Journal of Bodywork & Movement Therapies 23 (2019) 658–665

Contents lists available at ScienceDirect

Journal of Bodywork & Movement Therapies

journal homepage: www.elsevier.com/jbmt

PREVENTION & REHABILITATION: Cross-Sectional study

Factors associated with musculoskeletal disorders and disability in elementary teachers: A cross-sectional study

Diogo Henrique Constantino Coledam [a, *], Raymundo Pires Júnior [b], Edineia Aparecida Gomes Ribeiro [c], Arli Ramos de Oliveira [d]

[a] Federal Institute of Education, Science and Technology of São Paulo, Boituva, Brazil
[b] University of Northern Paraná, Londrina, Brazil
[c] Federal University of Mato Grosso do Sul, Corumbá, Brazil
[d] Londrina State University, Londrina, Brazil

ARTICLE INFO

Article history:
Received 6 November 2017
Received in revised form
3 March 2018
Accepted 13 May 2018

Keywords:
Epidemiology
Musculoskeletal disease
Musculoskeletal pain
School teachers

ABSTRACT

The purpose of this study was to analyze factors associated with musculoskeletal disorders and disability in elementary teachers. This is a cross-sectional study from a representative sample of Brazilian elementary teachers (n = 530). Data were collected using a self-report questionnaire. Sociodemographic, work-related, and behavioural characteristics were the exposure variables. The outcomes were musculoskeletal symptoms, disability, and musculoskeletal disease. Musculoskeletal disease was used as an outcome, as well as an exposure variable when musculoskeletal symptoms and disability were the outcomes. Prevalence ratios (PR) were estimated by Poisson regression. Variables associated with musculoskeletal symptoms were: length of employment ≥20 years (PR = 1.41), perception of inappropriate infrastructure of schools (RP = 1.21), physical activity (PR = 0.80), and high stress (PR = 1.16) for upper limbs; high stress (PR = 1.23) and perception of inappropriate infrastructure of schools (RP = 1.16) for back/neck; common mental disorders (PR = 1.14 to 1.30), and musculoskeletal disease (PR = 1.19 −1.62) for all regions of the body. Musculoskeletal disease (PR = 2.46 to 3.37) and perception of inappropriate infrastructure of schools (PR = 1.53 to 1.95) were associated to disability in all regions of the body. Length of employment >20 years was associated with disability in the upper limbs (PR = 2.06). Common mental disorders were associated with disability in the upper limbs (PR = 1.53) and back and neck (PR = 1.47) while sitting time >120 min/day was inversely associated with disability in the lower limbs (PR = 0.64). The predictors of musculoskeletal disease were length of employment ≥20 years (PR = 1.97), perception of inappropriate infrastructure of schools (PR = 1.57), strength and flexibility activities (PR = 1.66), TV viewing time ≥ 120 min (PR = 1.37), sports practice (PR = 0.39), and common mental disorders (PR = 1.39). Although the associations varied according to the outcome, common mental disorders, perception of inappropriate infrastructure of schools, high stress, and length of employment are variables to be considered in the prevention of musculoskeletal disorders in teachers. When analyzed as an exposure variable, musculoskeletal disease was the main predictor of musculoskeletal symptoms and disability.

1. Introduction

Musculoskeletal disorders (MSD) are health problems of the musculoskeletal system (muscles, tendons, skeleton, cartilage, ligaments, and nerves) and include all kinds of ill-health ranging from transitory disorders to irreversible and disabling injuries (Luttmann and Griefahn, 2003). Although varying according to the country, MSD have a high economic impact on society due to direct and indirect medical and non-medical costs, disability, and loss of productivity of workers (Gaskin and Richard, 2012; Oh et al., 2011). Considering years lived with the disability, MSD are the second most common cause of disability worldwide (Vos et al., 2012).

