



Prevalence of work-related musculoskeletal disorders among pediatric long-term ventilatory care unit nurses: Descriptive cross-sectional study

Brightlin Nithis Dhas^{a,*}, Lillikutty Joseph^b, Julee Ansa Jose^b, Jain Mariya Zeeser^b, Jasmine Priyadharshini Devaraj^b, Manigandan Chockalingam^c

^a Occupational Therapy Department, Qatar Rehabilitation Institute, Hamad Medical Corporation, Doha, Qatar

^b Pediatric Long Term Ventilatory Care Unit, Almaha Center for Children and Young Adults, Wakra, Qatar

^c School of Health Sciences, National University of Ireland Galway, Galway, Ireland

ARTICLE INFO

Article history:

Received 16 August 2022

Revised 18 November 2022

Accepted 16 December 2022

Keywords:

Long term care

Musculoskeletal disorders

Nurses

Pediatric

Pain

Prevalence

ABSTRACT

Purpose: Prevalence of musculoskeletal disorders (MSD) is widely reported among nurses but not specific to nurses working in pediatric long-term ventilatory care (PLTVC) units. The purpose of this study is to determine the prevalence of MSD among nurses working in PLTVC settings.

Design and methods: Cross-sectional descriptive design. Using the Extended Nordic Musculoskeletal Questionnaire, 127 nurses working in PLTVC units were recruited to examine the prevalence of single-site, two-site, and multi-site MSDs in nine body parts.

Results: 90.6% of participants reported a lifetime prevalence of MSD in single site, 95% CI [84.21, 94.51]; 53.5% in two-sites, 95% CI [44.89, 61.99]; 46% in multi-sites, CI [28.38, 44.87]. The most common pain site was lower back (55.1%) followed by neck (35.4%), shoulder (33.9%), upper back (29.1%), wrist/hand (17.3%), ankle/ft (15.7%), knee (15%), hips/thighs (11.8%), and elbow (7.9%). There was a statistically significant difference in participants' years of experience in PLTVC among those reporting multi-site pain ($M = 6.10$, $SD = 5.58$) and the rest ($M = 3.77$, $SD = 3.84$) of the group reporting no pain or pain in one or two sites; $t = (2.77)$, $p = .006$, 95% CI [0.66, 3.98].

Conclusions: There is a high prevalence of MSD among PLTVC nurses. There seems to be a relationship between years of experience in PLTVC settings and multi-site pain.

Practice implications: PLTVC nurses must take additional precautions, since working in this environment increases the possibility of developing pain in multiple sites, particularly if they have been working for more than six years.

© 2022 The Authors. Published by Elsevier Inc. This is an open access article under the CC BY license (<http://creativecommons.org/licenses/by/4.0/>).

Introduction

The Centers for Disease Control and Prevention defines work-related musculoskeletal disorders as injuries or disorders of the muscles, nerves, tendons, joints, cartilage, and spinal disc that are in part a result of the work environment and one's performance at work, which makes the condition worse or more prolonged (Centers for Disease Control and Prevention, 2020). According to published reports, musculoskeletal disorders (MSD) are a commonly occurring occupational health problem among nurses, with prevalence rates ranging from 54% to 92% (Arsalani et al., 2014; Bernal et al., 2015; Davis & Kotowski, 2015; Gaowgzeh, 2019; Nasaif et al., 2022). MSDs can occur in the hands, wrists, elbows, shoulders, necks, low backs, feet, and legs; however,

the low back, knees, and neck are the most commonly affected sites among nurses (Soylar & Ozer, 2018).

According to Dias (2019), MSDs are the primary cause of absenteeism among nursing professionals, resulting in lost productivity for employers. There are several general intervention strategies such as the use of patient lift systems, patient handling training, multi-component interventions, and cognitive behavioral therapy that are often mentioned in the literature to help protect the nurses from musculoskeletal injuries, but evidence supporting any of these interventions is limited at best (Richardson et al., 2018). Conversely, Kneafsey et al. (2015) suggested that organizational policies and state regulations could effectively modify nursing practices that contribute to the development of MSDs and consequently reduce the incidence and prevalence of MSDs among nurses. As the working environment and workplace performance play a significant role in MSDs, regulations and policies for prevention and management must be contextually appropriate. Although there are many organizational policies and regulations for preventing and managing work-related MSDs among nurses,

* Corresponding author at: Qatar Rehabilitation Institute, Hamad Medical Corporation, Doha P03050, Qatar.

E-mail address: bdhas@hamad.qa (B.N. Dhas).

context-specific policies are relatively scarce. Therefore, to develop and implement these context-specific policies, the identification of factors associated with MSDs and the exploration of the context-specific prevalence of MSDs are necessary.

