thank the nurses who completed the questionnaire and particularly Prof. Mehmet Ziya FIRAT for his valuable support in the statistical analysis.

References

Abo El Ata, G., El Desouky, S., Manawil, M., & Khalifa, E. (2016). Assessment of work-related musculoskeletal symptoms in operation room nurses. *Curr Sci Int, 5*(2), 215-222.

Amin, N. A., Nordin, R., Fatt, Q. K., Noah, R. M., & Oxley, J. (2014). Relationship between Psychosocial Risk Factors and Work-Related Musculoskeletal Disorders among Public Hospital Nurses in Malaysia. *Annals of occupational and environmental medicine, 26*, 23-23.

Attar, S. M. (2014). Frequency and risk factors of musculoskeletal pain in nurses at a tertiary centre in Jeddah, Saudi Arabia: a cross sectional study. *BMC research notes, 7*, 61-61.

Bae, S. H., & Fabry, D. (2014). Assessing the relationships between nurse work hours/overtime and nurse and patient outcomes: systematic literature review. *Nurs Outlook, 62*(2), 138-156.

Bernal, D., Campos-Serna, J., Tobias, A., Vargas-Prada, S., Benavides, F. G., & Serra, C. (2015). Work-related psychosocial risk factors and musculoskeletal disorders in hospital nurses and nursing aides: a systematic review and meta-analysis. *International journal of nursing studies, 52*(2), 635-648.

Choobineh, A., Movahed, M., Tabatabaie, S. H., & Kumashiro, M. (2010). Perceived demands and musculoskeletal disorders in operating room nurses of Shiraz city hospitals. *Industrial health, 48*(1), 74-84. doi:10.2486/indhealth.48.74.

Côté, J. N. (2012). A critical review on physical factors and functional characteristics that may explain a sex/gender difference in work-related neck/shoulder disorders. *Ergonomics, 55*(2), 173-182. doi:10.1080/00140139.2011.586061.

Freimann, Coggon, D., Merisalu, E., Animägi, L., & Pääsuke, M. (2013). Risk factors for musculoskeletal pain amongst nurses in Estonia: a cross-sectional study. *BMC Musculoskelet Disord, 14*, 334-334.

Gul, A., Ustundag, H., Kahraman, B., & Purisa, S. (2014). Evaluation of Musculoskeletal Pain among Nurses. . *Journal of Health Science and Profession, 1*(1), 1-10. doi:10.17681/hsp.77225.

Kahraman, T., Genc, A., & Goz, E. (2016). The Nordic Musculoskeletal Questionnaire: cross-cultural adaptation into Turkish assessing its psychometric properties. *Disability and Rehabilitation, 38*(21), 2153-2160.

Kalkim, A., Midilli, T. S., & Dogru, S. (2019). Musculoskeletal disorder symptoms in nurses and etiological factors: A cross-sectional research. *Ann Med Res, 26*(3), 374-381.

Kandemir, D., Karaman, A., Altun Ugraş, G., & Oztekin, D. (2019). Determination of Musculoskeletal System Pain in Operating Room Nurses. *Journal of Education and Research in Nursing, 16*(1), 1-7.

Keriri, H. (2013). Prevalence and risk factors of low back pain among nurses in operating rooms, Taif, Saudi Arabia. *Am J Res Commun,* 1(11), 25.

Khasnabis, C., Heinicke Motsch, K., & Achu, K. (2010). Community-Based Rehabilitation: CBR Guidelines. Retrieved from https://www.ncbi.nlm.nih.gov/books/NBK310943/.

Kuorinka, I., Jonsson, B., Kilbom, A., Vinterberg, H., Biering-Sørensen, F., Andersson, G., & Jørgensen, K. (1987). Standardised Nordic questionnaires for the analysis of musculoskeletal symptoms. *Applied ergonomics, 18*(3), 233-237.

Lin, S. C., Lin, L. L., Liu, C. J., Fang, C. K., & Lin, M. H. (2020). Exploring the factors affecting musculoskeletal disorders risk among hospital nurses. *Plos One, 15*(4), e0231319. doi:10.1371/journal.pone.0231319.

Long, M. H., Bogossian, F. E., & Johnston, V. (2013). The prevalence of work-related neck, shoulder, and upper back musculoskeletal disorders among midwives, nurses, and physicians: a systematic review. *Workplace health & safety, 61*(5), 223-230.

