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Prevalence of musculoskeletal symptoms in blue-collar workers: association with individual and lifestyle related factors

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Abstract

This study aimed to investigate the 12-month and 7-day prevalence of musculoskeletal symptoms in different body regions and its association with different individual and lifestyle-related factors among blue-collar workers of a Portuguese manufacturing company. One hundred and thirty-six blue-collar workers participated in the study. Musculoskeletal symptoms were assessed using the Nordic Musculoskeletal Questionnaire, and the physical activity level and sitting time were assessed with the IPAQ-Short Version. The 12-month prevalence was higher in the low back region (56.6%), followed by the wrist/hand (50%), the shoulder (45.6%) and the neck (44.9%). In the last 7 days, the four most affected body regions were: the low back region (25%), the shoulder (20.6%) and the neck and wrist/hand (19.9%). Regarding individual factors, significant associations were found between age and the prevalence of musculoskeletal symptoms in the shoulder ($\chi^2(2)=6.783$; $p=0.034$), elbow ($\chi^2(2)=6.813$; $p=0.033$), wrist/hand ($\chi^2(2)=6.999$; $p=0.030$), thigh/hip ($\chi^2(2)=9.771$; $p=0.008$), neck ($\chi^2(2)=9.293$; $p=0.010$) and the low back region ($\chi^2(2)=6.190$; $p=0.045$), with the older workers reporting a higher prevalence of musculoskeletal symptoms. Moreover, women reported a significantly higher prevalence of musculoskeletal symptoms in the neck than men ($\chi^2(1)=5.054$; $p=0.025$). Overweight and obese workers had a significantly higher prevalence of symptoms in the shoulder ($\chi^2(2)=10.595$; $p=0.005$) and neck (($\chi^2(2)=6.521$; $p=0.038$). Regarding lifestyle-related factors, no significant associations were found between physical activity level or sitting time ($p>0.05$) and the prevalence of musculoskeletal symptoms in any of the body regions. To conclude, blue-collar workers have a high prevalence of musculoskeletal symptoms. Individual factors like age, gender and BMI seem to influence the prevalence of musculoskeletal symptoms in different body regions, but lifestyle-related factors such as the physical activity level and sitting time seem not to be associated with the prevalence of musculoskeletal symptoms in the blue-collar workers of this sample. The present results emphasize the need of workplace interventions to prevent musculoskeletal symptoms in this population.

1. INTRODUCTION

The sectorization of labor, that emerged from the Industrial Revolution, forced workers to perform tasks repetitively or to stay for longer periods of time in a maintained posture during their working hours, which causes pain, physical discomfort and, consequently, musculoskeletal disorders (Gupta et al., 2016; Sjögrena et al., 2006). Musculoskeletal disorders describe a group of injuries and/or disabilities affecting muscles, bones, nerves, tendons, ligaments, joints, cartilages or spinal discs (Bureau of Labor Statistics Occupational Safety and Health, 2012). According to the World Health Organization (WHO), work-related musculoskeletal disorders have multifactorial causes or risk factors (WHO, 1995).

Blue-collar workers frequently represent an occupational category with higher physical workloads, spending most of their labor time standing or walking (Chen, Perry, Yang, & Yang, 2017; Schreuder, Roelen, Koopmans, & Groothoff, 2008; Yildirim, Gunay, & Karadibak, 2014). According to different authors, there is an annual prevalence of musculoskeletal symptoms in these employees ranging from 61% (Aghilinejad, Choobineh, Sadeghi, Nouri, & Ahmadi, 2012) to 72% (Ghasemkhani, Mahmudi, & Jabbari, 2008). Likewise, it is stated that workers engaging higher physical workloads report a higher prevalence of symptoms and in more body regions than those with lighter workloads (Widanarko et al., 2011). Furthermore, the high prevalence of musculoskeletal disorders in blue-collar workers is a major cause of absenteeism, diminished working abilities, higher medical costs and decreased productivity (Hanebuth, Meinel, & Fischer, 2006; Manjunatha, Kiran, & Thankappan, 2011).