* Corresponding author. Federal Institute of Education, Science and Technology of São Paulo, 100 Zélia de Lima Rosa av. Boituva, São Paulo, Brazil.
E-mail addresses: diogohcc@yahoo.com.br (D.H. Constantino Coledam), raymundopires67@gmail.com (R.P. Júnior), edineia.edf@gmail.com (E.A.G. Ribeiro), arli_o@yahoo.com.br (A.R. de Oliveira).

https://doi.org/10.1016/j.jbmt.2018.05.009
1360-8592/

Another aspect that causes a serious public health problem is that MSD usually present a comorbidity burden (Gore et al., 2012).

Despite the multifactorial etiology, some work-related variables are associated with MSD in adults (Costa and Vieira, 2010). Teachers are among the professionals at risk of developing MSD. Elementary teachers perform different work-related tasks such as generally preparing and conducting lessons in fixed positions, frequent reading, assessing students' work performed during classes or at home, and also being involved in extracurricular activities (Erick and Smith, 2013). In addition, a large proportion of teachers are exposed to other risks such as psychosocial problems due to poor working conditions (Cezar-Vaz et al., 2015). All these aspects contribute to a high prevalence of MSD according to region of the body: lower back 45.6 to 68.0% (Ceballos and Santos, 2015; Cheng et al., 2016; Erick and Smith, 2014; Yue et al., 2012; Zamri et al., 2017), neck 27.2 to 60.1% (Ceballos and Santos, 2015; Darwish and Al-Zuhair, 2013; Ehsani et al., 2018; Yue et al., 2012; Zamri et al., 2017), shoulders 31.6 to 63.4% (Ceballos and Santos, 2015; Cheng et al., 2016; Darwish and Al-Zuhair, 2013; Zamri et al., 2017), wrists 16.2 to 56.7% (Ceballos and Santos, 2015; Cheng et al., 2016; Darwish and Al-Zuhair, 2013), and lower limbs 19.1 to 40.0% (Ceballos and Santos, 2015; Darwish and Al-Zuhair, 2013). When analyzing the prevalence of MSD considering any region of the body, the prevalence ranged from 73.5 to 95% (Ceballos and Santos, 2015; Darwish and Al-Zuhair, 2013; Erick and Smith, 2011). The high prevalence of MSD indicates the need to investigate this outcome in teachers.

After analyzing the literature available about MSD in teachers, some gaps should be highlighted. First, as can be observed in a systematic review (Erick and Smith, 2011), epidemiological studies conducted in developing countries are scarce (Erick and Smith, 2015), particularly in South America, and second, the majority of previous studies analyzed factors associated with either general MSD (Cheng et al., 2016; Darwish and Al-Zuhair, 2013) or only specific regions of the body such as neck/shoulder or lower back (Bandpei et al., 2014; Ehsani et al., 2018; Erick and Smith, 2014; Yue et al., 2012; Zamri et al., 2017). For this reason, information on factors associated with MSD in all regions of the body is limited. Similarly, there is a lack of information regarding disability due to musculoskeletal symptoms in teachers, a condition that reflects the severity of MSD. Knowledge about risks associated with MSD and disability according to body region will contribute to developing strategies to promote health and prevent MSD in elementary teachers. Therefore, the aim of this study was to analyze factors associated with MSD and disability in elementary teachers.

2. Material and methods

2.1. Study design and population

An epidemiological cross-sectional study conducted in 2014 with a representative sample of elementary school teachers from the municipal system of Londrina, Paraná, Brazil. Sociodemographic information about Londrina city can be found elsewhere (Brazilian Institute of Geography and Statistics, 2016). According to the Municipal Department of Education, Londrina had 74 elementary schools in the urban area in 2014, with approximately 2500 teachers distributed in the following regions: north (32.8%), south (20.0%), east (20.3%), west (22.1%), and center (4.8%).