Pediatric long-term ventilatory care (PLTVC) settings often care for children with severe body impairments, extreme limb and spinal deformities, and chronic respiratory failure resulting from conditions such as neurologic disorders, neuromuscular disease, or airway abnormalities requiring long-term mechanical ventilation (Chau et al., 2017). Although the prevalence of MSDs among nurses working specifically in PLTVC settings has not been studied, studies among nurses working in intensive care units point to a high overall MSD prevalence of 95.9% and a site-specific prevalence of 58.8% for lower back, 44.6% for back, 33.7% for shoulders, 30.3% for neck, 14.9% for feet, 14.6% for arms, 9.6% for wrists, and 7.4% for the head (Sezgin & Esin, 2015). A smaller study was conducted by Lurati and Kim (2021) on 38 nurses in adult intensive care units and neonatal intensive care units. According to this study, nurses working in adult intensive care units were more likely to suffer from knee problems than nurses working in neonatal intensive care units, where ankle/ft problems were more prevalent. Accordingly, MSD experiences differ depending on the workplace, so work-setting-specific MSD prevalence data are necessary.

Often, children admitted to a long-term care facility, such as the PLTVC settings, depend entirely on nurses for their self-care needs due to their disabilities and the chronic nature of their illnesses, which is different from intensive care units (Bettger et al., 2012). There is evidence that nursing tasks such as bed feeding and hygiene care substantially affect low-back pain intensity (Serranheira et al., 2015), making PLTVC nurses more susceptible to MSDs than other pediatric nurses. Although their care may be similar to those of other pediatric nurses in other settings, the PLTVC nurses, for example, have to work around the numerous lifesaving devices that must be connected constantly, even as they deal with children's self-care needs, compromising their body posture. With several lifesaving pieces of equipment surrounding the children in PLTVC, there is limited space for the nurses working in these environments to care for the children, further complicating their task performance. Moreover, the fragility of children receiving care in these settings adds to the nursing care challenges in these settings.

Considering their unique tasks and the demanding conditions they work in, it is imperative to study the prevalence of MSDs among nurses in PLTVC settings. There is a paucity of research on the prevalence of MSD among nurses working in PLTVC settings (Davis & Kotowski, 2015). Therefore, the primary objective of the study is to determine the prevalence of MSD among nurses working in PLTVC settings.

Design and methods

Using the Extended Nordic Musculoskeletal Questionnaire (NMQ-E), a cross-sectional study design was used to examine the distribution and effects of musculoskeletal pain among nurses working in a large hospital's PLTVC units. The survey was completed by the participants following the provision of informed consent for participation. The participants were given one week to respond to the informed consent. The study was approved by the Institutional Review Board of Hamad Medical Corporation (MRC-01-20-435).

Participants and setting

Registered nurses working in three PLTVC units in Hamad Medical Corporation were the target population of this study. For inclusion in this study, the nurse should have had at least six months of direct patient care. Nurses who are not directly involved in patient care, including nurse administrators and student nurses, were excluded. Nurses from two units were recruited between October 2020 and February 2021 and from the third unit from February 2022 to April 2022. Due to renovations and relocation in the third unit during the planned

initial data collection period, it was necessary to delay data collection in this unit.

The nurses in PLTVC units were selected as they provide care for children with complex medical needs in a restrictive environment with complex lifesaving instruments, which makes them unique in the nursing profession. Members of the research team informed all nurses in the three units about the purpose of the research at unit meetings and were assured of data confidentiality to reduce any information bias. In addition, individual meetings were arranged with participants to invite them to take part in the study.

Measures

The NMQ-E developed by Dawson et al. (2009) was used in the study. The NMQ-E is a modified version of the Nordic Musculoskeletal Questionnaire, which was developed by Kuorinka et al. (1987) as a screening tool to identify work-related musculoskeletal pain in nine body regions. Each of the nine body regions has 11 questions, resulting in the generation of 99 data items. Respondents were asked to provide information about lifetime prevalence of pain, age of onset, history of hospitalizations and job changes, yearly prevalence and monthly prevalence, as well as information regarding consequences of pain in the past year such as participation restrictions at home, visits to the doctor, and sick time. Except for the question regarding the age of the onset of pain, all response options were dichotomous (yes/no). The NMQ-E is a reliable instrument for gathering information regarding onset, prevalence, and consequences of musculoskeletal pain and can be used for descriptive studies as well as longitudinal studies of disease outcome (Dawson et al., 2009). In order to describe the participants and their demographic characteristics, an investigator-developed demographic questionnaire consisting of seven questions was used to collect information on age, gender, nationality, job title, education level, length of service as a nurse, and length of service in PLTVC units. A member of the research team was present during data collection; however, both the NMQ-E and the investigator-developed demographic questionnaire were filled out by participants as self-reports.