The contribution of the individual factors to the prevalence of musculoskeletal symptoms, such as age, gender or anthropometric characteristics (e.g. Body Mass Index) have been widely investigated. Regarding age, most of the available literature reported that older workers in physically demanding jobs seem to complaint more about musculoskeletal disorders than younger employees (de Zwart, Broersen, Frings-Dresen, & Van Dijk, 1997; Hussain, 2004). Similarly, when compared to men, women often report a higher number of painful regions and a higher prevalence of musculoskeletal symptoms (de Zwart et al., 1997; Widanarko et al., 2011). Other authors also reported a significant association between Body Mass Index (BMI) and the presence of musculoskeletal symptoms, especially in the lower limbs (Andersen, Haahr, & Frost, 2007), with overweight and obese workers reporting higher 12-month prevalence of musculoskeletal symptoms and having a higher probability of developing work-related musculoskeletal disorders (Aghilinejad et al., 2012; Viester et al., 2013).

Regarding the influence of lifestyle-related factors, it has been stated that blue-collar workers submitted to prolonged sitting during their labor hours are more likely to develop musculoskeletal disorders (Hallman, Gupta, Mathiassen, & Holtermann, 2015). Furthermore, Van Amelsvoort, Spigt, Swaen, and Kant (2006) demonstrated a significantly decrease in sick leaves caused by musculoskeletal disorders when workers were active in their leisure time, compared to workers with a more sedentary behavior, which suggests that physical activity is beneficial. Similarly, several authors demonstrated positive effects of different workplace physical activity interventions on sick leave, costs, new episodes of pain, physical discomfort, and consequently, musculoskeletal disorders among workers (Kellett, Kellett, & Nordholm, 1991; Kietrys, Galper, & Verno, 2007; Tveito, Hysing, & Eriksen, 2004; Tveito & Eriksen, 2009; Zebis et al., 2011).

Furthermore, other risk factors should be recognized. Especially in the low back region, different investigations recognized occupational risk factors such as inadequate standing and sitting postures, heavy lifting and repetitive movements, to be significant risk factors for pain in this body region among different industrial workers (Goswami et al., 2016; Miranda, Viikari-Juntura, Punnett, & Riihimaki, 2008; Yildirim et al., 2014). Similarly, risk factors associated with the psychosocial context of work, namely poor workplace social environment, job dissatisfaction or low job control, have been shown to influence pain and other symptoms in the low back region of workers of an automobile manufacturing company (Kerr et al., 2001). Likewise, a study conducted with offshore workers from an oil company demonstrated that occupational stressors, in particular stress with their own safety, were important predictors of musculoskeletal pain in different body regions, highlighting the role of psychosocial factors in work-related musculoskeletal disorders, often little taken into consideration (Chen, Yu, & Wong, 2005).

Workplace health promotion initiatives are programs that aim to promote health by reducing its risks and actively prevent the beginning of disease (Goetzel & Ozminkowski, 2008). This may be operationalized using different types of strategies, namely decreasing stress, excess of body weight, improving nutrition and increasing physical activity and fitness levels. Indeed, in the last 20 years, the number of these programs has been growing, as their advantages for employees and companies are increasingly being recognized, as they help to reduce employee's health care costs and disability and improve employee's productivity (Wang et al., 2010).

Studies in different countries have investigated the prevalence of musculoskeletal symptoms in manufacturing or industrial workers like blue-collars and the association with different risk factors. However, according to Serranheira (2007), in Portugal, the limited data available reported by the National Centre for Protection Against Occupational Hazards revealed a gradual increase in the number of cases of musculoskeletal disorders and the consequent increase of absenteeism and the use of the Portuguese health care system and health insurance companies by workers. According to the same author there is a lack of studies investigating this matter, especially the 7-day prevalence, and its association with different factors in this particular occupational group.

