RBSO Revista Brasileira de Saúde Ocupacional
ISSN: 2317-6369 (online)
http://dx.doi.org/10.1590/2317-6369000019919

Research article

Rosângela Souza Lessa[a]
https://orcid.org/0000-0002-6044-010X

Rita de Cássia Pereira Fernandes[b]
https://orcid.org/0000-0002-3353-5365

[a] Universidade Federal da Bahia (UFBA), Programa de Pós-Graduação em Saúde, Ambiente e Trabalho. Salvador, BA, Brazil.

[b] Universidade Federal da Bahia (UFBA), Departamento de Medicina Preventiva e Social, Programa de Pós-Graduação em Saúde, Ambiente e Trabalho. Salvador, BA, Brazil.

Contact:
Rita de Cássia Pereira Fernandes
E-mail:
ritafernandes@ufba.br

The authors declare that this study was supported by a Master's Scholarship provided by the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (Capes), Ministério da Educação, and that there is no conflict of interest.

The authors declare that parts of the work were presented at the 8th International Congress of Physiotherapy, in 2016, and at the 10th Brazilian Congress of Epidemiology, in 2017.

Article based on Rosângela Souza Lessa's master's thesis entitled "Pain in lower limbs in urban cleaning workers", presented in 2015 at the Postgraduate Program in Health, Environment and Work at Universidade Federal da Bahia.

Lower extremity pain, physical and psychological demands in urban cleaning workers: a cross-sectional study

Dor nas extremidades inferiores, demandas físicas e psicológicas em trabalhadores da limpeza urbana: estudo transversal

Abstract

Objective: to describe the characteristics of the urban cleaning workers' job and investigate the prevalence and factors associated with pain in their lower limbs. *Methods:* cross-sectional study carried out in Bahia, Brazil. Data collected between 2009 and 2010. Pain was assessed using the Nordic Musculoskeletal Questionnaire, while psychosocial demands at work were measured using the Job Content Questionnaire. Physical demands were also evaluated, including general postures and cargo handling. We used multiple logistic regression analysis to identify factors associated with lower limb pain. *Results:* 624 workers participated. There was a high prevalence of pain in the lower limbs in the last seven days (23.7%) and in the last twelve months (42.1%), being higher among cleaning workers and collectors. Lower limb pain was associated with the following: longer than three years working for the company (OR = 1.34); high exposure to cargo handling (OR = 1.35); psychological demand at work (OR = 1.87); and poor physical conditioning (OR = 1.67). Working at urban cleaning involved great physical overload, being produced under time pressure. *Conclusion:* The results evidenced the need for measures to reduce cargo handling and changes in work organization, including breaks during the day and adjusting tasks to the available time, in order to avoid workers' physical and psychological overload.

Keywords: pain; occupational exposure; lower extremity; urban cleaning; occupational health.

Resumo

Objetivo: *descrever as características do trabalho e investigar a prevalência e os fatores associados à dor em membros inferiores em trabalhadores da limpeza urbana*. Métodos*: estudo de corte transversal, realizado na Bahia. Dados coletados entre 2009 e 2010. A dor foi avaliada por meio do* Nordic Musculoskeletal Questionnaire*, enquanto as demandas psicossociais no trabalho foram medidas pelo* Job Content Questionnaire*. Também foram avaliadas as demandas físicas, incluindo posturas gerais e manuseio de carga. A análise de regressão logística múltipla foi utilizada para identificar fatores associados à dor em membros inferiores.* Resultados*: 624 trabalhadores participaram da pesquisa. Constatou-se alta prevalência de dor em membros inferiores nos últimos sete dias (23,7%) e nos últimos doze meses (42,1%), sendo maior entre agentes de limpeza e coletores. A dor em membros inferiores foi associada a: mais de três anos de trabalho na empresa (OR = 1,34); alta exposição ao manuseio de cargas (OR = 1,35); demanda psicológica no trabalho (OR = 1,87); e condicionamento físico insuficiente (OR = 1,67). O trabalho na limpeza urbana envolveu grande sobrecarga física, com pressão de tempo para sua execução.* Conclusão*: evidenciou-se a necessidade de medidas para redução do manuseio de cargas e de mudanças na organização do trabalho, incluindo pausas durante a jornada e adequação das tarefas ao tempo disponível, a fim de evitar sobrecargas física e psicológica dos trabalhadores.*

Palavras-chave: *dor; exposição ocupacional; extremidade inferior; limpeza urbana; saúde do trabalhador.*

Received: June 7, 2019
Revised: January 9, 2020
Approved: June 10, 2020

Introduction

Workers who handle waste are exposed to several occupational risks, both through direct contact with microorganisms and the physical and psychological conditions imposed to them[1,2]. Furthermore, handling waste can cause wear and discomfort in some body regions, as a result from the high physical demands of this activity[3].

In Bahia, the garbage collection mechanism is predominantly manual, demanding strength and dynamism, as it requires the worker to jump from different levels, run and throw loads, performing repetitive movements during the work hours [3].

The association between static and cyclical work and injuries in workers[4] is more often reported in the literature than the health consequences related to the dynamic high-strain work that characterizes some occupations, such as that of urban cleaning workers (UCWs)[5]. However, this type of work can cause structural overloads in the human body, triggering pain symptoms that can compromise the lower limbs (LLs), as well as other body segments[6,7]. Lower limb pain may mainly originate from the musculoskeletal system and/or the venous system[8,9].

Musculoskeletal disorders (MSDs) are multi-causal in nature – with work being one of the possible determinants of their genesis and outcome – and are among the main causes of absence from work, constituting a relevant public health problem[10]. Several injuries affect the LLs and can cause painful symptoms, such as joint, tendon and muscle degenerations[11]. Another etiology of lower limb pain, in addition to musculoskeletal impairment, are deficits in the vascular system, characterized as venous insufficiency in the legs, especially reported in women, but also seen in male workers[9,11,12].

Evidence found in studies carried out in laboratory, with a general population, that had no preexisting pain complaints, which aimed at highlighting LL pain symptoms due to activities demanding the standing posture, demonstrated that many symptoms in the lower limbs are related to the vascular system (increased blood flow, skin temperature and leg circumference, in addition to muscle fatigue)[12].

Among the occupational factors associated with LL pain are: load handling, especially weight lifting; standing working posture; constant walking; kneeling posture; squats[12-14] and psychosocial factors[15].