Sample size

In all PLTVC units, there are 142 nurses. Due to the lack of data regarding the prevalence of MSDs in this specific subgroup of nurses, a modest prevalence of 50% was assumed. In order to achieve a 5% margin of error (precision) with a 95% confidence level for this population, a sample size of 104 is required. Nevertheless, all eligible nurses working in these units were recruited through a census sampling procedure.

Data analysis

Descriptive statistics were used to summarize the characteristics of the sample. Lifetime prevalence and point prevalence was included in the analysis based on the number of pain sites as reported by participants. Prevalence was estimated using percentages and the corresponding 95% confidence interval was calculated to measure the precision of the estimate. The association between categorical variables (educational status and nationality) was assessed using the Chi-square (χ^2) test. The independent *t*-test was used to compare the mean age, total experience, and experience in PLTVC units between the pain and non-pain groups. All *p* values presented are two-tailed, and *p* values <.05 was considered as statistically significant. A post hoc analysis of binomial logistic regressions was also conducted to determine the impact of participant characteristics on the likelihood of reporting MSDs in one or more, two or more, or three or more sites.

The statistical analysis was carried out using SPSS 22.0 (SPSS Inc. Chicago, IL) and EpiInfo (Centers for Disease Control and Prevention, Atlanta, GA).

Results

There were 142 nurses working in the three PLTV wards. All 139 eligible nurses were invited to participate, with the exception of three employees with only administrative responsibilities. A total of 130 nurses (94% response rate) completed the questionnaire. Data from three participants were not included in the analysis due to incomplete information provided. Consequently, 127 participants (91% response rate) were included in the final data analysis.

Characteristics of study participants

Participants were all female and comprised of 65% Indians, 31% Filipinos, and 4% other nationalities. Overall, 92% of nurses were staff nurses, and 8% were charge nurses. 80% of the participants had a Bachelor's degree, 19% had a Diploma, and 1% had a Master's degree. The mean age of the participants was 35.6 (SD = 6.12), the mean length of service was 13 years (SD = 6.5), and the mean length of service in PLTV units was 4.6 years (SD = 4.7).

Participants reported that they experienced musculoskeletal pain at several locations. Therefore, the prevalence of pain was assessed based on the number of painful sites reported by the participants rather than the mere presence of pain. The lifetime prevalence and prevalence of pain on the date of data collection is shown in Table 1.

Prevalence of pain with respect to each site is shown in Fig. 1. More than half of participants reported lower back pain, making it the most commonly reported site of MSD, followed by neck and shoulder, which was reported by over a third of participants.

The Table 2 illustrates the site-specific MSD, their age of onset, chronicity expressed as years with MSD and the development of MSD after employment at PLTV. Although the majority of MSDs reported by PLTV nurses were chronic and had existed before joining the units (calculated by subtracting PLTV experience from chronicity of pain), some participants reported developing pain after becoming a PLTV nurse, particularly in neck, upper back and lower back as shown in Table 2.

Prevalence of different types of pain consequences is shown in Table 3. More than half of the participants reported taking medicine to treat their MSDs, and nearly a tenth required hospitalization. A total of 15% of participants have changed jobs as a result of their MSDs.

When pain at one site at least, and two sites at least is considered, there are no statistically significant differences between the pain group and the non-pain group in terms of mean age, overall experience, and experience in PLTV units. In contrast, when participants reported pain at three or more sites, a statistically significant difference with an effect size of 0.6 was found between the pain and no-pain groups with respect to participants' years of experience at the PLTV. The results are presented in Table 4.

Pain was more prevalent among nurses with a Bachelor's degree (60 out of 103, 58.3%) than among nurses with a diploma (8 out of 16, 50%). However, the correlation between educational status and pain was not statistically significant when pain was present in at least one site ($X^2(1, 127) = [0.965, p = [0.326]]$) or at least three sites ($X^2(1, 127) = [0.107, p = [0.744]]$), but statistically significant when pain was present in at least two sites ($X^2(1, 127) = [4.859, p = [0.028]]$).

Statistically significant associations were observed between nationality and pain when pain was experienced in at least one site ($X^2(1, 127) = [4.254], p = [0.039]$, at least at two sites ($X^2(1, 127) = [19.612], p = [0.000]$, and at least three sites ($X^2(1, 127) = [4.842], p = [0.028]$). More proportion of nurses in the Filipino and Others combined nationality groups (Pain in at least one site: 44 out of 45, 97.8%; pain in at least two sites: 36 out of 45, 80%; pain in at least three sites: 22 out of 45, 48.9%) reported more pain prevalence compared to nurses of Indian nationality (Pain in at least one site: 71 out of 82, 86.6%; pain in at least two sites: 32 out of 82, 39%; pain in at least three sites: 24 out of 82, 29.3%).