In that sense, the aim of the present study was to investigate the 12-month and 7-day prevalence of musculoskeletal symptoms in different body regions and its association with different individual (age, gender and BMI) and lifestyle-related factors (physical activity level and sitting time) among blue-collar workers of a Portuguese manufacturing company.

2. MATERIALS AND METHODS

2.1. Study Design and sampling

This observational, cross-sectional study was approved by the ethical committee of the local University and by the board of the company. The study was conducted in a Portuguese multinational manufacturing company of water heaters. There are 1000 employees in the company, however, only a convenience sample of 220 were allowed by the administration board to participate. These employees perform prolonged shifts (7 hours and 30 minutes) and repetitive demanding tasks using mainly the upper limbs, while in the standing position. The main tasks that these workers perform during their working hours are loading heavy objects, use screwdrivers and place washers in equipment such as water heaters.

All the participants were full-time workers (40h/week) and had been employed in the company for at least 6 months. From the 220 employees invited, 209 agreed to participate (87 male; 122 female), with 136 of them being considered blue-collar workers (40 male; 96 female). The mean age of these workers was 37.4 ± 8.5 years and the mean BMI was 27.2 ± 4.9 Kg/m^2, which according to the World Health Organization (2019) represents a pre-obesity category. All participants expressed their consent to participate in the study by signing an informed consent form.

2.2. Individual data collection

Individual factors such as age and gender were self-reported. Height (m) of the participants was measured with the participants standing upright against a stadiometer in bare or stocking feet (Holtain Ltd., Crymmych, Pembrokeshire, UK). Weight (kg) was measured using a portable electronic weight scale (Tanita Inner Scan BC 532, Tokyo, Japan). BMI was calculated from the ratio between body weight and body height (kg/m2). Participants BMI was expressed as normal (18.5-24.9), overweight (25.0-29.9) and obese (>30.0), according to the World Health Organization (2019).

2.3. Musculoskeletal disorders and related symptoms

Musculoskeletal pain and related symptoms were assessed with the Standardized Nordic Musculoskeletal Questionnaire (NMQ) (Kuorinka, 1987), supplemented with questions about localized pain intensity. This questionnaire has already been validated to the Portuguese population by Mesquita, Ribeiro, and Moreira (2010). The NMQ consists of 27 questions of binary choice (yes or no).

The questionnaire has three questions correlating to nine anatomic regions (neck, shoulders, elbows, wrists/hands, dorsal region, low back region, hips/thighs, knees and ankles/feet). The first is “had some troubles or pain in the last 12 months”; the second is “in the last 12 months did you feel some limitation caused by work in the daily activities”; and the third is “had some troubles or pain in the last 7 days” (Kuorinka, 1987). The questionnaire also includes the numeric pain scale (scale 0-10) to assess the pain intensity in the last 7 days.

2.4. Physical Activity Level and Sitting Time Assessment

Physical activity level and sitting time were assessed using the short version of the International Physical Activity Questionnaire (IPAQ) (Craig et al., 2003). According to the Guidelines for the data processing and analysis of the IPAQ, total physical activity was expressed as metabolic equivalent (MET) minutes/week by weighting the reported minutes per week in each activity category by the metabolic equivalent specific to each activity (Total Physical Activity = 3.3 MET x walking minutes x walking days + 4.0 MET x moderate-intensity activity minutes x moderate days + 8.0 MET x vigorous-intensity activity minutes x vigorous-intensity days). Physical activity level of the participants was expressed as active, inactive and insufficiently active. Regarding the sitting time, blue-collar workers of this sample spend a median of 120 minutes sitting during the day.

2.5. Statistical Analysis

Data was analyzed with the Statistical Package for the Social Sciences (SPSS v. 25.0) software for Windows. Descriptive characteristics of the participants (age and BMI) were presented as mean ± standard deviation. The prevalence of musculoskeletal symptoms during the last 12 months and the last 7 days in each body region was described in percentage (%). The Chi-Square test was used to assess the association between the prevalence of musculoskeletal symptoms and the individual (age, gender and BMI) and lifestyle-related factors (physical activity level and sitting time). A p value under 0.05 was considered statistically significant.