Although widely reported in the world of work, referred to as "leg pain", among men and women who work predominantly standing up[13], this morbidity remains poorly investigated. Messing, Tissot and Stock[13], studying "leg pain" in a population from Quebec, found an association with working postures. In agreement with the authors[13], investigating the prevalence of pain in the lower limbs, which causes physical suffering during the workday and working limitations, imposes itself as an epidemiological research agenda in order to overcome its invisibility as a work-related problem. This perspective is not that of clinical investigation, which requires the propaedeutic arsenal for the pain etiological diagnosis, but rather of epidemiological research on painful symptoms.

As part of the project entitled "Health and Working Conditions in Urban Cleaning Workers", this study aimed to describe the characteristics of the work carried out in urban cleaning and to investigate the prevalence and factors associated with lower limb pain complaints in UCWs.

Methods

Design and participants

A cross-sectional study was carried out with all UCWs allocated to maintenance and operation activities in an outsourced company responsible for collecting and transporting solid household waste in Salvador, Bahia, considered the third most populous state capital of Brazil in 2010. The respondents' weekly workload was 44 hours and, depending on the function, work was performed during the day or at night. The study population consisted of 657 male workers. The only female respondent, the workers in administrative and management activities, and those on leave were excluded.

The study population included workers from the operation (collector, driver, cleaning agent) and maintenance sectors (mechanic, control and maintenance assistant, general service assistant, tire repair man, electrician, lubricator, bricklayer, painter, welder, inspector and washer). The domestic solid waste collection service is carried out by collectors and drivers, who are responsible for the daily collecting and disposing of this waste at the transshipment station or at the landfill[3]. The complementary services of urban cleaning, such as painting of curbs, poles, viaducts and walls, cleaning of beaches, weeding and mowing[16], are carried out by cleaning workers. Maintenance workers are responsible for maintaining the compactor trucks used to collect waste, as well as the company's physical structure[16].

Data collection

Data collection took place between December 2009 and April 2010. Prior to this stage, a training was carried out to administer the questionnaire and to adapt the questions. Master's and undergraduate Physiotherapy students of a public university interviewed the workers, at the beginning or at the end of the workday, ensuring the information privacy and confidentiality.

The questionnaire[17] contained questions about: sociodemographic information (age, education, race/skin color); total working lifetime, length of time in the company, working hours; overtime work; physical demands (general work postures and cargo handling) and psychosocial demands at work; physical conditioning, overweight (obtained through direct measurement of weight and height to calculate the Body Mass Index – BMI), smoking, drinking, housework; and painful symptoms in the lower limb segments.

Study variables

We used the Nordic Musculoskeletal Questionnaire (NMQ)[18], validated in Brazil and widely used to measure painful symptoms in different body segments. This instrument aims to measure the pain symptom and not its etiology. Lower limb pain in the thigh, knee, leg and ankle/foot segments was described for the twelve months and seven days prior to the questionnaire administration. In the descriptive stage of the study, the prevalence of pain in each of the different segments of the lower limbs and in the body as a whole were presented. In the analytical stage, the reporting of LL pain in the last twelve months was adopted as the dependent variable. The length of work in the company, length of weekly working hours, overtime, physical and psychosocial demands at work, as well as sociodemographic and extra-occupational variables were considered as independent variables.

The variable length of time working in the company, which corresponds to the period in the position, was described in months and stratified into the median. The workday had as a risk stratum the individuals with a weekly workload greater than 44 hours. The overtime variable was dichotomized (present or not).

Physical demand was assessed through questions that measured the postures adopted during work (walking, running, jumping from the truck) and cargo handling (lifting, pushing and pulling). Items were measured on six-point duration scales, with anchors at the ends (where 0 = never, and 5 = all the time). For analytical purposes, the data were dichotomized with the median cut. The physical demand questions had their dimensionality, as well as their reliability, evaluated (construct validity) in a study that included this UCW population. Both the structural validity analysis and the test-retest showed results that indicate the use of questions[19].

Psychosocial demands (demand, control and social support) at work were measured using the Job Content Questionnaire (JCQ), a version validated and translated into Portuguese[20]. To investigate the psychological demand and control at work items, UCWs answered nine questions for each item, with the control at work dimension being related to skills and authority in decision making. The psychological demand dimension is associated with the requirements imposed to perform tasks, involving time pressure, concentration level, task interruption and the need to wait for the work done by others in the team. The social support at work dimension incorporates the supervisor's and colleagues' support during job performance. In the study, these variables were stratified at the median and, in the descriptive phase of the study, they were presented either separately or combined in a variable that classified as high psychosocial exposure when at least two of the following conditions were met: high demand, low control and low social support. In the analytical phase, control, demand and social support were included separately in the model.

The analyzed sociodemographic characteristics were age (cut in the median, with the exposure stratum being those aged ≥ 33 years) and education, divided into two strata (the risk stratum was composed of those with at least a high school degree), and the extra-occupational variables were physical fitness (scale from 0 to 5, stratified into: 0-3 = insufficient fitness and 4-5 = sufficient fitness), BMI (between ≥ 25 and ≥ 30 = overweight or obesity and between < 18.5 and < 25 = normal or low weight), smoking (tobacco use or not), alcohol consumption (risk: drinking one to three times a week; reference: never drank, stopped drinking for more than a year or drinks from one to three times/month) and housework, cut in the median, exposed (≥ 2 hours in the last week).

Statistical analyses

Descriptive results are presented according to occupation (collectors, cleaning workers, drivers and maintenance workers), characterizing the population, occupational exposure variables, and the prevalence of pain in the lower limbs and their segments.

To present the physical demands at work, boxplots[21] were made for the four occupational groups. The diagrams show the distribution of

exposure to physical demands by group: a) collectors, b) drivers, c) cleaning workers and d) maintenance staff. The physical demands presented refer to the general working posture: 1) standing while working, 2) sitting, 3) running, 4) walking, 5) jumping, 6) squatting; or cargo handling: 7) lifting, 8) pushing and 9) pulling. All demands were measured on a six-point numerical scale (0-5), with anchors at the ends. The distribution of exposure for each physical demand appears in graphs, which show, on the x-axis, the four exposure groups (a-d) and, on the y-axis, the response scale for each measured demand (0-5 points).

