Is shoulder posture during work related to neck and shoulder symptoms among cleaners?

Postura do ombro durante o trabalho está correlacionada com sintomas no pescoço e ombros em trabalhadoras da limpeza?

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Abstract

Introduction: Cleaning workers perform tasks that may be related to the development of shoulder and neck symptoms. **Objective:** To analyze the correlation between shoulder elevation during work and the presence of neck and shoulder symptoms in cleaning workers. **Methods:** Symptoms were assessed using the Nordic Musculoskeletal Questionnaire. Shoulder elevation was recorded during work using triaxial inclinometers. Data were analyzed descriptively and via point-biserial correlation analysis. **Results:** The study included 22 women, most of whom were outsourced (73%), with an average age of 44 years (SD = 11.2), working an average of nine hours per day. Shoulder elevation at work was associated with the presence of shoulder symptoms (rpb = 0.51 and rpb = 0.45 for the 50th and 10th percentiles, respectively) and the percentage of time spent with the shoulder elevated above 30° (rpb = 0.47). No association was found between shoulder elevation and neck symptoms. **Conclusion:** The results highlight the need to reduce shoulder elevation in cleaning workers to manage musculoskeletal symptoms in the shoulder.

Keywords: Cumulative traumatic disorders. Domestic services. Occupational health. Risk factors.

Resumo

Introdução: *Trabalhadoras da limpeza realizam atividades durante o trabalho que podem estar relacionadas ao desenvolvimento de sintomas no ombro e pescoço.* ***Objetivo:*** *Analisar a correlação entre a elevação do ombro durante o trabalho e a presença de sintomas no pescoço e ombros em trabalhadoras da limpeza.* ***Métodos:*** *Os sintomas foram avaliados por meio do Questionário Nórdico de Sintomas Osteomusculares. A elevação do ombro foi registrada durante o trabalho por meio de inclinômetros triaxiais. Os dados foram analisados de forma descritiva e por meio da análise de correlação ponto bisserial.* ***Resultados:*** *Participaram da pesquisa 22 mulheres, trabalhadoras terceirizadas (73%), com média de idade de 44 anos (DP = 11,2), que trabalhavam em média nove horas por dia. A elevação do ombro no trabalho foi associada à presença de sintomas no ombro (rpb = 0,51 e rpb = 0,45 para os percentis 50 e 10, respectivamente) e à porcentagem de tempo em elevação do ombro acima de 30° (rpb = 0,47). Não houve associação entre a elevação do ombro e os sintomas no pescoço.* ***Conclusão:*** *Os resultados indicam a necessidade de reduzir a elevação do ombro em trabalhadoras da limpeza para o controle dos sintomas musculoesqueléticos do ombro.*

Palavras-chave: *Transtornos traumáticos cumulativos. Serviços domésticos. Saúde ocupacional. Fatores de risco.*

Introduction

Cleaning workers are exposed to risk factors for musculoskeletal disorders, such as intense work pace, handling heavy objects, and repetitive movements, in addition to the risk of falls on slippery surfaces and exposure to chemicals. These workers engage in physical activity at work for prolonged periods, requiring repetitive movements, especially of the upper limbs.[1-3]

Cleaning professionals are highly active in the workplace, and some studies have demonstrated that occupational physical activity (OPA) increases the risk of developing pain and musculoskeletal disorders, as well as cardiovascular diseases.[4-5] OPA is associated with repetitive movements, physical exertion, awkward postures, prolonged exposure without muscle recovery time, high blood pressure, among others.[6-7]

Leisure-time physical activity (LTPA) includes dynamic, conditioned movements performed voluntarily for short periods, allowing for sufficient recovery.[8] Unlike OPA, LTPA provides health benefits due to its self-regulated and safer conditions, with higher levels of LTPA associated with a lower risk of adverse cardiovascular events and all-cause mortality.[8-10]

Additionally, studies show that most cleaning professionals are women with low educational levels and social vulnerability, often foregoing rest, breaks, and days off to increase their income.[11-13] As a result, working conditions are associated with the prevalence of musculoskeletal disorders and discomfort in this population.[3-14]

