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Prevalence of musculoskeletal complaints among haemodialysis nurses – a comparison between Danish and Swedish samples

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Objective. The repetitiveness of priming and dismantling disposables for haemodialysis treatments might be an important contributor to musculoskeletal complaints. The objective was therefore to compare the prevalence of musculoskeletal complaints among haemodialysis nurses in Denmark and Sweden. **Methods.** For this cross-sectional study, nurses were recruited from haemodialysis centres in Denmark ($n = 194$) and Sweden ($n = 351$). Prevalence of musculoskeletal complaints was evaluated using the Nordic musculoskeletal questionnaire. **Results.** The percentage of nurses reporting musculoskeletal complaints from at least one part of their body was 90.2% in the Danish sample and 88.9% in the Swedish sample. The anatomical locations with the most complaints were the neck, lower back and hands. Except for the proportion of complaints concerning the neck, there were no differences between the countries. Absenteeism from work was mostly due to complaints regarding the hands. **Conclusion.** The prevalence of musculoskeletal complaints seems to be higher among haemodialysis nurses than among nurses in general. Because complaints concerning the hands are common, and also related to absenteeism from work, it is of particular importance that manufacturers of dialysis equipment and nurse managers acknowledge these occupational health and safety hazards in their efforts to create a good work environment.

Keywords: work-related musculoskeletal disorders; haemodialysis; nurse; Nordic musculoskeletal questionnaire; prevalence; ergonomics

1. Introduction

Musculoskeletal disorders (MSDs) in the nursing profession [1–6] are common, as they are in many other occupations [7–9]. Nurses who continuously perform physically demanding routine tasks, such as lifting or repositioning heavy patients, pushing devices or other medical equipment, and who lean over the bed during nursing activities often report discomfort or pain located in the neck, shoulders and lower back [1,3]. The prevalence of MSDs among nurses working in hospitals is found to be 31–55% for the neck, 37–72% for the shoulders, 10–13% for the elbows and 22–28% for the hands [2]. In most cases, subjective surveys have been used to investigate MSD prevalence among hospital nurses, typically looking at discomfort or pain during the past 12 months [3]. The most commonly used measure is the Nordic musculoskeletal questionnaire (NMQ) [2]. In their comprehensive review, Davis and Kotowski [3] reported a significantly higher yearly prevalence of MSDs in less developed countries compared to developed countries, although the underlying reasons for these findings are unknown. In summary, MSD discomfort or pain in at least one body region affects many nurses. While there has been a plethora of studies aimed

at determining MSD prevalence within the nursing context [1–6], to our knowledge no study has considered the working conditions of nurses in haemodialysis settings.

Compared to other hospital environments, the haemodialysis unit is typically loud and highly technical. Because haemodialysis machines are fundamental in providing treatment to patients, the machines naturally dominate the care environment [10]. In both Denmark and Sweden, day-to-day dialysis management, including execution of safe and evidence-based haemodialysis treatment, is among the responsibilities of dialysis nurses. Likewise, the dismantling of disposables from used material and cleaning and disinfection of dialysis machines, other equipment and surfaces used during treatment are all part of the nurses' duties.

Haemodialysis is a life-sustaining treatment that replaces kidney functions for patients with kidney failure. The haemodialysis system consists of a dialysis machine, a disposable dialyser, a disposable blood tubing set and a dialysate solution used within the machine and the dialyser. The blood tubing set and the dialyser make up a closed extracorporeal circuit through which the patient's blood circulates, while waste products and excessive fluid

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are removed from the human body [11]. Before the extracorporeal circuit can be utilized in dialysis treatment, both the blood tubing and the dialyser have to be primed by the dialysis nurse. The priming process, which occurs before the patient is connected, involves a number of manipulations and twisting forces using both hands to put up the extracorporeal circuit as well as manual clamping and sometimes turning to remove all air from the tube and dialyser. The entire priming process takes approximately 15 min to complete per treatment, but the expenditure of time varies depending on the equipment used. Proper priming is extremely important, because remaining air bubbles in the extracorporeal circuit could cause severe complications for the patient or have deadly outcomes [11,12]. Directly after cleaning, the priming process for the next treatment begins.

In 2010, 2.62 million people received renal replacement therapy worldwide, and the need for dialysis treatment has been projected to double by 2030 [13]. To address the fact that more patients are beginning haemodialysis treatment every year, renal services must continue to develop. At the same time, the staff are working under constant pressure due to insufficient resources [14,15]. For nurses, the challenge of caring for a large number of patients with renal diseases results in high levels of stress, burnout and dissatisfaction, which are further linked to high nurse turnover, staff shortages, poor morale and poor patient outcomes [14–18]. Whether the rapid growth in the number of people treated with dialysis has had any impact on dialysis nurses' musculoskeletal complaints is unknown, as no quantification of the prevalence of pain, musculoskeletal injuries or disabilities is available. The repetitiveness of priming and dismantling disposables for several treatments during each work shift might be an important contributor to haemodialysis nurses' musculoskeletal complaints. Based on the aforementioned, the aim of the present study was to compare the prevalence of musculoskeletal complaints among haemodialysis nurses in Denmark and Sweden.