Multivariate analysis to identify factors associated with LL pain was conducted using logistic regression. The selection of independent variables was based on the pathophysiological, theoretical and epidemiological plausibility of the associations, based on the most consistent evidence found in the literature. Based on this criterion, the multiple model initially included the following: age, education, race/skin color, working hours, overtime, working time at the company, load handling (lifting, pulling, pushing), dynamic work (running, jumping, walking), psychological demand, control at work, social support, housework, overweight, physical conditioning, drinking and smoking. Variables with magnitude of association (odds ratio – OR) equal to or above 30% (OR $\geq$ 1.30 or OR $\leq$ 0.70) were maintained in the final model[22]. Thus, the OR, measure of association provided in the logistic regression, is presented for each variable in the final model.

In the study, we adopted procedures consistent with the non-random nature of the investigated population, analytical statistics (OR) not followed by inferential statistics (confidence intervals or p-value), according to Silvany Neto[21] and other publications on the subject[23-26].

Data were analyzed using the statistical program software R, version 3.0.3 (2014-03-06).

Ethical considerations

The study was approved by the Research Ethics Committee of Hospital São Rafael, protocol number 48/09, on October 28, 2009. All participants signed the informed consent form.

Results

Of the 657 workers, 624 participated (95% response rate), all of them male, with a mean age of 33.9 years. Among the groups, 50.9% of drivers were over 39 years old, while 60.2% of collectors were under 32 (with a median of 30 years), and only 18% were 39 or older.

The population of UCWs had less than complete high school education, especially among collectors and cleaning workers, with drivers standing out with a higher level of education. More than 60% of UCWs reported sufficient physical fitness, but only 35.6% of drivers had this perception. Time working in the company and total working life had a median of 36 months and 19 years, respectively. Collectors and drivers had been with the company (function) for less than 3 years. The UCWs' weekly workload was greater than 44 hours, with overtime work prevailing, mainly among drivers and collectors, evidenced both by the high frequency of overtime and by the average worked weekly hours (**Table 1**).

Table 2 shows the absolute and relative frequencies of work psychosocial aspects for each occupational group, where the frequencies of low control, high demand, low social support and high psychosocial exposure are seen, combining the three dimensions. High psychological demand and low control prevailed, especially among collectors. Drivers had more control at work as compared to collectors. Low social support across groups had a similar prevalence.

In **Figure 1**, boxplots show the distribution of responses from 0 to 5 for each physical demand (y-axis), according to occupational group (x-axis). It is observed that collectors had higher typical values for almost all physical demands, with a concentration of responses at the ends of the scale, scoring 5 for standing and running work, representing the adoption of these postures throughout the entire workday, and 0 for sitting work, meaning not adopting this posture during the workday. In addition, it is possible to observe that cargo handling occurs during almost the entire time of the collectors' working day, as seen for the variables lifting (first quartile already at point 4 of the scale and median at 5), pushing and pulling cargo (both with median at point 4 of the response scale). Jumping and running activities were more prevalent among collectors. It is noteworthy that the work of collectors and cleaning workers requires standing during most of the workday, so the sitting work graph consistently shows that these workers never or almost never sit down during the day, with concentrated results at the 0 end of the response scale. Cleaning workers and maintenance staff are more exposed to walking work. Drivers reached the highest values in the sitting position, as expected for this occupation. In addition, for almost all physical demands, asymmetries prevailed, characterizing the UCW'extremes of physical exposure. There is some variability in exposure between cleaning workers.

Table 1 Sociodemographic data, occupational and extra-occupational characteristics, according to occupational group, in urban cleaning workers, Bahia, 2010