3. RESULTS

3.1. 12-month and 7-day prevalence of musculoskeletal symptoms in blue-collar workers

The analysis of the NMQ data demonstrated that the 12-month prevalence of musculoskeletal symptoms is high, especially in the low back region (56.6%), followed by the wrist/hand (50%), the shoulder (45.6%) and the neck (44.9%). In the other body regions, the prevalence was 30.1% in the ankle/feet; 22.8% in the knee; and 19.1% in the elbow and thigh/hip regions.

Regarding the 7-day prevalence, the most affected body regions were: the low back region (25%), followed by the shoulder (20.6%), the wrist/hand and the neck (19.9%). In the other body regions, the prevalence was 13.2% in the ankles/feet; 8.1% in the elbow and knee; and 7.4% in the thigh/hip.

In tables 1 to 5, the percentage represents the proportion of participants reporting pain in each body region by category (column). It is also important to note that each participant may report pain in more than one body region.

3.2. Association between musculoskeletal symptoms and individual factors (age, gender and BMI)

Significant associations were found between age and the prevalence of musculoskeletal symptoms in the shoulder (p=0.034), elbow (p=0.033), wrist/hand (p=0.030), thigh/hip (p=0.008), neck (p=0.010) and the low back region (p=0.045), with the older workers within the 41-60 age group presenting a higher prevalence of musculoskeletal symptoms, except for the low back region in which the highest prevalence was found in the 31-40 age group (Table 1).

Table 1. Association between musculoskeletal symptoms and age

Body Regions	20-30 years (n=33)	31-40 years (n=59)	41-60 years (n=44)	Chi-Square Test
Shoulder (n=62)	9 (27.3%)	28 (47.5%)	25 (56.8%)	$\chi^2(2)=6.783$; ***p*=0.034***
Elbow (n=26)	4 (12.1%)	8 (13.6%)	14 (31.8%)	$\chi^2(2)=6.813$; ***p*=0.033***
Wrist/Hand (n=68)	10 (30.3%)	32 (54.2%)	26 (59.1%)	$\chi^2(2)=6.999$; ***p*=0.030***
Thigh/Hip (n=26)	5 (15.2%)	6 (10.2%)	15 (34.1%)	$\chi^2(2)=9.771$; ***p*=0.008***
Knee (n=31)	5 (15.2%)	12 (20.3%)	14 (31.8%)	$\chi^2(2)=3.333$; *p*=0.189
Ankles/Feet (n=41)	7 (21.2%)	22 (37.3%)	12 (27.3%)	$\chi^2(2)=2.852$; *p*=0.240
Neck (n=61)	8 (24.2%)	27 (45.8%)	26 (59.1%)	$\chi^2(2)=9.293$; ***p*=0.010***
Dorsal region (n=19)	5 (15.2%)	8 (13.6%)	6 (13.6%)	$\chi^2(2)=0.051$; *p*=0.975
Low back region (n=77)	14 (42.4%)	32 (55.2%)	31 (23.0%)	$\chi^2(2)=6.190$; ***p*=0.045***

***p*<0.05**

Gender was significantly associated with the prevalence of musculoskeletal symptoms in the neck region (p=0.025), with females presenting a higher prevalence than male workers Table 2).