Most musculoskeletal symptoms reported by cleaning workers affect the shoulder joint. Studies on cleaning and janitorial workers in Malaysia found that around 80% of female workers experienced some dysfunction in this region.[11] A study on school cleaning workers in China reported a 64% prevalence of shoulder symptoms in the previous 12 months.[3]

In Brazil, a considerable portion of people seeking rehabilitation treatment, particularly those with upper limb injuries, perform cleaning activities.[15] In 2020, according to social security data on occupational accident benefits, musculoskeletal and connective tissue diseases were the most prevalent (40%) among cleaners and domestic workers, with back pain and shoulder injuries the leading causes of accident-related absences.[16]

Studies have shown that neck and shoulder disorders are correlated with cleaning activities and handling equipment used in this type of work.[17-18] The neck and shoulder regions are anatomically and biomechanically related, with shoulder elevation increasing the overload on these areas.[13] Thus, shoulder and cervical spine problems can be easily confused and often overlap. The spine and shoulder have a biomechanical relationship based on muscle insertions that connect the shoulder girdle to the spine, such as the trapezius, levator scapulae, cervical extensor, and flexor muscles. Muscle activation imbalances can result in neck pain,[19] and biomechanical and muscle activation alterations during shoulder elevation in cleaning tasks have already been demonstrated.[18]

Another phenomenon that explains pain in these regions is innervation. Shoulder pain can be transmitted through the brachial plexus and cervical nerve roots, particularly at the C5-6 level. The suprascapular nerve originates in the upper trunk (C5, C6) of the brachial plexus and extends to the scapular notch, passing under the transverse scapular ligament.[1]

Other studies have assessed shoulder joint movements using inclinometers, relating musculoskeletal injuries and symptoms to variations in upper limb angles in different professions, including cleaning workers.[13-17] However, there is a lack of research considering other parameters, such as the duration and range of motion of the movements these workers perform.

Unlike economically developed countries, cleaning work in Brazil involves little mechanization and the profession has a high demand for healthcare services. Thus, it is important to identify factors associated with the presence of musculoskeletal symptoms in this population. Analyzing shoulder elevation during work using inclinometry provides direct and reliable measurements,[20] which can guide more specific ergonomic interventions. However, few studies have conducted this analysis over prolonged periods. Madeleine et al.,[18] recorded task-related data for three to seven minutes. Evaluating movements over a more representative period would help avoid observation bias, making the data collected more consistent with the worker's daily routine.

Thus, the aim of this study was to analyze the time spent in pre-established shoulder elevation angles of 30°, 60°, and 90° and their 10th, 50th, and 90th percentiles during work among cleaning service workers and to correlate these variables with the presence of musculoskeletal symptoms in the neck and shoulder. A secondary objective was to correlate the presence of musculoskeletal symptoms in the neck and shoulder with body mass index (BMI). The study hypothesis is that there will be a correlation between shoulder elevation during work and the presence of musculoskeletal symptoms in the neck and shoulder, and with BMI.

Methods

This is a cross-sectional observational study conducted in accordance with STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) guidelines,[21] involving cleaning service workers. The data analyzed in this study were obtained from primary research conducted by the Preventive Physiotherapy and Ergonomics Laboratory (LAFIPE) at the Federal University of São Carlos (UFSCar). The study was approved by the Research Ethics Committee of the same institution (CAAE: 32954414.4.0000.5504 and 79234617.0.0000.5504).

Sample

The study sample was obtained by convenience. Women performing domestic cleaning services and outsourced workers involved in cleaning at UFSCar were selected for the study. Participants were recruited in 2016 and 2018 and signed an informed consent form.

G*Power software was used to calculate the study's sample size. To that end, the calculation considered the application of point-biserial correlation, an effect size of 0.7, a two-tailed test, a 5% significance level, and 95% power. The sample size obtained was 16 subjects.

Inclusion and exclusion criteria

The inclusion criteria for the primary studies were age between 18 and 60 years and a work load of at least 4 hours per day or 20 hours per week. The exclusion criteria for the primary studies were being pregnant, having diseases or disorders that affected mobility, allergy to adhesive tapes, and engaging in other paid activities besides cleaning tasks. The exclusion criteria for the present study included errors in inclinometer signal processing.