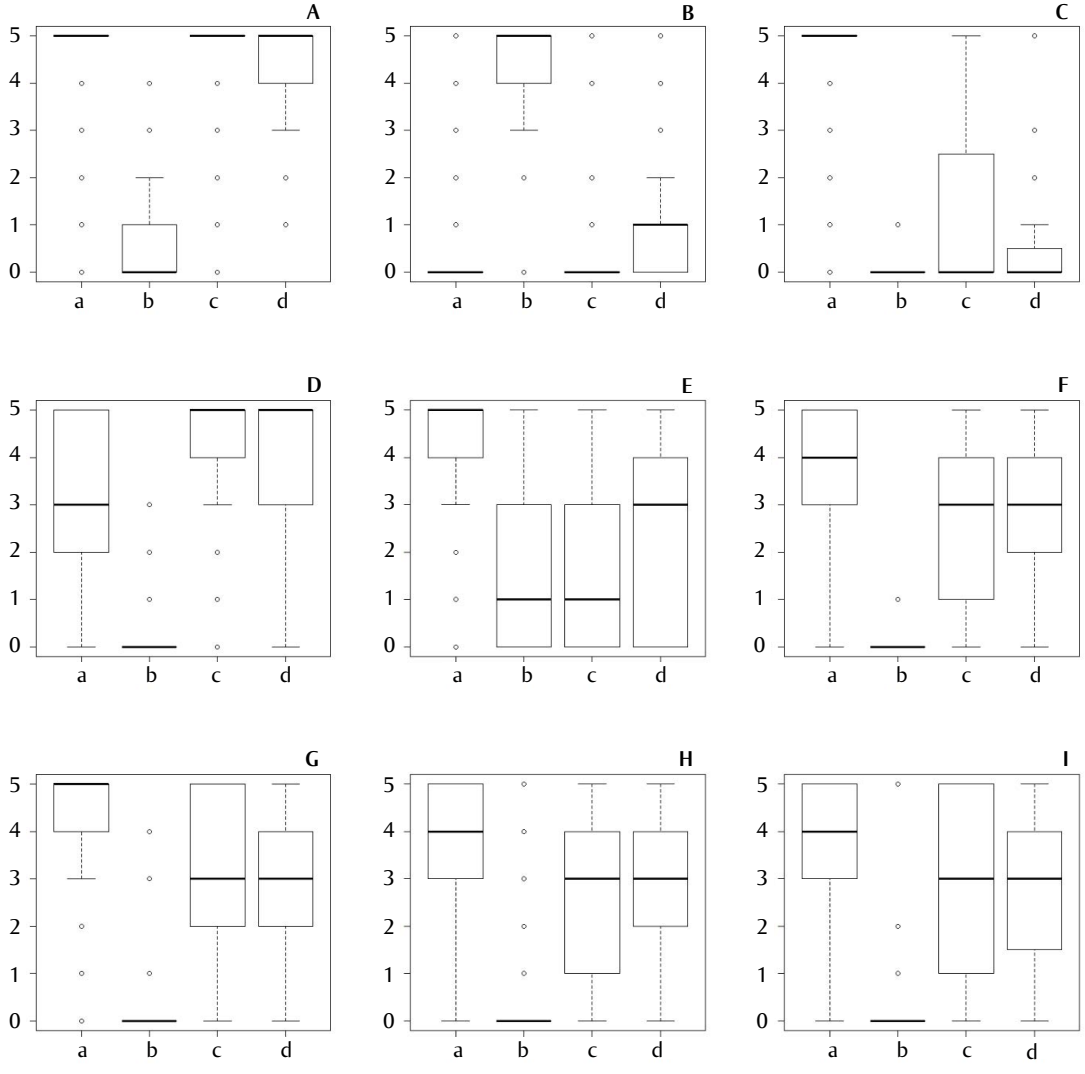
	Occupation groups				
	Collectors n = 367 (58.8%)	*Drivers n = 118 (18.9%)*	*Cleaning workers n = 87 (13.9%)*	*Maintenance staff n = 52 (8.3%)*	*Total n = 624 (100.0%)*
Variables	*Frequencies*				
	n (%)	*n (%)*	*n (%)*	*n (%)*	*n (%)*
Age*					
< 28	123 (33.5)	7 (6.0)	9 (10.3)	9 (17.3)	148 (23.8)
28-32	98 (26.7)	17 (14.7)	25 (28.7)	12 (23.1)	152 (24.5)
33-38	79 (21.5)	33 (28.4)	31 (35.6)	12 (23.1)	155 (24.9)
≥ 39	67 (18.3)	59 (50.9)	22 (25.4)	19 (36.5)	167 (26.8)
Race/Skin color*					
Black	236 (64.5)	40 (33.9)	48 (55.2)	20 (39.2)	344 (55.3)
Brown	110 (30.1)	60 (50.8)	35 (40.2)	27 (52.9)	232 (37.3)
White	20 (5.4)	18 (15.3)	4 (4.6)	4 (7.9)	46 (7.4)
Education*					
< complete high school	273 (74.6)	31 (26.3)	60 (69.8)	28 (54.9)	392 (63.1)
≥ complete high school	93 (25.4)	87 (73.7)	26 (30.2)	23 (45.1)	229 (36.9)
Overtime					
Yes	343 (93.5)	117 (99.2)	37 (42.5)	34 (65.4)	531 (85.1)
No	24 (6.5)	1 (0.8)	50 (57.5)	18 (34.6)	93 (14.9)
Weekly working hours					
> 44 hours	311 (84.7)	106 (89.8)	59 (70.2)	39 (72.2)	517 (82.9)
≤ 44 hours	56 (15.3)	12 (10.2)	25 (29.8)	15 (27.8)	107 (17.1)
Working life*					
≥ 19 years	147 (40.4)	84 (71.8)	50 (57.5)	31 (59.6)	312 (50.3)
< 19 years	217 (59.6)	33 (28.2)	37 (42.5)	21 (40.4)	308 (49.7)
Physical conditioning					
Insufficient	132 (36.0)	76 (64.4)	43 (49.4)	26 (50.0)	277 (44.4)
Sufficient	235 (64.0)	42 (35.6)	44 (50.6)	26 (50.0)	347 (55.6)
	*Mean (SD**)*	*Mean (SD**)*	*Mean (SD**)*	*Mean (SD**)*	*Mean (SD**)*
Age*	31.8 (7.97)	38.9 (7.64)	34.9 (6.69)	36.0 (8.94)	33.9 (8.33)
Weekly working hours*	55.7 (14.3)	59.6 (13.1)	47.1 (9.0)	49.6 (11.0)	54.8 (13.8)
	Median	*Median*	*Median*	*Median*	*Median*
Working life* (in years)	16.0	23.0	19.0	20.5	19.0
Time in the company (in months)	35.0	26.5	59	38	36.0

*The values recorded are valid data for each variable. Ignored data were evidenced by recording absolute numbers.

**SD: standard deviation.

Table 2 Frequency of psychosocial exposure at work, according to occupational group, in urban cleaning workers, Bahia, 2010

	Occupation groups				
	Collectors n = 367	*Drivers n = 118*	*Cleaning workers n = 87*	*Maintenance staff n = 52*	*Total n = 624*
Variables	*n (%)*	*n (%)*	*n (%)*	*n (%)*	*n (%)*
Low control	198 (54.5)	31 (26.7)	40 (46.5)	8 (15.4)	277 (44.9)
High psychological demand	215 (60.7)	59 (50.0)	32 (38.6)	12 (23.5)	318 (52.5)
Low social support	163 (44.8)	55 (46.6)	29 (33.7)	22 (43.1)	269 (43.5)
High psychosocial exposure at work	193 (54.8)	57 (49.1)	38 (46.3)	13 (26.0)	301 (50.2)



Y-axis: response scale of physical demand variables (0-5): (0) never to (5) all the time.
X-axis: occupation: a) collectors; b) drivers; c) cleaning workers; and d) maintenance staff.
A: standing work; B: sitting; C: running; D: walking; E: jumping; F: squatting, G: lifting load; H: pushing load; I: pulling load.

Figure 1 Distribution of physical demands by occupational group of urban cleaning workers, Bahia, 2010

Table 3 shows the prevalence of pain in the lower limbs and their segments, in which the prevalence of LL pain in the last seven days was 23.7% (n = 148) and in twelve months, 42.1 % (n = 263). Cleaning workers and collectors had higher prevalence of LL pain in the last twelve months as compared to drivers and maintenance workers. Regarding reported pain in the thigh/knee and leg segments, a higher prevalence was observed among cleaning workers and collectors, both in the seven days and in the twelve months prior to answering the questionnaire. For the foot/ankle segment, there was more pain among collectors than in the other groups in the twelve months prior.

Table 4 shows the unadjusted and adjusted associations between the independent variables and LL pain in the last twelve months. From the adjusted data, workers exposed to high psychological demand at work were found to have more LL pain (OR = 1.87) than those less exposed to this demand. In addition, those who had been working for a longer time in the company (OR = 1.34) and workers subjected to high cargo handling presented pain symptoms, with a 35% higher chance of pain than those exposed to work with low cargo handling. UCWs with insufficient physical fitness were more likely to report LL pain as compared to those with sufficient fitness (OR = 1.67).