Table 2. Association between musculoskeletal symptoms and gender

Body Regions	Male (n=40)	Female (n=96)	Chi-Square Test
Shoulder (n=62)	16 (40.0%)	46 (47.9%)	χ2(1) = 0.713; *p*=0.398
Elbow (n=26)	4 (10.0%)	22 (22.9%)	χ2(1) = 3.047; *p*=0.081
Wrist/Hand (n=68)	16 (40.0%)	52 (54.2%)	χ2(1) = 2.267; *p*=0.132
Thigh/hip (n=26)	6 (15.0%)	20 (20.8%)	χ2(1) = 0.621; *p*=0.431
Knee (n=31)	10 (25.0%)	21 (21.9%)	χ2(1) = 0.157; *p*=0.692
Ankles/Feet (n=41)	13 (32.5%)	28 (29.2%)	χ2(1) = 0.149; *p*=0.700
Neck (n=61)	12 (30.0%)	49 (51.0%)	χ2(1) = 5.054; ***p*=0.025***
Dorsal Region (n=19)	5 (12.5%)	14 (14.6%)	χ2(1) = 0,102; *p*=0.749
Low back region (n=77)	20 (51.3%)	57 (59.4%)	χ2(1) = 0.741; *p*=0.389

***p*<0.05**

Significant associations were found between BMI and the prevalence of musculoskeletal symptoms. Obese workers had a significantly higher prevalence of musculoskeletal symptoms in the neck (*p*=0.038) in comparison with the other BMI categories, and overweight workers had a significantly higher prevalence of symptoms in the shoulder (*p*=0.005) (Table 3).

Table 3. Association between musculoskeletal symptoms and BMI (in kg/cm^2)

Body Regions	Normal (n=53)	Overweight (n=48)	Obese (n=35)	Chi-Square Test
Shoulder (n=62)	15 (28.3%)	28 (58.3%)	19 (54.3%)	$\chi^2(2)$=10.595; ***p*=0.005***
Elbow (n=26)	7 (13.2%)	11 (22.9%)	8 (22.9%)	$\chi^2(2)$=1.962; *p*=0.375
Wrist/Hand (n=68)	22 (41.5%)	24 (50.0%)	22 (62.9%)	$\chi^2(2)$=3.843; *p*=0.146
Thigh/Hip (n=26)	6 (11.3%)	12 (25.0%)	8 (22.9%)	$\chi^2(2)$=3.474; *p*=0.176
Knee (n=31)	10 (18.9%)	8 (16.7%)	13 (37.1%)	$\chi^2(2)$=5.583; *p*=0.061
Ankles/Feet (n=41)	14 (26.4%)	13 (27.1%)	14 (40.0%)	$\chi^2(2)$=2.178; *p*=0.337
Neck (n=61)	19 (35.8%)	20 (41.7%)	22 (62.9%)	$\chi^2(2)$=6.521; ***p*=0.038***
Dorsal region (n=19)	11 (20.8%)	4 (8.3%)	4 (11.4%)	$\chi^2(2)$=3.487; *p*=0.175
Low back region (n=77)	29 (54.7%)	26 (57.4%)	21 (60.0%)	$\chi^2(2)$=0.245; *p*=0.885

***p*<0.05**

3.3. Association between musculoskeletal symptoms and lifestyle-related factors (physical activity level and sitting time)

No significant associations were found between physical activity level (Table 4) or sitting time (Table 5) and the prevalence of musculoskeletal symptoms in the different body regions (*p*>0.05).

Table 4. Association between musculoskeletal symptoms and physical activity level

Body Regions	Active (n=104)	Inactive (n=19)	Insufficiently Active (n=13)	Chi-Square Test
Shoulder (n=62)	51 (49.0%)	5 (26.3%)	6 (46.2%)	χ2(2) = 3.346; *p*=0.188
Elbow (n=26)	19 (18.3%)	4 (21.1%)	3(23.1%)	χ2(2) = 0.226; *p*=0.893
Wrist/Hand (n=68)	53 (51.0%)	7 (36.8%)	8(61.5%)	χ2(2) = 2.047; *p*=0.359
Thigh/hip (n=26)	22 (21.2%)	4 (21.1%)	0 (0%)	χ2(2) = 3.398; *p*=0.183
Knee (n=31)	26 (25.0%)	4 (21.1%)	1(7.7%)	χ2(2) = 2.005; *p*=0.367
Ankles/Feet (n=41)	30 (28.8%)	5 (26.3%)	6 (46.2%)	χ2(2) = 1.798; *p*=0.407
Neck (n=61)	45 (43.3%)	9 (47.4%)	7 (53.8%)	χ2(2) = 0.579; *p*=0.749
Dorsal Region (n=19)	17 (16.3%)	1 (5.3%)	1 (7.7%)	χ2(2) = 2.113; *p*=0.348
Low back region (n=77)	61 (59.2%)	7 (36.8%)	9 (69.2%)	χ2(2) = 4.152; *p*=0.125