Instruments

Sociodemographic questionnaire: a semi-structured questionnaire containing questions about sex, age, marital status, body weight, height, physical activity practice, medical history, and lifestyle habits.

Nordic Musculoskeletal Questionnaire (NMQ): a tool that identifies musculoskeletal symptoms in different body regions over the previous 12 months and seven days. This questionnaire also assesses functional disability and the need for healthcare professional treatment.[22] For this study, the prevalence of neck and shoulder symptoms in the previous 12 months and seven days was evaluated.

Equipment

Shoulder elevation movement was recorded using an inclinometer (Logger Teknologi, Sweden, and Axivity, United Kingdom). This is a direct measurement of postures and movements, using gravity as a reference to assess joint mobility.[20] The sampling frequency was set at 25 Hz.

Procedures

Participants were recruited by phone or in person at their workplace. After being informed about the study's objectives and procedures, assessments and data collection were scheduled according to the workers' availability. The evaluators were trained to use the instruments and administer the questionnaires.

The evaluators also clarified any doubts the participants had during questionnaire completion and the period they were using the equipment. Objective assessments were conducted during working hours without causing any inconvenience to the workers. After the initial explanations, participants completed the sociodemographic and NMQ questionnaires in a designated area.

For upper limb movement analysis, the sensor was positioned on the right arm below the insertion of the deltoid muscle, allowing for the assessment of arm elevation movements which were measured relative to the gravitational line, without differentiating between shoulder flexion and abduction.[20,23,24] To locate this structure, manual palpation was performed during resisted shoulder abduction movement.

After securing the sensor with double-sided adhesive tape, a reference position was recorded, which is considered the neutral shoulder position, with the arms resting along the body while standing still for 15 seconds. Next, the worker returned to work and was instructed to perform their tasks as naturally as possible.

The data recorded during work were selected for analysis, saved to a computer, and exported to a spreadsheet. The variables obtained through inclinometry were the time spent with arm elevation above 30°, 60°, and 90°, as well as the 10th, 50th, and 90th percentiles of arm elevation, representing the minimum, average, and maximum amplitude of shoulder postural exposure, respectively.[20, 23-25]

Data analysis

The data collected from the questionnaires were tabulated and analyzed using descriptive and statistical methods (means, frequencies, and standard deviations) to characterize the study sample. The point-biserial correlation test was applied between the continuous variables (shoulder elevation movement and BMI) and dichotomous variable (musculoskeletal symptoms in the neck and shoulder). A significance level of 5% was adopted. Interpretation of the point-biserial correlation coefficient (rpb) was as follows: strong (rpb > 0.50), moderate (rpb between 0.30 and 0.50) or weak correlation (rpb < 0.30).[26] All statistical analyses were performed using SPSS software (version 22.0).

Results

This study included 22 women with an average age of 44 years (SD = 11.2), married (55%), with children (100%), and incomplete elementary education (41%) (Table 1).

Table 1 - Sociodemographic and occupational profile of the workers (n = 22)

Sociodemographic data	n (%)
Age (years)*	44 (11.2)
< 30 years	2 (9.6)
30-50 years	13 (59.1)
> 50 years	7 (31.8)
Schooling	
Incomplete elementary	9 (40.9)
Complete elementary	6 (13.6)
Complete secondary	7 (31.8)
Marital status	
Married	12 (54.5)
Single	3 (13.6)
Divorced	7 (31.8)
Has children	22 (100)
Employment status	
Formal	3 (13.6)
Hourly housekeeper/Self-employed	3 (13.6)
Outsourced	16 (72.7)
Weekly work load (hours)*	45.0 (8.8)
Days worked per week*	5 (0.8)
Hours worked per day*	9 (0.6)
Wage	
< 1 minimum wage	1 (4.5)
Between 1 and 2 minimum wage	21 (95.5)
Body mass index (kg/m²)*	30.1 (7.1)
Underweight	1 (4.5)
Normal weight	4 (18.2)
Overweight	6 (27.3)
Obese	11 (50.0)
Engages in leisure physical activity	3 (13.6)
Alcoholic beverage consumption (> 3x week)	4 (18.2)