Table 3 Prevalence (%) of pain in lower limbs and their segments, according to occupational group and total population, in urban cleaning workers, Bahia, 2010

Period/Segment	*Occupation groups*				
	Collectors n = 367	*Drivers n = 118*	*Cleaning workers n = 87*	*Maintenance Staff n = 52*	*Total n = 624*
Last seven days	*n (%)*	*n (%)*	*n (%)*	*n (%)*	*n (%)*
Lower limbs	82 (22.3)	27 (22.9)	27 (31.0)	12 (23.1)	148 (23.7)
Thigh/Knee	49 (13.4)	13 (11.0)	20 (23.0)	7 (13.5)	89 (14.3)
Leg	37 (10.1)	10 (8.5)	10 (11.5)	5 (9.6)	62 (9.9)
Ankle/Foot	24 (6.5)	8 (6.8)	5 (5.7)	3 (5.8)	40 (6.4)
Last twelve months	*n (%)*	*n (%)*	*n (%)*	*n (%)*	*n (%)*
Lower limbs	158 (43.1)	42 (35.6)	43 (49.4)	20 (38.5)	263 (42.1)
Thigh/Knee	95 (25.9)	28 (23.7)	32 (36.8)	10 (19.2)	165 (26.4)
Leg	78 (21.3)	18 (15.3)	21 (24.1)	10 (19.2)	127 (20.4)
Ankle/Foot	43 (11.7)	11 (9.3)	8 (9.2)	5 (9.6)	67 (10.7)

Table 4 Gross and adjusted analysis of factors associated with lower limb pain in urban cleaning workers, Bahia, 2010 (n = 583)

Independent variables	*OR gross*	*OR adjusted*
Psychological demand at work		
High	1.86	1.87
Low	1.00	1.00
Cargo handling		
High exposure	1.35	1.35
Low exposure	1.00	1.00
Working time at the company		
≥ 36 months	1.28	1.34
< 36 months	1.00	1.00
Physical conditioning		
Insufficient	1.54	1.67
Sufficient	1.00	1.00

OR: odds ratio.

Discussion

Characteristics of the working population and urban sanitation work

The UCWs participating in the study are mostly black individuals, all male, with low education and high weekly working hours. Other studies carried out with workers in this professional category corroborate the results found here regarding age, gender and education[2,5,27]. The evidenced characteristics may reveal work that is socially unrecognized and of great physical demand, which may explain the greater presence of less educated workers, of black race/color, who have greater difficulty in entering prestigious professions, in addition to supposedly young workers tolerant to strenuous physical work, such as collectors. The Brazilian Classification of Occupations (CBO)[28] points out incomplete elementary education, physical preparation and agility[28] as requirements for street sweepers and collectors, implying the selection of physically healthy young people to carry out heavy work. The CBO description contradicts what Ergonomics advocates as a requirement to reconcile work and health: adequate, less burdensome working conditions and workers' non-adaptation to adverse work[29,30].

A study carried out with workers from the same population reveals protection strategies adopted by collectors throughout the workday, in order to avoid injuries, revealing knowledge acquired in practice[3]. These anticipation methods include, among others, the "garbage reduction strategy", in which the practice of swinging garbage bags makes it possible to detect sharp-edged objects and prevent accidents[31].

Although most of the UCWs had less than three years of work in the company, more than 50% of them had a total working life of 19 years or more, a fact that, in addition to indicating a short time spent in urban cleaning, can also show these workers' early entrance in the labor market, considering that half of the collectors are under 30 years old. Excessive working hours and constant overtime instances are possible health damage factors[2]. For these workers, the amount of garbage on public roads determines the pace and duration of work, compromising actual breaks for body rest and reduction of psychological fatigue[3].

UCWs are subject to high psychological demand, mainly collectors and drivers, responsible for collecting garbage on the streets[3], an activity that requires a state of alert, given the large flow of vehicles, demanding attention and agility[28] in order to avoid accidents[1]. In addition, they are pressured not to exceed the working hours, despite the need for more time for collection, especially on days after weekends and festivities[3]. Conversely, they are charged for the care of work equipment, such as the truck, which must not be overloaded with garbage, making it necessary to increase the number of trips to the landfill and, consequently, resulting in a longer workday. Contradictions such as this may confront workers with a high psychological demand[3].

A relevant finding of this study was the low control over work among collectors and cleaning workers, particularly as compared to drivers, with whom collectors share their work on the streets. A considerable difference was found between these occupations with regard to the degree of autonomy and leadership, aspects assessed by the control dimension of the demand-control model[20]. Drivers are the team leaders, enjoying greater decision-making power, including being in charge of collectors, to whom they impose their authority delegated by the company[3]. Therefore, UCWs' exposure to psychosocial demands is not homogeneous, considering the results described according to the four occupational groups.

A study carried out with garbage collectors in Iran showed similar prevalences related to high exposure to psychological demands at work, highlighting that 56% of collectors had low control at work. It was also found that control at work was inversely proportional to the UCWs' level of education[2], which differs from what was found in this study, in which drivers had higher education and control at work, while collectors had lower education and control.

In addition to the findings on psychosocial exposure, it is important to discuss the characteristics of work in urban cleaning, which has a striking physical nature[2]. For the tasks to be executed, the worker's body often serves as a tool for the predominant physical work. This physical demand was evidenced, according to the four occupation groups.

The collectors' high physical demand was observed during almost all their working hours, a fact that can be explained by the permanence of these workers in cargo handling activities, adopting anomalous postures during this period. Furthermore, long workdays imply in insufficient time for recovery from physical wear and tear, favoring pain conditions.

Another study carried out with solid waste workers in Iran[5] also found similar data on exposure to physical and psychological demands in the collectors' work, including time pressure for carrying out collection and repetitions in cargo lifting activities.

In this study, collectors experience constant excessive tension to maintain postural misalignments in the ankle/foot, leg and thigh/knee, in view of the various movements required in a working day.

The principles of biomechanics explain that the absence of neutral alignment of the joints generates an imbalance in tendons, ligaments and muscles that, in addition to compromising their function, can cause pain[32].

The presence of fast body movements conditions the muscles to high tension peaks, causing muscle fatigue, when there should be periods of low intensity, interspersed with frequent breaks, as it is strenuous work[32]. From this work situation, in which UCWs produce rapid movement of the body while carrying heavy bags, buckets and garbage boxes and throwing them into the truck, in addition to jumping up and down the running board, it is possible to explain the referred pain in the lower limbs and, particularly, in the ankles and feet.