Table 5. Association between musculoskeletal symptoms and sitting time (in minutes)

Body Regions	<120 min (n=58)	≥120 min (n=78)	Chi-Square Test
Shoulder (n=62)	28 (48.3%)	34 (43.6%)	χ2(1) = 0.294; *p*=0.587
Elbow (n=26)	14 (24.1%)	12 (15.4%)	χ2(1) = 1.648; *p*=0.199
Wrist/Hand (n=68)	33 (56.9%)	35 (44.9%)	χ2(1) = 1.924; *p*=0.165
Thigh/hip (n=26)	9 (15.5%)	17 (21.8%)	χ2(1) = 0.848; *p*=0.357
Knee (n=31)	11 (19.0%)	20 (25.6%)	χ2(1) = 0.842; *p*=0.359
Ankles/Feet (n=41)	15 (25.9%)	26 (33.3%)	χ2(1) = 0.882; *p*=0.348
Neck (n=61)	26 (44.8%)	35 (44.9%)	χ2(1) = 0.000; *p*=0.996
Dorsal Region (n=19)	5 (8.6%)	14 (17.9%)	χ2(1) = 2.408; *p*=0.121
Low back region (n=77)	33 (56.9%)	44 (57.1%)	χ2(1) = 0.001; *p*=0.977

When analyzing the association between reported pain and sitting time, regardless of the body region, no significant association was found (Table 6).

Table 6. Association between musculoskeletal symptoms, regardless of body region, and sitting time (in minutes)

Body Regions	<120 min	≥120 min	Chi-Square Test
Pain	49 (36.0%)	67 (49.3%)	$\chi2(1) = 0.053$; p=0.818
No Pain	9 (6.6%)	11 (8.1%)	

4. DISCUSSION

This study investigated the 12-month and 7-day prevalence of musculoskeletal symptoms in different body regions and its association with different individual (age, gender and BMI) and lifestyle-related factors (physical activity level and sitting time) among blue-collar workers of a Portuguese manufacturing company.

The results of the present study revealed that the prevalence of musculoskeletal symptoms is high in blue-collar workers, with the four most affected body regions in the last 12 months being the low back region (56.6%), followed by the wrist/hand (50%), the shoulder (45.6%) and the neck (44.9%). Regarding the 7-day prevalence, the percentages are lower, even though the four most affected body regions are the same, with the low back region similarly registering the highest prevalence (25%), followed by the shoulder (20.6%) and the wrist/hand and neck with 19.9%.

The majority of investigations in blue-collar workers also confirm that the low back seems to be the body region where the highest prevalence of pain is described (Ng, Tamrin, Yik, Yusoff, & Mori, 2013; Widanarko, Legg, Stevenson, Devereux, & Jones, 2013). Previous studies have reported a prevalence of 54% (Widanarko et al., 2013) and 58% (Ng et al., 2013), which is very close to the percentages reported here, regarding the 12-month prevalence. Indeed, the workers of this sample perform heavy loading and lifting tasks during their working hours, which according to Miranda et al. (2008) are significant predictors of low back pain among blue-collar workers. Regions such as the neck and the shoulder are also pointed out as the most prevalent regions with musculoskeletal symptoms in this population, registering in previous investigations a prevalence of 43% and 42%, respectively, which is also very close with the results presented in this paper (Widanarko et al., 2013).