2.2. Sample

Sample size was estimated using the parameters: N = 2.500, a 50% outcome prevalence, 5% sample error, confidence interval of 95%, and design effect of 1.5, using the software OpenEpi 3.01. The minimum number of participants required was 500. All schools were invited to participate in the study, and 63 accepted. Data were collected from 595 teachers, stratified according to the region of the city. However, the final sample consisted of 530 teachers due to errors or failure to complete a questionnaire variable. The inclusion criteria in the study were: a-) having been a teacher of municipal schools for at least 1 year and working in an elementary school; b-) not being retired or on medical leave during data collection; c-) not having been work relocated (i.e., teacher reallocated as a secretary).

2.3. Procedures

The study was approved by the Ethics Committee for Research involving human beings of the State University of Londrina, process 118/2014. The guidelines of Resolution N° 466/2012 of the National Health Council were followed. All participants signed an informed written consent containing the objectives, procedures, risks, and benefits of the study, as well as the researchers' contact details. After authorization from the Municipal Education Department to conduct the study, all schools were visited and the project presented to the principals. Following acceptance, the project and procedures were presented to the teachers and a day scheduled for data collection. Teachers were randomly selected using a spreadsheet with data from all teachers in each school. The number of teachers required in each school was proportional to the school and region size. Data collection was performed on a single day. The self-reported questionnaires (printed) were delivered to teachers at the beginning of the work shift or during intervals between classes. The questionnaires were completed individually and returned to the researcher in an opaque envelope. Schools with absent teachers on the day of data collection were visited again. All procedures were conducted in the schools where the teachers worked and the order of visits and data collection carried out randomly.

2.4. Variables

All variables were assessed using a self-report questionnaire. Prior to data collection a pilot study (n = 50) was conducted to analyze reproducibility of the questionnaire, administered on a seven day test-retest basis, and the variables included in this study presented acceptable reproducibility (intraclass coefficient >0.5 for continuous variables and kappa index > 0.40 for categorical variables).

2.5. Exposure variables

The exposure variables of this study were gender, age, income, marital status, number of children, work shift, length of employment, perception of school infrastructure, current leisure time physical activity, flexibility and strength activities, sports practice, overweight, TV viewing time, computer use, sitting time, standing time, high stress, and common mental disorders. Gender, age, marital status, number of children, and length of employment were analyzed using open questions. Teachers indicated their usual work shift (morning, afternoon, night, or combination in the case of more than one work shift). The questions used to assess the other dependent variables were as follows: Perception of school infrastructure, “Do you consider the infrastructure of your school appropriate?” with answer options “Yes”, “No”, and “Partially”; To complement the question, ergonomic aspects that should be considered were described (noise, temperature, lighting, cleaning, ventilation, size, and furniture); High stress, “Has a doctor or psychologist already reported that you have high stress”, “Yes”, “No”; Flexibility and strength activities, " How many days a week do you perform flexibility and muscle strengthening exercises?”, “None”,

"One", "Two", "Three", "≥ Four"; Sports practice, " Do you practice sports (i.e., soccer, volleyball, basketball, running)?", "Yes", "No". Participants also answered open questions on their standing and sitting time during work as well as TV viewing and computer use during leisure time. Familial income was estimated according to the values proposed by the Brazilian Market Research Association (2012). The long form of the International physical activity questionnaire - IPAQ, Portuguese version (Matsudo et al., 2001), was used to assess current physical activity. Common mental disorders were assessed by the Brazilian version of a Self Report Questionnaire (Santos et al., 2009) and the cut-off adopted was 7/8. Overweight was estimated using body mass index and weight and height were self-reported.

2.6. Outcomes

The outcomes of the study were diagnosed musculoskeletal disease, musculoskeletal symptoms, and disability due to musculoskeletal disorders using a self-report questionnaire. Diagnosed musculoskeletal disease was analyzed as an outcome and also an exposure variable when musculoskeletal symptoms and disability were outcomes, due to its importance in the multivariate analysis adjustment. Diagnosed musculoskeletal disease was estimated using the question "Has a doctor already reported that you have a musculoskeletal disease", "Yes", "No".