Another important factor is the continuous dynamic stabilization of muscle groups[32] when pushing containers loaded with garbage and fixing them on the truck, causing energy expenditure, resulting in muscle fatigue and a deficit in blood supply to replenish nutrients to the muscles, accumulating metabolites and culminating in muscle overload and, consequently, pain.

Lower limb pain and work demands

A high morbidity of lower limbs was found among UCWs, being evident in cleaning workers and collectors for the past twelve months. Findings of high prevalence of painful symptoms in lower limbs are in line with studies carried out with UCW in Brazil and other countries[5,7,8].

This is young population that reports frequent presence of pain in their work previous week and in the last twelve months and, despite the complaint, remains at work, exposed to the occupational factors described. The pain that workers are urged to bear on a daily basis favors lower limb disorders, which are aggravated over time, leading to incapacity for occupational activities[5,33].

In addition to work absenteeism, the search for health services is one of the consequences of MSDs[33]. In Iran, 35% of surveyed collectors sought treatment for musculoskeletal pain, 20% was absent from work and 53% reported that they could leave work in the future due to musculoskeletal disorders[5].

The presence of frequent joint movements in knees are physical characteristics of the UCWs' occupation, especially cleaning workers and collectors, who had, respectively, more pain records in this segment. While the latter perform jumps and squats, the former remain long squatted. The literature indicates that tasks that associate weight lifting with squats and occupations with high physical demands are associated with knee disorders[14].

In the general population, the complaint of leg pain among men has a lower magnitude than among women, resulting from the presence of risk factors for venous disease, which is intrinsic to the female gender[34]. However, a laboratory study found a greater increase in leg volume in men than in women, due to the edema generated during standing, sitting activities and when alternating these postures[35].

In the segment of the ankles and feet, the literature emphasizes that the postures taken at work trigger pain. A study conducted by Lin et al.[36] with laboratory participants detected that the maintenance of the standing posture, without pauses, the type of footwear, and the rigid surfaces generate foot pain. Also, the literature indicates that there is a relationship between work while walking – such as that performed by collectors participating in this study, with constant displacement and walking – with increased plantar muscle pressure and a low threshold for vascular symptoms[37]. However, although the prevalence is higher among collectors, it is important to emphasize that morbidity from distal end segments is present in all UCWs' occupational groups.

The analyses showed an association between high psychological demand at UCWs' work with pain in the lower limbs, and other investigations carried out with this population point to a relationship between physically demanding work and pain in the lower limbs[5,8].

The results of research in work environments, aiming to identify factors associated with lower limb pain, are in line with the findings of this study[7,8]. Among UCWs in Egypt, high job control and short period of activity as a collector were protective factors against musculoskeletal symptoms. However, handling loads above 20 kg and frequent walking were strongly associated with pain symptoms[8].

In a study carried out in Iran, physical demand (lifting, pulling, pushing, walking, going up and down the running board), psychological demand and control at work were associated with musculoskeletal pain[5]. In this study, working for more than 36 months at the company, that is, three years of activity as UCW, and high exposure to handling loads, increased by 35% the chance of lower limb pain among workers. Among the psychosocial factors, the protective role of the high degree of control was not evidenced, but the high psychological demand increased by 87% the prevalence of pain in the lower limbs.

It is known that work under high psychological demands can cause individuals to become

mentally ill[15], but its role on developing physical symptoms among workers is still being discussed.

Several theories seek to explain the psychosocial mechanisms that lead to musculoskeletal pain[38] in workers. Work with high psychological demand and low control contributes to the occurrence of musculoskeletal disorders in the upper limbs. It is possible that such exposure could explain LL pain in UCWs, whose work is strongly marked by low control and high demand.

Psychosocial factors may act directly or indirectly on the musculoskeletal system and, consequently, may play a musculoskeletal nature role in lower limb pain. They can also increase the muscular activity of the worker, who, in order to respond to task demands, exacerbates his individual internal capacity, adopts inappropriate postures or undergoes longer exposure time to complete tasks, generating abnormal mechanical loads on their bodies. The body's defense mechanisms can also interpret the demands required as a threat and trigger a physiological cascade of response to stress, such as increased muscle tone and reduced local circulation[39]. Thus, specific physiological markers are activated and explain the role of psychosocial demands in musculoskeletal pain.

In this study, UCWs who reported insufficient fitness had 67% more pain than those who thought they were sufficiently fit. But the possible protective role of good physical conditioning is not always seen in worker populations, and its effect on the musculoskeletal system changes in the context of exhausting physical work[30].

A study conducted among plastics industry workers points to the interaction between conditioning and heavy physical work in determining musculoskeletal pain[30]: workers who reported poor physical conditioning were 3.19 times more likely to have pain in the neck, shoulder or upper region of the back, than those with good conditioning, occurring, however, only among individuals less physically exposed at work. The evidenced findings confirm the protective effect of good physical conditioning against pain, but work with high physical demand has modified this effect. Among workers exposed to exhausting physical work, good physical conditioning was insufficient to protect the musculoskeletal system. In the case of heavy physical work, physically fit or poorly conditioned workers had a high prevalence of pain. These data demonstrate that exposure to high physical demands at work can increase morbidity among workers, regardless of their individual physical conditioning[30]. However, this is a relevant variable in studies on pain and work should not be neglected, as it is necessary to better understand its role, given the interest in modifiable risk factors – such lifestyle factors as physical conditioning – from the perspective of pain prevention.

The approach to LL pain in this study, incorporating all segments in the analytical phase, is based on the discussion about multiple pain, or concurrent pain in more than one body segment[40]. In a study with a pool of surveys that included the population of urban cleaning and footwear industry workers, about 60% of individuals with ankle/foot pain simultaneously presented leg pain; only 14% of complaints of pain in ankle/foot occurred in isolation in this segment, while, in 86% of cases, the pain affected more than two body segments simultaneously, predominantly the more proximal ones; those with leg pain had seven times the prevalence of ankle/foot pain than those without leg pain[40]. Thus, adopting the analysis of the pain outcome in the lower limbs considering the body region, and not the body segments alone, may be the most appropriate and recommended approach[40].

In our study, age was not associated with the outcome, that is, the prevalence of the outcome is high, not varying according to age. A likely explanation lies in the fact that the population studied is mostly young, with little variation in the variable's range. Thus, in a group with greater age homogeneity, there was no relevant difference in the occurrence of the outcome by age group.