The high prevalence of musculoskeletal disorders in this group of workers may be related to the high physical demands. Effectively, blue-collar workers, as previously mentioned, represent an occupational group with higher physical workloads (Chen et al., 2017; Schreuder et al., 2008; Yildirim et al., 2014). When physical work demands exceed the safety margin of the individual physical capacities, the risk of physical deterioration increases and can be translated into musculoskeletal disorders, poor work ability and sickness absenteeism (Holtermann et al., 2010). However, workload was not assessed objectively in this study and a causative relationship cannot be established.

As previously described, the contribution of different individual factors to the prevalence of musculoskeletal pain and related symptoms have been widely investigated in the literature. In the present investigation, significant associations were found between age, gender and BMI and the prevalence of musculoskeletal symptoms in different body regions.

Regarding age, the older blue-collars of this sample demonstrated a higher prevalence of musculoskeletal symptoms. Indeed, similar results were reported by de Zwart et al. (1997), demonstrating that musculoskeletal complaints among workers in a physically demanding job increases with age, which can be a consequence of the physiological degenerative processes associated with aging (De Magalhães, Curado, & Church, 2009). Furthermore, a higher number of years in the same job continually exposes the worker to the same occupational risk factors, leading to higher or continuous musculoskeletal complaints (Tinubu, Mbada, Oyeyemi, & Fabunmi, 2010).

The results of this study also revealed an association between gender and the prevalence of musculoskeletal symptoms although only in the neck, with women reporting a significantly higher prevalence than male workers of this manufacturing company. Overall, for the other body regions, the present study also found a tendency for a higher prevalence of symptoms in females, except for the knee and ankles/feet. Previous investigations in workers with physically demanding occupations have also reported significant differences between male and female gender, with most of them similarly confirming a higher prevalence of neck symptoms in females, corroborating our results (Miranda, Viikari-Juntura, Martikainen, Takala, & Riihimäki, 2001; Widanarko et al., 2011). However, these authors also reported significant associations between gender and musculoskeletal symptoms in other body regions, such as the shoulders, the wrists/hands, the upper back and the hips/thighs, with women also reporting higher prevalence of symptoms and in more body regions than male employees (Widanarko et al., 2011).

The present results also revealed that obese workers had a significantly higher prevalence of musculoskeletal symptoms in the neck, and that overweight workers had a significantly higher prevalence of symptoms in the shoulder, when compared to the ones within the normal BMI category. Results of previous investigations have similarly suggested that overweight and obese workers have higher 12-month prevalence of musculoskeletal symptoms, being at a higher probability of developing work-related musculoskeletal disorders (Aghilinejad et al., 2012; Viester et al., 2013). However, in the studies conducted by Andersen et al. (2007) and Viester et al. (2013), significant associations between BMI and musculoskeletal symptoms were reported essentially in the lower limbs (Andersen et al., 2007; Viester et al., 2013), unlike our results that reported significant associations essentially in the upper limbs. These differences in results may be attributable to the specificities of the studied samples. Both studies (Andersen et al., 2007; Viester et al., 2013) analysed general working populations and the present study analysed workers using mainly the upper limbs, which may have influenced the results.

In order to verify the influence of the lifestyle-related factors on the prevalence of musculoskeletal symptoms, this study conducted both an analysis of the physical activity level of the participants as well as the time they spend in the sitting position.