Table 1 - Sociodemographic and occupational profile of the workers (n = 22) (continued)

Sociodemographic data	n (%)
Diagnosed diseases	
Hypertension	9 (40.9)
Dizziness symptoms	5 (22.7)
Diabetes	3 (13.6)
Back pain	3 (13.6)
Altered thyroid	3 (13.6)
Leg pain	2 (9.1)
Arthritis	1 (4.5)
Shoulder pain	1 (4.5)
Respiratory problems	1 (4.5)
Anxiety	1 (4.5)
Fibromyalgia	1 (4.5)
Hypercholesterolemia	1 (4.5)
Medication use	
Hypertension	8 (36.4)
Pain	4 (18.2)
Diabetes	1 (4.5)

Note: *mean (standard deviation).

Most of the workers were outsourced (73%). The average number of hours worked per day was 9 (SD = 0.6), and the majority (95.5%) earned between 1 to 2 minimum monthly wages. Half of the participants were classified as obese (50%), followed by overweight (27.3%). In regard to disease, 40.9% of workers had hypertension, making it the most common illness in this group. Symptoms of dizziness were reported by 22.7% of participants, and the region most frequently affected was the spine (13.6%). The most commonly used medications were for hypertension (36%) and pain relief (18%) (Table 1).

Musculoskeletal symptoms in the neck and shoulders identified by the NMQ were frequent in the previous 12 months (27.3 and 31.8%, respectively) and in the seven days before the study (13.6 and 22.7%, respectively).

Duration of arm elevation above 30°, 60°, and 90°, as well as the 10th, 50th, and 90th percentiles of arm elevation, are presented in Table 2, showing that workers spend around 25% of their working time with their arms above 30° and only 2% of the time with their arms above 90°. The shoulder elevation percentiles indicate that the minimum range of motion was around 8°, average 19°, and maximum 47°.

Table 2 - Duration of arm elevation above 30°, 60°, and 90°, and the 10th, 50th, and 90th percentiles

Variables	Percentage	Hours
Elevation time above 30° (%)	24.9 (20.20)	1.42 (1.50)
Elevation time above 60° (%)	6.8 (7.40)	0.36 (0.39)
Elevation time above 90° (%)	2.3 (3.70)	0.27 (0.39)
Minimum range – 10th percentile (°)	7.7 (6.20)	-
Mean range – 50th percentile (°)	18.6 (8.20)	-
Maximum range – 90th percentile (°)	47.1 (22.20)	-

Note: Data presented as mean (standard deviation).

There was a significant correlation between the percentage of shoulder elevation time above 30°, the 10th percentile, and the 50th percentile of shoulder elevation with shoulder symptoms in the previous seven days (Table 3). The results show a strong correlation between the 50th percentile of shoulder elevation and shoulder symptoms in the previous seven days, as well as moderate correlations between these symptoms and the 10th shoulder elevation percentile and the percentage of shoulder elevation time above 30°.

There was a significant correlation between BMI and shoulder symptoms in the previous 12 months (Table 4 and Figure 1). Figure 1B shows that there is a higher concentration of pain-free workers in lower BMI ranges and a greater concentration of workers with pain in higher ranges, which justifies the correlation found.

Table 3 - Point-biserial correlation coefficient between shoulder elevation and musculoskeletal symptoms in the neck and shoulder

Variables	12 months		7 days	
	Neck	Shoulder	Neck	Shoulder
Elevation time above 30° (%)	0.25	0.36	0.31	0.47*
Elevation time above 60° (%)	0.34	0.21	0.12	0.08
Elevation time above 90° (%)	0.36	-0.13	-0.06	-0.01
Minimum range – 10th percentile (°)	0.27	0.30	0.35	0.45*
Mean range – 50th percentile (°)	0.27	0.33	0.32	0.51*
Maximum range – 90th percentile (°)	0.23	0.25	0.12	0.14

Note: *p < 0.05.