The frequency of overtime is quite high in this population and it is mentioned by almost 100% of drivers and collectors. As there is no variability in this exposure, it was not possible to verify a difference in the occurrence of the outcome between exposed and unexposed UCWs that would determine a reasonable association (≥ 30%). However, it is possible to affirm that strenuous working hours can play a relevant role in the high prevalence of pain observed in this population of workers.

Likewise, high exposure to anomalous working postures is predominant in the studied population, making it difficult to show the effect (odds ratio between exposed and unexposed individuals) of this exposure on the occurrence of the studied outcome. Thus, the high prevalence of pain and the high exposures shown here are highlighted, given that these are young workers, whose occupational demands can lead to disabling conditions with harmful consequences for their lives.

The cross-sectional design, which makes it impossible to establish a temporal relationship of previous exposure with the outcome, is a limitation of the study. The procedures adopted to ensure privacy and confidentiality, which are relevant

aspects for research in the world of work and for the validity of the research, stand out as strengths, particularly with regard to minimizing information and selection biases. Workers were informed about the institution responsible for the research, a public university, and about the company having only allowed the researchers access to the workplace, without having any participation in the research. In addition, data collection through a structured questionnaire, adopting uniformity in procedures regarding interview techniques, certainly contributed to the internal validity of the study.

Conclusion

Work in urban cleaning exposes workers involved in operation and maintenance activities to high physical and psychosocial demands. It was possible to characterize that work in terms of these demands, observing some variations in exposure across the occupational groups. We identified that the collectors' work has strong physical and psychosocial characteristics, being this the group with the highest percentage of young black workers, with low education, and who, together with drivers, commonly exceed the 44-hour workweek. Lower limb pain was evidenced among UCWs, with 42,1% prevalence in the preceding twelve months and 23,7% in the last seven days prior to data collection. The study identified both occupational factors (high psychological and physical demand at work, longer working time in the company) and extra-occupational factors (insufficient physical conditioning) associated with UCWs' lower limb pain.

The study contributes to knowledge about lower limb pain in workers, showing characteristics of the UCWs' labor activities that can be used to plan interventions aimed at its prevention, such as changes in the organization of work, by adapting the pace of work to the available time and introducing breaks and features for safe and comfortable handling of loads.

Author's contributions

Lessa RS and Fernandes RCP equally contributed to the study design, data collection, analysis and interpretation, preparation, critical reviews, and approval of the final published version, and assume full responsibility for the work carried out and the content published here.

References

1. Pereira-de-Paiva MH, Calassa-Albuquerque MC, Latham EE, Furtado-Bezerra C, da-Silva-Sousa A, Cunha-e-Silva-de-Araújo L, et al. Occupational hazards of Brazilian solid waste workers: a systematic literature review. Rev Bras Med Trab. 2017;15(4):364-71.
2. Ziaei M, Choobineh A, Abdoli-Eramaki M, Ghaem H, Jaberi O. Psychological and physical job demands, decision latitude, and work-related social support among Iranian waste collectors. Waste Manag. 2019;95:377-87.
3. Camada IMO, Pataro SMS, Fernandes RCP. Heavy physical work under time pressure: the garbage collection service–a case study. Work. 2012;41(1 Suppl):462-9.
4. Fernandes RCP, Assunção AA, Carvalho FM. Tarefas repetitivas sob pressão temporal: os distúrbios musculoesqueléticos e o trabalho industrial. Cien Saude Colet [Internet]. 2010 [cited 2015 June 12];15(3):931-42. Available from: http://www.scielo.br/scielo.php?script=sci_arttext&pid=S1413-81232010000300037&lng=en
5. Ziaei M, Choobineh A, Abdoli-Eramaki M, Ghaem H. Individual, physical, and organizational risk factors for musculoskeletal disorders among municipality solid waste collectors in Shiraz, Iran. Ind Health. 2018;56(4):308-19.
6. Pataro SMS, Fernandes RCP. Trabalho físico pesado e dor lombar: a realidade na limpeza urbana. Rev Bras Epidemiol [Internet]. 2014 [cited 2015 July 15];17(1):17-30. Available from: http://www.scielo.br/scielo.php?script=sci_arttext&pid=S1415-790X2014000100017&lng=en
7. Cardoso RK, Rombaldi AJ, Silva MC. Distúrbios osteomusculares e fatores associados em coletores de lixo de duas cidades de porte médio do sul do Brasil. Rev Dor [Internet]. 2014 [cited 2015 May 14];15(1):13-6. Available from: http://www.scielo.br/scielo.php?script=sci_arttext&pid=S1806-00132014000100013&lng=en
8. Abou-Elwafa HS, El-Bestar SF, El-Gilany AH, Awad EES. Musculoskeletal disorders among municipal solid waste collectors in Mansoura, Egypt: a cross-sectional study. BMJ Open. 2012;2(5):e001338.
9. Bertoldi CML, Proença RPC. Doença venosa e sua relação com as condições de trabalho no setor de produção de refeições. Rev Nutr [Internet]. 2008 [cited 2018 Aug 27];21(4):447-54. Available from: https://www.scielo.br/j/rn/a/6tf9HRqvsn4wg83wbq3gfJp/abstract/?lang=pt

10. Punnett L. Musculoskeletal disorders and occupational exposures: how should we judge the evidence concerning the causal association? Scand J Public Health. 2014;42(13 Suppl):49-58.

11. D'Souza JC, Franzblau A, Werner RA. Review of epidemiologic studies on occupational factors and lower extremity musculoskeletal and vascular disorders and symptoms. J Occup Rehabil. 2005;15(2):129-65.

12. Coenen P, Parry S, Willenberg L, Shi JW, Romero L, Blackwood DM, et al. Associations of prolonged standing with musculoskeletal symptoms – A systematic review of laboratory studies. Gait Posture. 2017;58:310-8.

13. Messing K, Tissot F, Stock SR. Distal lower-extremity pain and word postures in the Quebec population. Am J Public Health. 2008;98(4):705-13.

14. Ezzat AM, Li LC. Occupational physical loading tasks and knee osteoarthritis: a review of the evidence. Physiother Can. 2014;66(1):91-107.