2. Methodology

This cross-sectional study was conducted from November 8, 2017 to January 15, 2018 in Sweden and from March 7, 2018 to May 20, 2018 in Denmark.

2.1. Research ethics

The study protocol was approved by the Regional Ethics Review Board in Uppsala, Sweden (registration number 2017/229) and reported to the Danish Data Protection Agency (ID-number 1-16-02-806-17). For the Danish data, no ethical approval was needed as the study does not involve human biological material (ID-number 1-10-72-168-17). All participants were informed about the aim of the survey and participated voluntarily.

2.2. Study population and sample size

A convenience sampling procedure was used. All centres listed in the respective national renal registry were eligible for inclusion. A written request for study involvement was sent by regular mail to the head of each centre. Nurses who voluntarily agreed to participate were then recruited from 14 out of 25 haemodialysis centres in Denmark and from 33 out of 72 haemodialysis centres in Sweden. These centres employed a total of 482 and 541 nurses, respectively. The response rate was 40.2% in Danish haemodialysis centres and 64.9% in Swedish haemodialysis centres. Thus, the samples consist of 194 Danish haemodialysis nurses and 351 Swedish haemodialysis nurses.

2.3. Data collection

All data were collected using a web-based survey. The haemodialysis nurses' experiences of MSDs were evaluated with the NMQ. The NMQ consists of 15 items covering nine anatomical areas (neck, shoulders, upper back, lower back, hands, feet, knees, thighs and elbows), with the possibility to separate left and right [19]. The NMQ is a standardized and extensively used questionnaire evaluating the prevalence of musculoskeletal complaints; it has been applied and validated in a wide range of occupational health contexts. The validity of the NMQ has been tested against clinical history [19,20], and test–retest methods have been applied in various samples, including nursing staff [19].

2.4. Data analysis

The collected data were first manually checked for inconsistencies and corrections were made if possible, the goal being to reduce the amount of missing data. For instance, several incomplete entries regarding the participants' year of birth were corrected because a number of participants had reported their year of birth by abbreviating it, e.g., writing '62' instead of 1962. All descriptive and inferential statistics were calculated in IBM SPSS Statistics version 24.0. A probability level of $p < 0.05$ (two-tailed) was accepted as statistically significant for all tests. For continuous variables, the independent t test was used to evaluate differences between the two countries' samples. Categorical data were compared using the χ^2 test. The η coefficient [21] was used for a non-linear association, which is an association between a variable measured on an interval scale (age, working years, working hours) and a variable with two categories (yes/no for MSD prevalence). The ϕ coefficient was used to evaluate the association between two dichotomous variables (gender male/female and yes/no for MSD prevalence). Cramer's V was used to evaluate the association between handedness (right/left/both) and MSD prevalence [22]. Items in the NMQ covering left or right body segments (i.e., shoulder) were unified into one variable in the data analysis.

Table 1. Demographic data for haemodialysis nurses in Denmark and Sweden.

| Variable | Denmark (<i>n</i> = 194) | | Sweden (<i>n</i> = 351) | | Test value |
|----------------------------------|---------------------------|-------------------|--------------------------|-------------------|----------------------------------|
| | <i>M</i> [95% CI] | <i>SD</i> (range) | <i>M</i> [95% CI] | <i>SD</i> (range) | |
| Age (years) | 47.6 [46.0, 49.2] | 11.1 (24.0–66.0) | 45.4 [45.3, 47.5] | 10.5 (23.0–67.0) | $t = -1.197, p = 0.232$ |
| Working as nurse (years) | 20.6 [19.1, 22.2] | 11.1 (<1–42.0) | 18.9 [17.8, 20.0] | 10.6 (<1–44.0) | $t = -1.785, p = 0.075$ |
| Working in haemodialysis (years) | 13.1 [11.8, 14.4] | 9.0 (<1–42.0) | 10.7 [9.7, 11.6] | 9.3 (<1–42.0) | $t = -2.968, p = 0.003^{**}$ |
| Working hours/week | 32.9 [32.4, 33.5] | 3.8 (15.0–37.0) | 35.6 [35.2, 36.1] | 3.9 (19.1–38.3) | $t = 7.633, p < 0.001^{***}$ |
| | % | Missing data | % | Missing data | |
| Gender, female | 97.4 | <i>n</i> = 1 | 92.2 | <i>n</i> = 4 | $\chi^2 = 5.993, p = 0.014^{**}$ |
| Right handed | 88.5 | <i>n</i> = 3 | 88.6 | <i>n</i> = 1 | $\chi^2 = 1.216, p = 0.544$ |
| Left handed | 5.2 | | 6.9 | | |
| Both handed | 6.3 | | 4.5 | | |

** $p < 0.01$, *** $p < 0.001$, significant difference between Danish and Swedish nurses working in haemodialysis care.

Note: CI = confidence interval.