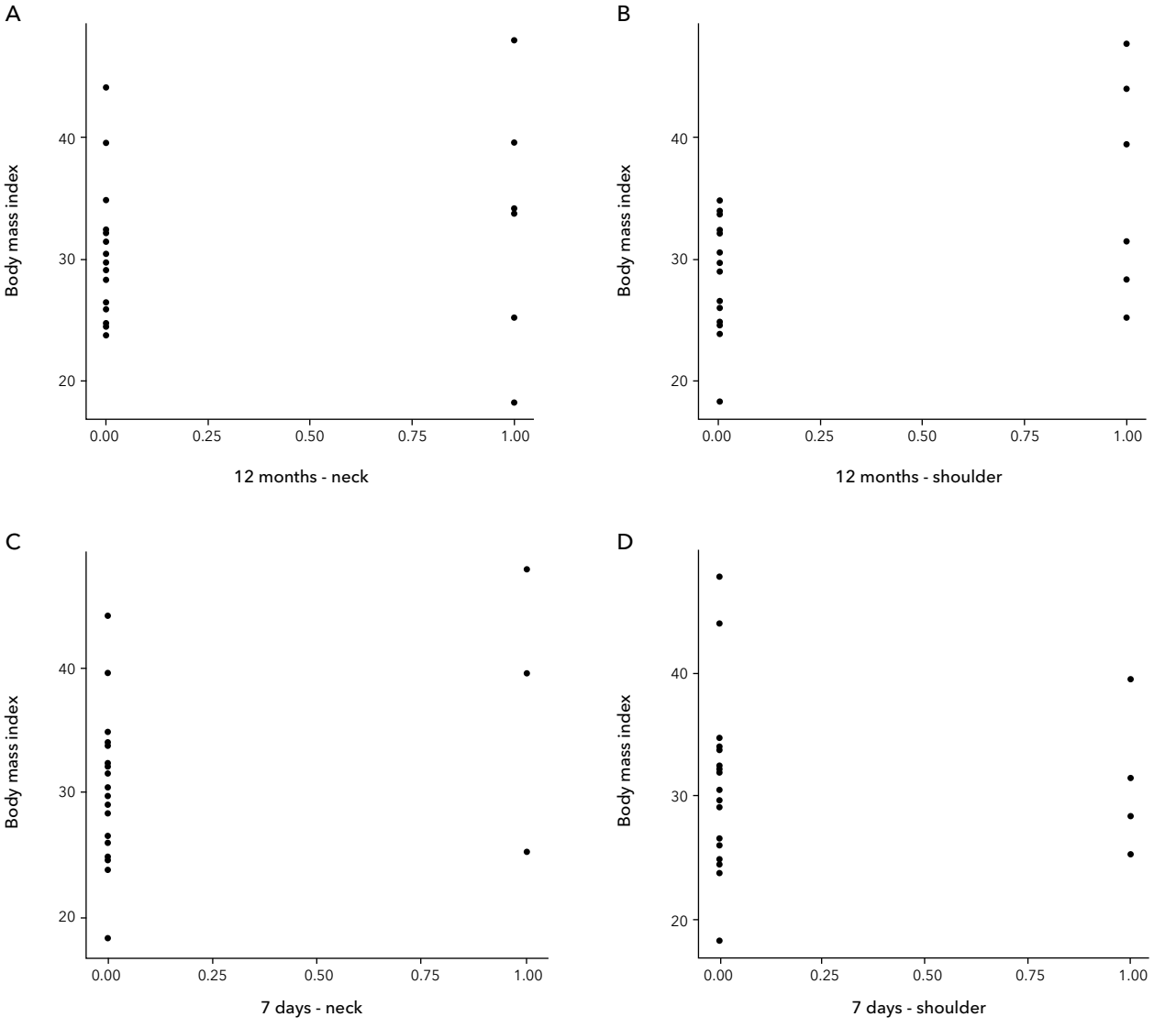

Figure 1 - Scatter plots between body mass index and musculoskeletal symptoms in the neck and shoulder.