15. Cardoso JP, Araújo TM, Carvalho FM, Oliveira NF, Reis EJFB. Aspectos psicossociais do trabalho e dor musculoesquelética em professores. Cad Saude Publica [Internet]. 2011 [cited 2018 June 12];27(8):1498-506. Available from: http://www.scielo.br/scielo.php?script=sci_arttext&pid=S0102-311X2011000800005&lng=en

16. Pereira ALP, Fernandes RCP. Trabalho e distúrbios musculoesqueléticos na limpeza urbana. In: Fernandes RCP, Lima MAG, Araújo TM, editors. Tópicos em saúde, ambiente e trabalho: um olhar ampliado. Salvador: EDUFBA; 2014. p. 103-28.

17. Fernandes RCP. Distúrbios musculoesqueléticos e trabalho industrial [dissertation]. Salvador: Universidade Federal da Bahia; 2004.

18. Pinheiro FA, Tróccoli BT, Carvalho CV. Validação do Questionário Nórdico de Sintomas Osteomusculares como medida de morbidade. Rev Saude Publica [Internet]. 2002 [cited 2014 Mar 10];36(3):307-12. Available from: http://www.scielosp.org/scielo.php?script=sci_arttext&pid=S0034-89102002000300008&lng=pt

19. Fernandes RCP, Cunha LP, Lima VMC, Santos KOB. Mensurando a demanda física no trabalho: estrutura fatorial e confiabilidade de itens sobre posturas, manuseio de carga e repetitividade. Cad Saude Publica [Internet]. 2019 [cited 2019 Mar 12];35(1):e00123218. Available from: http://www.scielo.br/scielo.php?script=sci_arttext&pid=S0102-311X2019000105003&lng=en

20. Araújo TM, Karasek R. Validity and reliability of the job content questionnaire in formal and informal jobs in Brazil. SJWEH Suppl. 2008;34(6):52-9.

21. Silvany Neto AM. Bioestatística sem segredos. Salvador: Edição do autor; 2008.

22. Costa EFO, Andrade TM, Silvany Neto AM, Melo EV, Rosa ACA, Alencar MA, et al. Common mental disorders among medical students at Universidade Federal de Sergipe: a cross-sectional study. Braz J Psychiatry [Internet]. 2010 [cited 2018 Oct 22];32(1):11-9. Available from: http://www.scielo.br/scielo.php?script=sci_arttext&pid=S1516-44462010000100005&lng=en

23. Hahn GJ, Meeker WQ. Assumptions for Statistical Inference. Am Stat. 1993;4(1):1-11.

24. Rothman KJ. Six persistent research misconceptions. J Gen Intern Med. 2014;29(7):1060-4.

25. Greenland S. Randomization, statistics, and causal inference. Epidemiology. 1990;6(1):421-9.

26. Strasak AM, Zaman Q, Pfeiffer KP, Göbel G, Ulmer H. Statistical errors in medical research – a review of common pitfalls. Swiss Med Wkly. 2007;137(3-4):44-9.

27. ElWahab EWA, Eassa SM, Lotfi SE, El Masry SA, Shatat HZ, Kotkat AM. Adverse health problems among municipality workers in Alexandria (Egypt). Int J Prev Med. 2014;5(5):545-56.

28. Brasil. Ministério do Trabalho. Classificação Brasileira de Ocupações. CBO 5142-15: varredor de rua [Internet]. Brasília, DF: Ministério do Trabalho; 2019 [cited 2019 Mar 23]. Available from: https://www.ocupacoes.com.br/cbo-mte/514215-varredor-de-rua

29. Guérin F, Laville A, Daniellou F, Duraffourg J, Kerguelen A. Compreender o trabalho para transformá-lo: a prática da ergonomia. São Paulo: Blucher; 2001.

30. Mascarenhas ALM, Fernandes RCP. Aptidão física e trabalho físico pesado: como interagem para a ocorrência de distúrbio musculoesquelético? Cad Saude Publica [Internet]. 2014 [cited 2016 Oct 14];30(10):2187-98. Available from: http://www.scielo.br/scielo.php?script=sci_arttext&pid=S0102-311X2014001002187&lng=en

31. Vasconcelos RC, Lima FPA, Abreu ACMS, Silva RCR, Camarotto JA, Murta EP. A estratégia de "redução" e a carga de trabalho dos coletores de lixo domiciliar de uma grande cidade: estudo de caso baseado na Análise Ergonômica do Trabalho. Rev Bras Saude Ocup [Internet]. 2008 [cited 2016 Oct 18];33(117):50-9. Available from: http://www.scielo.br/scielo.php?script=sci_arttext&pid=S0303-76572008000100006&lng=en

32. Dul J, Weerdmeester B. Postura e movimento. In: Dul J, Weerdmeester B. Ergonomia prática. 3rd ed. Itiro Lida, translator. São Paulo: Blucher; 2012. p. 17-54.

33. Brasil. Ministério da Saúde. Secretaria de Vigilância em Saúde. Departamento de Vigilância em Saúde Ambiental e Saúde do Trabalhador. Dor relacionada ao trabalho: lesões por esforços repetitivos (LER): distúrbios osteomusculares relacionados ao trabalho (Dort). Brasília, DF: Ministério da Saúde; 2012.

34. Barros N Jr. Insuficiência venosa crônica. In: Pitta GBB, Castro AA, Burihan E, editores. Angiologia

e cirurgia vascular: guia ilustrado. Maceió: UNCISAL; 2003. p. 2-17.

35. Chester MR, Rys MJ, Konz SA. Leg swelling, comfort and fatigue when sitting, standing, and sit/standing. Int J Ind Ergon. 2002;29(5):289-96.
36. Lin YH, Chen CY, Cho MH. Influence of shoe/floor conditions on lower leg circumference and subjective discomfort during prolonged standing. Appl Ergon. 2012;43(5):965-70.
37. Messing K, Stock S, Tissot F. The importance of not standing too long. Arch Environ Occup Health. 2013;68(2):128-9.
38. Huang GD, Feuerstein M, Sauter SL. Occupational stress and work-related upper extremity disorders: concepts and models. Am J Ind Med. 2002;41(5):298-314.
39. Lanfranchi JB, Duveau A. Explicative models of musculoskeletal disorders (MSD): from biomechanical and psychosocial factors to clinical analysis of ergonomics. Eur Rev Appl Psychol. 2008;58(4):201-13.
40. Fernandes RCP, Pataro SMS, Carvalho RB, Burdorf A. The concurrence of musculoskeletal pain and associated work-related factors: a cross sectional study. BMC Public Health [Internet]. 2016 [cited 2019 Aug 10];16:628. Available from: https://bmcpublichealth.biomedcentral.com/articles/10.1186/s12889-016-3306-4