In blue-collar workers, it has been described that prolonged sitting during the working hours leads to musculoskeletal disorders, particularly in the neck and shoulder (Hallman et al., 2015) and in the low back region (Gupta et al., 2015; Hallman et al., 2016). However, results of the present investigation found no significant differences between the prevalence of musculoskeletal symptoms in any of the body regions when comparing the workers with lower sitting time and the workers experiencing higher sitting time, which is not in agreement with the previously mentioned studies. The same was reported regarding the physical activity level of the blue-collar workers of this sample, as no statistical differences in the prevalences of musculoskeletal symptoms were found between the workers within the three categories described in the IPAQ for any of the body regions. These results are also not in line with the study conducted by Haukka, Ojajärvi, Takala, Viikari-Juntura, and Leino-Arjas (2012) who concluded that high levels of physical activity have a significantly positive effect on musculoskeletal pain or discomfort in employees (Haukka et al., 2012). Similarly, Van Amelsvoort et al. (2006) demonstrated a significantly less sickness absence by musculoskeletal disorders in active workers in their leisure time than sedentary ones, which suggests the benefits of physical activity. However, it should be noted that this investigation was conducted in blue-collar workers, which in itself represents a higher physical demanding job, with less sitting time (Schreuder et al., 2008). Thus, the classification of an employee as physically active can be mostly influenced by their labor activity and not by the time they spend actually doing leisure time physical activity. This can explain the difference between the results presented here and the results of previous investigations, as they only quantified the leisure time physical activity of the assessed workers (Haukka et al., 2012). This assumption is confirmed by previous studies conducted in blue-collar workers, where it was quantified the actual time they spent in occupational and leisure time physical activity, being demonstrated that this population spends higher periods of time walking and less time sitting during the work day than in the leisure time (Hallman et al., 2015), which can have influenced the present results for these variables.

As previously mentioned, musculoskeletal pain in the working population can have multifactorial causes, in which age, high BMI, occupational stress and work-related physical factors such as heavy loading, twisting movements of the trunk, working with a flexed spinal posture or the hands above shoulders level, seem to play an important role (Aghilinejad et al., 2012; Chen et al., 2005; da Costa & Vieira, 2010; de Zwart et al., 1997; Goswami et al., 2016; Kerr et al., 2001; Miranda et al., 2001). Due to high morbidity rates, the importance of preventive measures has been increasingly emphasized in the last years. In that sense, several authors have performed different workplace physical activity interventions aiming to decrease workers BMI, sick leave, medical costs; to increase employees physical activity levels; and to prevent new episodes of pain and physical discomfort, and consequently, continuous or new musculoskeletal disorders among workers, demonstrating significantly positive effects (Christensen et al., 2011; Kellett et al., 1991; Kietrys et al., 2007; Moreira-Silva, Santos, Abreu, & Mota, 2014; Tveito et al., 2004; Tveito & Eriksen, 2009; Zebis et al., 2011).

For future studies, when studying the associations between physical activity and musculoskeletal pain among the working-age population, researchers should also address the influence of others factors which are strongly related to pain, such as individual, psychosocial and work-related factors (Chen et al., 2005; Kerr et al., 2001; Miranda et al., 2001; Osilla et al., 2012; Widanarko et al., 2011). More research with prospective design is needed in order to achieve more reliable information about the true effects of physical activity not only on the musculoskeletal health, but also for example on the delay of the influence of the individual factors, like aging; and on the psychosocial factors, as workplace physical activity interventions can promote and improve workers relationships/interaction.

A limitation of this study is that the sample, although not small, may have not been large enough to reveal significant associations between some explored variables. Moreover, the assessment of physical activity levels was done using an instrument that does not differentiate the physical activity performed in the leisure context from the physical activity in a labor context.

5. CONCLUSIONS

The population of the study (i.e., employees in job groups with high physical demands) is well documented to have a high risk of physical deterioration, as shown by the high 12-month and 7-day prevalence of musculoskeletal symptoms.

In the present sample, individual factors like age, gender and BMI were associated with a higher prevalence of musculoskeletal symptoms in different body regions, but lifestyle-related factors such as physical activity level and sitting time seem not to be associated with the prevalence of musculoskeletal symptoms in the blue-collar workers of this sample.

If proven effective, specific interventions in this job group can provide scientifically meaningful information for the development of public health promotion strategies for employees at higher risk for physical deterioration, such as blue-collar workers. This knowledge can be beneficial for occupational health professionals, companies and employees in these job groups. Despite the difficulties, an epidemiological perspective is needed since both musculoskeletal symptoms and physical exercise concern vast populations.

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