Table 4 - Point-biserial correlation coefficient between musculoskeletal symptoms in the neck and shoulder and body mass index

Musculoskeletal symptoms	Body mass index
12 months	
Neck	0.19
Shoulder	0.55*
7 days	
Neck	0.38
Shoulder	0.15

Note: *p < 0.05.

Discussion

The findings of the present study indicated that there was a significant correlation between the percentage of shoulder elevation time above 30°, the 10th percentile, and the 50th percentile of shoulder elevation with shoulder symptoms in the previous seven days. There was also a correlation between BMI and shoulder symptoms in the previous 12 months. The cleaning professionals had an average age of 44 years, had children, and low education levels. The literature suggests that this occupation is composed primarily of women with low educational levels.[11,12,14]

The majority work more than 8 hours per day and earn between one and two minimum monthly wages. With respect to health profile, half the workers were obese, and the most common diagnosis was hypertension. Hypertension in this population is common and related to the prolonged physical activity performed at work, which makes them more prone to cardiovascular diseases.[27] A possible explanation for this finding is that physical activity increases blood pressure and heart rate for 24 hours, and when this increase is chronic, it becomes a risk factor for cardiovascular diseases.[8] Physical activity at work is associated with a higher likelihood of adverse cardiovascular events.[10]

Musculoskeletal symptoms were frequent in the neck and shoulders. Shoulder and cervical pathologies generally overlap, with evidence suggesting that cervical pathologies can cause shoulder pain and vice versa, in addition to being the most affected areas in these workers.[11,18,19] Other studies also report that pain is frequent, also affecting the hand/wrist and elbow regions.[11,14] These findings are consistent with a study by Unge et al.,[17] who, using inclinometry in cleaning workers, found a higher percentage of time spent in neck and shoulder flexion, in addition to increased complaints of symptoms in these areas. Madeleine et al.[18] also used inclinometry in cleaning workers and identified neck and shoulder pain and increased muscle activity in these regions on the days analyzed.

The literature reports that shoulder elevation during work is related to musculoskeletal symptoms. The initial hypothesis of this study was partially confirmed, since there was a correlation between musculoskeletal symptoms in the shoulder and variables related to shoulder elevation during work. However, in contrast to the expectation of a correlation between larger ranges of motion and the presence of symptoms, an association was found with the 10th and 50th percentiles. A possible explanation for this finding may be the short duration of exposure at higher shoulder elevation ranges (6.8% of the time above 60° and 2.3% above 90°). Despite exhibiting shoulder elevation levels below 30°, the 10th and 50th percentiles demonstrated that even at ranges not considered a risk for shoulder elevation according to ergonomic guidelines, there was a correlation with shoulder symptoms. One possible explanation for this finding may be related to the presence of obesity and overweight in the study sample. The correlation between shoulder symptoms and BMI was strong, indicating that the higher the BMI, the greater the proportion of shoulder symptoms in the previous seven days. This finding may suggest that inflammation associated with obesity contributes to the occurrence of symptoms. Another explanation would be that women with higher BMI may have greater biomechanical disadvantage when elevating the arm, such that even non-extreme ranges of movement may cause joint overload in the shoulder.

One of the main limitations of the study was the small sample size. Moreover, the use of an inclinometer and analysis of a few hours of work may not be representative of all tasks performed. The use of objective measurements of shoulder postures and movements should be carried out to better understand the effect of work on neck and shoulder symptoms in cleaning workers. Another limitation is the absence of strength measurements in task performance.

Conclusion

There was a significant correlation between the percentage of shoulder elevation time above 30°, the 10th percentile, and the 50th percentile of shoulder elevation and shoulder symptoms in the previous seven days. BMI was also correlated with shoulder symptoms during the same time period. The results indicate the need to reduce shoulder elevation in cleaning workers to control shoulder musculoskeletal symptoms.

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Authors' contributions

VFC and TOS were responsible for the conception and design of the study. TS, VFC, MIT, JSG, and CSM conducted the literature review. Data acquisition was performed by VFC and JSG, and data analysis and interpretation by TS, VFC, MIT, and TOS. All authors participated in the intellectual development and review of the manuscript and approved its final version.

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