Finally, a separate binomial logistic regression was conducted to understand the impact of age, nationality, education level, length of service as a nurse, and length of service in PLTV units on the likelihood of participants reporting pain in at least one site, two sites, or three sites. The logistic regression model was statistically significant for pain in at least two sites, $\chi^2(5) = 36.813, p < .001$, and pain in at least three sites, $\chi^2(5) = 16.260, p = .006$; however, it was not statistically significant when the pain was in at least one site, $\chi^2(5) = 10.517, p = .062$.

For pain in at least two sites, the model explained 33.6% (Nagelkerke R^2) of the variance and correctly classified 72.4% of cases. Nationality (Wald = 13.849, $p < .001$), length of service in PLTV settings (Wald = 8.160, $p = .004$) and education level (Wald = 6.239, $p = .012$) contributed significantly to the model. However, age (Wald = 0.664, $p = .415$) and length of service as a nurse (Wald = 0.612, $p = .413$) were not significant factors. The Odds Ratio for nationality, length of service in PLTV settings, and education are 5.890 (95% CI: 2.315–14.987), 1.211 (95% CI: 1.062–1.382), and 0.136 (95% CI: 0.029–0.651), respectively.

For pain in at least three sites, the model explained 16.5% (Nagelkerke R^2) of the variance and correctly classified 70.9% of cases. Similar to pain in at least two sites, nationality (Wald = 4.188, $p = .041$) and length of service in PLTV settings (Wald = 7.413, $p = .006$) were the two factors that contributed significantly to the model, and age (Wald = 0.145, $p = .704$) and length of service as a nurse (Wald = 0.072, $p = .788$) continue not to contribute significantly to the model. In addition, when pain in at least three sites was considered, even the education level (Wald = 1.405, $p = .236$) did not add significantly to the model. The odds ratio for nationality is 2.420 (95% CI: 1.038–5.639), and for length of service in PLTV settings is 1.180 (95% CI: 1.048–1.330). The regression tables for all three models are presented in the supplementary material.

Discussion

In this study, the prevalence of MSDs in the context of PLTV units is explored for the first time. It is not uncommon for surveys conducted in Middle Eastern countries to have a high response rate in comparison to surveys conducted in Western countries (Meyer et al., 2022), and this study is no exception. It has a very high response rate (91%) which ensures high study quality. A high prevalence of MSDs is found in this population, with 90, 53, and 36 percentages for pain in at least one site, pain in at least two sites, and pain in at least three sites, respectively. It has been reported that Asian nurses have a high prevalence of MSDs (40–95%) (Krishnan et al., 2021), similar to the results of this study. In this study, 36% of MSDs were found at three or more sites,

Table 1
MSD prevalence.

No of sites	Lifetime prevalence				Point prevalence			
	Frequency	Percentage	95% CI		Frequency	Percentage	95% CI	
			Lower	Upper			Lower	Upper
Pain in at least one site	115	90.6	84.21	94.51	42	33.1	25.49	41.6
Pain in at least two sites	68	53.5	44.89	61.99	21	16.5	11.08	23.96
Pain in at least three sites	46	36.2	28.38	44.87	9	7.1	3.77	12.92

CI - Confidence interval.