Luan, H. D., Hai, N. T., Xanh, P. T., Giang, H. T., Van Thuc, P., Hong, N. M., & Khue, P. M. (2018). Musculoskeletal Disorders: Prevalence and Associated Factors among District Hospital Nurses in Haiphong, Vietnam. *BioMed research international,* 3162564-3162564.

Luhmann, D., Stoll, S., Burkhardt-Hammer, T., & Raspe, H. (2006). Prevention of relapsing backache. *GMS Health Technology Assessment, 2*, 1-11. doi:10.1371/journal.pone.0231319.

Munabi, I. G., Buwembo, W., Kitara, D. L., Ochieng, J., & Mwaka, E. S. (2014). Musculoskeletal disorder risk factors among nursing professionals in low resource settings: a cross-sectional study in Uganda. *BMC nursing, 13*(1), 7-7. d

Nutzi, M., Koch, P., Baur, H., & Elfering, A. (2015). Work-Family Conflict, Task Interruptions, and Influence at Work Predict Musculoskeletal Pain in Operating Room Nurses. *Safety and health at work, 6*(4), 329-337.

Ovayolu, O., Ovayolu, N., Genc, M., & Col-Araz, N. (2014). Frequency and severity of low back pain in nurses working in intensive care units and influential factors. *Pakistan journal of medical sciences, 30*(1), 70-76.

Petersen, R. S., & Marziale, M. H. P. (2017). Analysis of work capacity and stress among nursing professionals with musculoskeletal disorders. *Revista gaucha de enfermagem, 38*(3), 67184-67184.

Pinar, R. (2010). Work-Related Musculoskeletal Disorders in Turkish Hospital Nurses. *Turkiye Klinikleri Tip Bilimleri Dergisi, 30*(6), 1869. doi:10.5336/medsci.2009-13539.

Rathore, F. A., Attique, R., & Asmaa, Y. (2017). Prevalence and Perceptions of Musculoskeletal Disorders Among Hospital Nurses in Pakistan: A Cross-sectional Survey. *Cureus, 9*(1), 1001-1001.

Ribeiro, T., Serranheira, F., & Loureiro, H. (2017). Work related musculoskeletal disorders in primary health care nurses. *Applied Nursing Research, 33*, 72-77. d

Sezgin, D., & Esin, M. N. (2015). Predisposing factors for musculoskeletal symptoms in intensive care unit nurses. *International nursing review, 62*(1), 92-101. doi:10.1111/inr.12157.

Simsek, S., Yagci, N., & Senol, H. (2017). Prevalence of and risk factors for low back pain among healthcare workers in Denizli. *The journal of the Turkish Society of Algology, 29*(2), 71-78.

Singh, J., Lal, H., & Kocher, G. (2012). Musculoskeletal disorder risk assessment in small scale forging industry by using RULA method. *International Journal of Engineering and Advanced Technology, 1*(5), 513-518.

Souza, A. C., & Alexandre, N. M. C. (2012). Musculoskeletal symptoms, work ability, and disability among nursing personnel. *Workplace health & safety, 60*(8), 353-360.

Soylar, P., & Ozer, A. (2018). Evaluation of the prevalence of musculoskeletal disorders in nurses: A systematic review. *Medicine Science, 7*(3), 479-485.

Storheim, K., & Zwart, J.A. (2014). Musculoskeletal disorders and the Global Burden of Disease study. *Annals of the rheumatic diseases, 73*(6), 949-950. doi:10.1136/annrheumdis-2014-205327.

Tezel, A. (2005). Musculoskeletal complaints among a group of Turkish nurses. *The International journal of neuroscience, 115*(6), 871-880. doi:10.1080/00207450590897941.

Thinkhamrop, W., Sawaengdee, K., Tangcharoensathien, V., Theerawit, T., Laohasiriwong, W., Saengsuwan, J., & Hurst, C. P. (2017). Burden of musculoskeletal disorders among registered nurses: evidence from the Thai nurse cohort study. *BMC nursing, 16*(68), 1-9. doi:10.1186/s12912-017-0263-x.

Viester, L., Verhagen, E. A., Oude Hengel, K. M., Koppes, L. L., van der Beek, A. J., & Bongers, P. M. (2013). The relation between body mass index and musculoskeletal symptoms in the working population. *BMC Musculoskelet Disord, 14*, 238.

Wang, D., Dai, F., & Ning, X. (2015). Risk Assessment of Work-Related Musculoskeletal Disorders in Construction: State-of-the-Art Review. *Journal of Construction Engineering and Management, 141*, 04015008. doi:10.1061/(ASCE)CO.1943-7862.0000979.