Table 2. Prevalence of musculoskeletal complaints in single or multiple body sites and prevalence of absenteeism from work due to musculoskeletal complaints.

| Anatomical area | Musculoskeletal complaints in past 12 months (%) | | | Musculoskeletal complaints in past 7 days (%) | | | Absenteeism from work due to musculoskeletal complaints in past 12 months (%) | | |
|-----------------|--|--------------------------|----------|---|--------------------------|----------|---|--------------------------|----------|
| | Denmark (<i>n</i> = 194) | Sweden (<i>n</i> = 351) | <i>p</i> | Denmark (<i>n</i> = 194) | Sweden (<i>n</i> = 351) | <i>p</i> | Denmark (<i>n</i> = 194) | Sweden (<i>n</i> = 351) | <i>p</i> |
| Neck | 64.4 | 51.6 | 0.004** | 35.1 | 30.2 | 0.245 | 5.7 | 5.1 | 0.787 |
| Shoulders | 49.5 | 45.0 | 0.317 | 27.8 | 25.9 | 0.629 | 8.8 | 4.8 | 0.070 |
| Upper back | 48.5 | 43.9 | 0.304 | 24.7 | 23.4 | 0.717 | 5.7 | 4.3 | 0.464 |
| Lower back | 62.4 | 55.8 | 0.139 | 37.1 | 31.3 | 0.171 | 8.8 | 6.8 | 0.415 |
| Hands | 58.8 | 50.1 | 0.053 | 37.1 | 31.3 | 0.171 | 10.8 | 8.8 | 0.448 |
| Feet | 23.7 | 22.8 | 0.807 | 14.4 | 12.0 | 0.410 | 3.1 | 2.0 | 0.421 |
| Knees | 32.0 | 31.3 | 0.882 | 13.9 | 19.7 | 0.092 | 1.5 | 2.8 | 0.340 |
| Thighs | 29.9 | 26.2 | 0.356 | 11.9 | 15.4 | 0.257 | 1.5 | 1.1 | 0.686 |
| Elbows | 18.0 | 17.9 | 0.979 | 10.8 | 9.7 | 0.673 | 2.1 | 3.4 | 0.369 |

** $p < 0.01$, significant difference between Danish and Swedish nurses working in haemodialysis care.

3. Results

The demographics of the nurses who responded to the questionnaire in Denmark and Sweden, respectively, are presented in Table 1. There was a difference between the countries regarding gender, work experience and working hours. Almost all Danish nurses were female, and they had worked a significantly longer time within haemodialysis services and had significantly shorter working hours per week compared to the Swedish nurses.

The percentage of nurses reporting musculoskeletal complaints from at least one part of their body during the past 12 months was 90.2% in the Danish sample and 88.9% in the Swedish sample. As can be seen in Table 2, in both countries the anatomical locations with the most complaints during the past 12 months as well as the past 7 days were the neck, lower back and hands. Except for the proportion of complaints concerning the neck during the past 12 months, there were no differences in musculoskeletal complaints between the countries. The

most common musculoskeletal complaint involving absenteeism from work concerned the haemodialysis nurses' hands (Table 2).

Table 3 presents the non-linear association between occurrences of musculoskeletal complaints in the covered anatomical areas and demographics (age, gender, handedness, working years and working hours). There were weak correlations between complaints and age, working years and working hours, and there were no associations between complaints and gender or handedness.

4. Discussion

The presented data are consistent with the assumption that the prevalence and impact of musculoskeletal complaints concerning the hands may be substantially higher among haemodialysis nurses than among nurses in general. Indeed, the prevalence of complaints concerning hands was found to be twice that reported for hospital nurses

Table 3. Correlation coefficients between variables.

| Musculoskeletal complaints | Age (years) | Working as nurse (years) | Working in haemodialysis (years) | Working hours/week | Gender (male/female) | Handed (left/right/both) |
|----------------------------|-------------|--------------------------|----------------------------------|--------------------|----------------------|--------------------------|
| Neck | 0.360 | 0.295 | 0.254 | 0.320 | 0.055 | 0.023 |
| Shoulder | 0.306 | 0.347 | 0.301 | 0.260 | 0.027 | 0.034 |
| Upper back | 0.257 | 0.270 | 0.250 | 0.258 | 0.031 | 0.087 |
| Lower back | 0.268 | 0.273 | 0.304 | 0.284 | 0.062 | 0.024 |
| Hands | 0.277 | 0.290 | 0.266 | 0.279 | 0.078 | 0.071 |
| Feet | 0.297 | 0.305 | 0.258 | 0.265 | 0.072 | 0.032 |
| Knees | 0.336 | 0.306 | 0.297 | 0.280 | 0.032 | 0.069 |
| Thighs | 0.261 | 0.276 | 0.303 | 0.255 | 0.057 | 0.081 |
| Elbows | 0.247 | 0.258 | 0.272 | 0.229 | 0.033 | 0.035 |