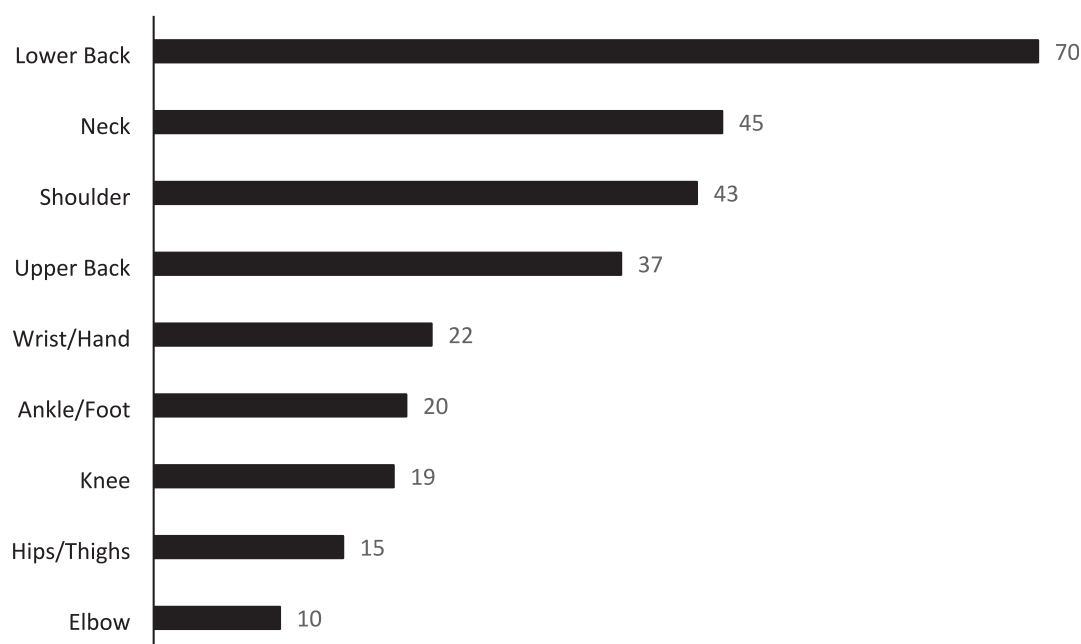


Fig. 1. Presence of pain reported with respect to each site ($n = 127$).

which is unique and substantial finding. Multisite prevalence of MSDs among these specialized nurses is not only concerning; it also warrants further investigation and exploration of the reasons for such a finding in future research.

According to Tinubu et al. (2010), nurses working with adults most frequently experience back pain, followed by neck and shoulders, which is consistent with the findings of the present study. The present findings suggest that nurses are at risk of developing MSDs of the lower back, neck, and shoulders regardless of whether their patients are children or adults. According to the study participants, the chronicity of their pains indicates that they had been experiencing them prior

to joining the PLTVC. These findings indicate that being a nurse may contribute to these conditions, not necessarily working at the PLTVC. Even so, working in PLTVC may contribute to the persistence of these conditions among nurses and should therefore be addressed. Rather, the participants developed upper back pain after they joined PLTVC, which may indicate that the positioning of beds and lifesaving equipment are placing a greater strain on their upper backs. Future studies should confirm such an assertion by analyzing the various tasks performed by these nurses and their associated MSDs.

A point prevalence of MSD in at least one site was 33%, indicating that one out of three nurses at PLTVC work with pain at any given

Table 2

Descriptive statistics for site specific MSD.

Site	MSD n (%)	MSD_P n (%)	Age of onset		No. of years with pain		Development of pain after joining PLTVC (No. of years)	
			Mean (SD)	Median (IQR)	Mean (SD)	Median (IQR)	Mean (SD)	Median (IQR)
Lower Back	70 (55.1)	28 (22)	30.97 (6.50)	30 (28–32)	3.76 (3.85)	3 (1–5)	−0.55 (5.68)	0.0 (−3–2.4)
Neck	45 (35.4)	18 (14.2)	33.33 (6.50)	32 (29–38)	4.26 (3.65)	3 (2–7)	−1.41 (5.89)	−1.5 (−6–2.4)
Shoulder	43 (33.9)	11 (8.7)	33.43 (7.29)	31.5 (29–35.75)	3.6 (3.39)	2 (1–5)	−2.25 (5.58)	−0.7 (−6–0.87)
Upper Back	37 (29.1)	17 (13.4)	30.68 (5.23)	30 (28–33)	4.44 (3.67)	3 (2–6.25)	0.31 (4.81)	0.2 (−2.25–3.1)
Wrist/Hand	22 (17.3)	5 (3.9)	33.05 (7.75)	31 (28.75–37.25)	3.18 (4.25)	2 (0.75–4)	−1.4 (6.05)	−1 (−2.95–0.25)
Ankle/Foot	20 (15.7)	4 (3.1)	32.63 (7.42)	31 (28–34)	2.53 (2.39)	2 (1–4)	−3.11 (4.77)	−2.6 (−6–0.0)
Knee	19 (15)	3 (2.4)	33.79 (8.19)	32 (30–36.5)	2.71 (2.13)	2 (1–5)	−3.56 (5.44)	−2.5 (−6.75–0.68)
Hips/Thighs	15 (11.8)	4 (3.1)	31 (5.28)	30 (27–32)	3 (3)	2 (0.5–5)	−1.46 (4.68)	−1 (−5.5–1.15)
Elbow	10 (7.9)	1 (0.8)	36.7 (8.73)	37 (30–39.25)	3.3 (4.9)	1.5 (0.75–4)	−3.14 (5.35)	−1.7 (−4.25–0.75)

PLTVC – Pediatric long-term ventilatory care unit.