[2,5] as well as for primary health care nurses [4]. This divergence is plausible given the repetitiveness of priming and dismantling of disposables and other specific duties that haemodialysis nurses perform each work shift, as non-haemodialysis nurses are generally not exposed to such musculoskeletal risk factors. It is also worth noting the four times greater prevalence of complaints concerning the hands among Scandinavian haemodialysis nurses, compared to normative reference data for healthy adults [23]. The prevalence of hand complaints in haemodialysis nurses, however, was in line with previously reported proportions in office workers [9] and some handicraft workers [7]. Because complaints concerning the hands are common, and also related to absenteeism from work, it is of particular importance that manufacturers of dialysis equipment and nurse managers acknowledge this specific occupational health and safety hazard in their efforts to create a good work environment for haemodialysis nurses.

For almost half a century, lower back pain and neck and shoulder pain have been considered important occupational problems among nurses [2,3], and lifting and moving people are considered the main risk factors for development of MSDs among healthcare personnel [24]. Because haemodialysis nurses are not exempt from such duties, it is not surprising that the prevalence of these complaints among Scandinavian dialysis nurses is rather similar to other figures reported for the nursing context [2,3,6]. Moreover, haemodialysis nurses' complaints concerning the lower back, neck and knees were in accordance with previously reported prevalence figures among Scandinavian public-sector employees (of which 50% were health care personnel) [25].

In our Scandinavian samples of haemodialysis nurses, 9 out of 10 individuals had experienced musculoskeletal complaints in any body part during the past 12 months. The corresponding proportion among healthy adults is 7 out of 10 [23], thus, this is a problem worth acknowledging. MSDs affect all kind of workers all over the world and are a costly work-related health problem [24]. Although the origins of MSDs are known to be multifactorial and associated with both occupational and non-occupational factors, it is of particular interest to further investigate

potential occupational risk factors. Nurses, as the largest professional group in health care, are at a particular risk of experiencing work-related MSDs [1–6]. However, given that nurses' working conditions vary greatly across nursing disciplines, it is also important to investigate whether the prevalence of MSDs varies by type of nurse occupation and the specific working tasks associated with various occupations [26].

The present results also showed weak correlations between musculoskeletal complaints and age, working years and working hours. This could partly be explained by the previously reported association between work posture, heavy or complex lifting of patients and work-related MSDs in nurses [1,3,27]. According to European data, there is a trend towards static work postures, where prolonged standing and sitting are considered a significant risk factor for MSDs in all occupations [24]. Haemodialysis nurses both stand and sit while working; however, no data are available on how much time they spend sitting and standing during each work shift. Moreover, Serranheira et al. [26] demonstrated that when specific nursing tasks are performed more than 10 times a day, the probability of having musculoskeletal complaints increases, particularly complaints concerning the upper back, lower back, hands and feet. With adequate risk management measures, occupational risk hazards due to such repetitive working tasks could probably be prevented.

4.1. Limitations

Due to the cross-sectional design and the self-report method for data gathering used in the present study, certain potential biases have to be considered. One primary limitation of the cross-sectional study design is that there is generally no evidence of causal relationships. Hence, we can only draw firm conclusions about the prevalence of, not the cause of, the musculoskeletal complaints reported. The present study may also be prone to non-response bias due to the rather low response rates. The Danish sample, in particular, might not be representative of the population, and the comparisons between countries therefore have to be interpreted with caution. Misclassification or recall

bias might be inherent in the study, as musculoskeletal complaints up to 1 year back are to be reported. Previous research has shown that there might be a small risk of misclassification of the location of musculoskeletal complaints. For instance, respondents have reported complaints about neck conditions as shoulder discomfort, which of course could be explained by the fact that the trapezius muscle is involved in these regions [28]. This problem might not apply to the present study, however, as all participants had learned about human anatomy during their nursing education.

5. Conclusion

Compared to previous findings [1–6], the prevalence of musculoskeletal complaints seems to be higher among haemodialysis nurses than among nurses in general. Because complaints concerning the hands are common, and also related to absenteeism from work, it is of particular importance that manufacturers of dialysis equipment and nurse managers acknowledge these occupational health and safety hazards in their efforts to create a good work environment.

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