MSD – Musculoskeletal disorders.

MSD_P – Musculoskeletal disorders after joining pediatric long-term care ventilatory care unit.

SD – Standard deviation.

IQR – Inter-quartile range.

Table 3
Prevalence of pain consequences.

	Frequency	Percentage	95% CI	
			Lower	Upper
Prevalence of pain symptoms that prevented participation in normal work	48	37.8	29.8	46.5
Prevalence of pain symptoms that led to doctor consultation	51	40.2	32	48.9
Prevalence of pain symptoms that led to intake of medications	68	53.5	44.9	62
Prevalence of pain symptoms that led to availing sick leave	45	35.4	27.7	44.1
Prevalence of pain symptoms that led to hospitalization	11	8.7	4.9	14.8
Prevalence of pain symptoms that led to change of jobs	19	15	9.8	22.2

CI– Confidence interval.

time. Providing quality nursing care requires a workforce that is injury-free. With approximately one third of the nursing force working with an injury every day, there is a possibility that nursing care may not be at its best in a PLTVC environment. Further attention is required to prevent and better manage MSDs in order to protect nurses' well-being as well as the wellbeing of the patients they care for. In view of the high point prevalence rate of MSDs, the high multi-site prevalence rate of MSDs, and the back, neck and shoulders being the most vulnerable sites for developing MSDs among PLTVC nurses, researchers, hospital administrators and policy makers should take a closer look at the professional practice of nurses in order to address these health concerns common to nurses.

Although hospitalization for MSDs is very low, a high proportion of nurses are taking medication for pain, having doctor consultations, and taking sick leave as a result of MSDs. While many nurses experienced disruptions in their regular work, the percentage of nurses changing jobs was low. MSDs result in significant absences from work, resulting in lost productivity among nurses (Dias, 2019), and multiple interventions have been tested. There is, however, no substantial evidence supporting the effectiveness of such interventions (Richardson et al., 2018). Thus, it is necessary to develop novel interventions to address this issue. It has been found that a significant percentage of nurses arrive at work in pain. Therefore, improvements to the management of PLTVC workplaces, such as assessing pain during every nursing shift, allocating and periodically alternating physically demanding tasks, and providing coaching on the job site, including workplace physical activity programs. A difference in PLTVC experience between multi-site pain group and no-pain group is an indication that the experience of working in PLTVC may contribute to the development of multi-site pain earlier in the career of nurses. It is, therefore, necessary to investigate the environments in PLTVC and job duties in this setting to identify context-specific risk factors.

The primary aim of this study is to document the prevalence of MSDs among nurses working in PLTVCs and not to explore factors associated with their experience of MSDs. However, post-hoc analysis revealed an interesting observation regarding the nationalities of the participants and their experience with MSDs. The presence of multinational

workforce in this setting allowed for making such comparisons. The participants' nationality was the only participant characteristic that added significantly to the regression models when participants who reported at least pain in two sites or when they reported pain in at least three sites were considered, in addition to their length of service in PLTVC settings. It has to be noted that other physical and psychological factors such as body mass index, job tenure, and lifestyle factors which are known to be associated with musculoskeletal symptoms (Krishnan et al., 2021) were not taken into account in this study. Therefore, these findings need further exploration in future research before any meaningful and valid interpretations can be made.

Practice implications

Employees' health is the responsibility of both the employer and the employee alike. The high prevalence of MSDs found in nurses working in PLTVC settings warrants attention from nursing managers to provide appropriate preventative support and training for nurses working in these settings. PLTVC nurses must take additional precautions, since working in this environment increases the possibility of developing pain in multiple sites, particularly if they have been working for more than six years.

The high prevalence of MSDs among nurses working in PLTVCs recognises and reiterates the need for further research in this setting and the development of appropriate guidelines and policies to prevent and manage MSDs. Future research could focus on identifying specific factors associated with and/or predictive of MSDs among PLTVC nurses that informs context-specific interventional strategies.

Limitations

The representativeness of the study findings is limited because the recruitment was limited to PLTVC units of one hospital. However, it must be noted that the three PLTVC units are the only PLTVC units in the country. The use of a cross-sectional survey design limits the inferring of any causal associations. Future studies should consider the use of longitudinal designs to examine the relationship between working

Table 4
Differences in age and experience between participants who reported pain and those who did not report pain.

Number of sites	Variable	Pain group M(SD)	No-pain group M(SD)	Mean Difference	95% CI		p-value
					Lower	Upper	
At least one site (n = 115, pain group; n = 12, no-pain group)	Age	35.45 (6.31)	36.17 (5.06)	−0.71	−0.44	3.02	0.71
	Total Experience	13.12 (6.38)	13.92 (5.52)	−0.79	−4.58	2.99	0.68
	PLTVC Experience	4.61 (6.70)	4.58 (4.49)	0.03	−2.78	2.84	0.99
At least two sites (n = 68, pain group; n = 59, no-pain group)	Age	35.50 (6.12)	35.54 (6.23)	0.04	−2.23	2.15	0.97
	Total Experience	13.46 (6.12)	12.90 (6.43)	0.55	−1.68	2.78	0.62
	PLTVC Experience	5.34 (4.97)	3.77 (4.12)	0.55	−1.68	2.78	0.62
At least three sites (n = 46, pain group; n = 81, no-pain group)	Age	36.20 (6.73)	35.14 (5.87)	1.06	−1.20	3.32	0.36
	Total Experience	14.14 (6.87)	12.66 (5.91)	1.48	−0.81	3.78	0.20
	PLTVC Experience	6.10 (5.58)	3.77 (3.84)	2.32	0.66	3.98	0.006

PLTVC – Pediatric long-term ventilatory care unit.

M – Mean.

SD – Standard deviation.

in PLTV setting and the development of multi-site MSDs. Furthermore, since the data collection instrument was based on self-report the reporting of MSD might be influenced by social desirability.

Conclusions

The study contributes to the limited evidence in the literature regarding the prevalence of MSDs among pediatric nurses particularly, those working in long-term ventilatory care settings. The high MSD prevalence among PLTV nurses found in this study is consistent with previous studies on MSD prevalence among nurses working in adult settings. The relationship found between working in PLTV settings and multisite prevalence of MSDs among these specialized nurses warrants further investigation.

Funding sources

The study was funded by the Medical Research Center grant from Hamad Medical Corporation.

Role of the funding source

The funding source did not have any role in the study design, data collection and analysis, decision to publish, or preparation of the manuscript.

Data availability statement

Data could not be shared due to institutional restrictions.

Contributors

Hancley Soj.: Investigation. Jean Saley Johnson.: Conceptualization. Prem Chandra.: Formal analysis.

CRedit authorship contribution statement

Brightlin Nithis Dhas: Conceptualization, Formal analysis, Methodology, Data curation, Project administration, Writing – original draft. **Lilikutty Joseph:** Conceptualization, Project administration, Writing – original draft. **Julee Ansa Jose:** Investigation, Writing – original draft. **Jain Mariya Zeaser:** Investigation, Writing – original draft. **Jasmin Priyadarshini Devraj:** Investigation, Writing – original draft. **Manigandan Chockalingam:** Formal analysis, Writing – original draft.

Declaration of Competing Interest

The authors Brightlin Nithis Dhas, Lilikutty Joseph, Julee Ansa Jose, Jain Mariya Zeaser, and Jasmin Priyadarshini Devraj are employed at Hamad Medical Corporation and Manigandan Chockalingam is employed at National University of Ireland Galway. The author salaries are paid by their respective employer.

Acknowledgements

We would like to thank all the nurses who participated in the study. We would like to thank Dr. Hanadi Khamis Mubarak Alhamad, Medical Director; Mr. Sultan Salim Hammam Al Abdulla, Chief of Occupational Therapy department; Ms. Mashaal Abdulla S S Jassim, Executive Director of Nursing, Ms. Anam Abdo Ali H Al-Mardahi, Director of Nursing at Qatar Rehabilitation Institute for their continuous support. We would like to thank Dr. Prem Chandra for formal analysis.

Open Access funding provided by the Qatar National Library.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.pedn.2022.12.015>.

References

- Arsalani, N., Fallahi-Khoshtknab, M., Josephson, M., & Lagerström, M. (2014). Musculoskeletal disorders and working conditions among Iranian nursing personnel. *International Journal of Occupational Safety and Ergonomics*, 20(4), 671–680. <https://doi.org/10.1080/10803548.2014.11077073>.
- 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. <https://doi.org/10.1016/j.ijnurstu.2014.11.003>.
- Bettger, J. P., Sochalski, J. A., Foust, J. B., Zubritsky, C. D., Hirschman, K. B., Abbott, K. M., & Naylor, M. D. (2012). Measuring nursing care time and tasks in long-term services and supports: One size does not fit all. *The Journal of Nursing Research*, 20(3), 159–168. <https://doi.org/10.1097/jnr.0b013e318263d977>.
- Centers for Disease Control and Prevention (2020). *Work-related musculoskeletal disorders & ergonomics*. Centers for Disease Control and Prevention. <https://www.cdc.gov/workplacehealthpromotion/health-strategies/musculoskeletal-disorders/> (Accessed 12 February 2020).
- Chau, S. K., Yung, A. W. Y., & Lee, S. L. (2017). Long-term management for ventilator-assisted children in Hong Kong: 2 decades' experience. *Respiratory Care*, 62(1), 54–64. <https://doi.org/10.4187/respcare.04989>.
- Davis, K. G., & Kotowski, S. E. (2015). Prevalence of musculoskeletal disorders for nurses in hospitals, long-term care facilities, and home health care. *Human Factors The Journal of the Human Factors and Ergonomics Society*, 57(5), 754–792. <https://doi.org/10.1177/0018720815581933>.
- Dawson, A. P., Steele, E. J., Hodges, P. W., & Stewart, S. (2009). Development and test-retest reliability of an extended version of the nordic musculoskeletal questionnaire (NMQ-E): A screening instrument for musculoskeletal pain. *The Journal of Pain*, 10(5), 517–526. <https://doi.org/10.1016/j.jpain.2008.11.008>.
- Dias, B. V. B. (2019). The main causes of absenteeism disease among nursing professionals – an integrative literature review. *Biomedical Journal of Scientific & Technical Research*, 16(4), 1–5. <https://doi.org/10.26717/bjstr.2019.16.002888>.
- Gaowgzeh, R. A. M. (2019). Low back pain among nursing professionals in Jeddah, Saudi Arabia: Prevalence and risk factors. *Journal of Back and Musculoskeletal Rehabilitation*, 32(4), 555–560. <https://doi.org/10.3233/bmr-181218>.
- Kneafsey, R., Clifford, C., & Greenfield, S. (2015). Perceptions of hospital manual handling policy and impact on nursing team involvement in promoting patients' mobility. *Journal of Clinical Nursing*, 24(1–2), 289–299. <https://doi.org/10.1111/jocn.12659>.
- Krishnan, K. S., Raju, G., & Shawkataly, O. (2021). Prevalence of work-related musculoskeletal disorders: Psychological and physical risk factors. *International Journal of Environmental Research and Public Health*, 18(17), 9361. <https://doi.org/10.3390/ijerph18179361>.
- 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. [https://doi.org/10.1016/0003-6870\(87\)90010-x](https://doi.org/10.1016/0003-6870(87)90010-x).
- Lurati, A., & Kim, S. (2021). Pilot evaluation of musculoskeletal disorders among adult ICU nurses versus neonatal ICU nurses in the United States. *CONNECT: The World of Critical Care Nursing*, 15(1), 11–22. <https://doi.org/10.1891/WFCN-D-20-00017>.
- Meyer, V. M., Benjamins, S., Moumni, M. E., Lange, J. F. M., & Pol, R. A. (2022). Global overview of response rates in patient and health care professional surveys in surgery: A systematic review. *Annals of Surgery*, 275(1), e75–e81. <https://doi.org/10.1097/SLA.0000000000004078>.
- Nasaif, H., Alaradi, M., Hammam, R., Bucheeri, M., Abdulla, M., & Abdulla, H. (2022). Prevalence of self-reported musculoskeletal symptoms among nurses: A multicenter cross-sectional study in Bahrain. *International Journal of Occupational Safety and Ergonomics*, 1–7. <https://doi.org/10.1080/10803548.2021.2025315>.
- Richardson, A., McNoe, B., Derrett, S., & Harcombe, H. (2018). Interventions to prevent and reduce the impact of musculoskeletal injuries among nurses: A systematic review. *International Journal of Nursing Studies*, 82, 58–67. <https://doi.org/10.1016/j.ijnurstu.2018.03.018>.
- Serranheira, F., Sousa-Uva, M., & Sousa-Uva, A. (2015). Hospital nurses tasks and work-related musculoskeletal disorders symptoms: A detailed analysis. *Work (Reading, Mass.)*, 51(3), 401–409. <https://doi.org/10.3233/WOR-141939>.
- Sezgin, D., & Esin, M. (2015). Predisposing factors for musculoskeletal symptoms in intensive care unit nurses. *International Nursing Review*, 62, 92–101. <https://doi.org/10.1111/inr.12157>.
- Soylar, P., & Ozer, A. (2018). Evaluation of the prevalence of musculoskeletal disorders in nurses: a systematic review. *Medicine Science International Medical Journal*, 7(3), 479–485.
- Tinubu, B. M. S., Mbada, C. E., Oyeyemi, A. L., & Fabunmi, A. A. (2010). Work-related musculoskeletal disorders among nurses in Ibadan, south-West Nigeria: A cross-sectional survey. *BMC Musculoskeletal Disorders*, 11, 12. <https://doi.org/10.1186/1471-2474-11-12>.