Musculoskeletal symptoms and disability were assessed using the Brazilian version (Barros and Alexandre, 2003) of the Standardized Nordic questionnaire (Kuorinka et al., 1987). The instrument provides a human body indicating nine areas (neck, shoulders, upper back, elbows, wrists/hands, lower back, hips/thighs, knees, and ankles/feet). For each area there are four dichotomous questions (yes or no) and in the present study we used two of them. Musculoskeletal symptoms were assessed by question 1: "Have you at any time during the last 12 months had trouble (such as ache, pain, discomfort, numbness) in:"; and disability was assessed by question 2: "During the last 12 months have you been prevented from carrying out normal activities (e.g. job, housework, hobbies) because of this trouble in:". Participants answered the questions for all regions of the body.

2.7. Statistical analysis

Descriptive statistics were performed using absolute and relative frequency. The Kappa Index and one-way Intraclass Coefficient Correlation were used to analyze test-retest reproducibility of the variables. The Chi-Squared test was used to analyze bivariate associations between exposures and outcomes of the study. Poisson regression was conducted to estimate the prevalence ratio (PR) and confidence intervals of 95% (CI95%). In the multivariate analysis, the final model was adjusted for variables that presented $P < 0.20$ in the Chi-Squared test and variables were entered into two hierarchical levels: Level 1 (Sociodemographic and work-related variables) and Level 2 (health-related variables). Sample weight, strata (region of the city), and primary sample units (schools) were taken into account using the command survey "svy" of STATA 13.0. Statistical significance was set at $P < 0.05$.

3. Results

The characteristics of the study participants are presented in Table 1. The highest proportion of participants are females, have a medium family income, length of employment >20 years, and between 30 and 49 years of age. With regard to musculoskeletal disorders, the prevalence was higher than 30% for diagnosed musculoskeletal disease, musculoskeletal symptoms in the regions of the neck, shoulders, wrists/hands, upper back, lower back, ankles/feet, and knees. The body regions that presented most disability were the shoulders, upper back, lower back, and knees.

Table 1
Characteristics of study participants (n = 530).

Variables	n	% (CI95%)
Gender		
Male	24	4.5 (2.9–6.7)
Female	506	95.5 (93.3–95.5)
Age		
Up to and including 29	65	12.2 (9.6–15.4)
30 to 39	180	33.9 (29.9–38.2)
40 to 49	206	39.0 (34.7–43.2)
>50 years	79	14.9 (12.0–18.2)
Familial Income		
Low	83	15.6 (12.7–19.0)
Medium	420	79.2 (75.5–82.6)
High	27	5.2 (3.4–7.3)
Length of employment		
Up to and including 9 years	136	25.6 (22.0–29.6)
10 to and including 19 years	175	33.1 (29.0–37.2)
≥20 years	219	41.3 (37.1–45.6)
Diagnosed musculoskeletal disease		
Yes	167	31.6 (27.6–35.7)
No	363	68.4 (64.3–72.4)
Musculoskeletal Symptoms*		
Neck	266	50.2 (45.8–54.5)
Shoulders	262	49.6 (45.1–53.8)
Upper Back	240	45.3 (41.0–49.6)
Elbows	64	12.1 (9.4–15.2)
Wrists/Hands	203	38.3 (34.1–42.6)
Lower Back	262	49.6 (45.1–53.8)
Hips/Thighs	115	21.7 (18.3–25.5)
Knees	174	32.9 (28.8–37.0)
Ankles/feet	175	33.1 (29.0–37.2)
Disability *		
Neck	51	9.6 (7.2–12.5)
Shoulders	69	13.1 (10.3–16.2)
Upper Back	58	11.0 (8.4–13.9)
Elbows	21	4.0 (2.5–6.0)
Wrists/Hands	41	7.7 (5.6–10.3)
Lower Back	76	14.3 (11.5–17.6)
Hips/Thighs	40	7.6 (5.4–10.1)
Knees	62	11.7 (9.1–14.7)
Ankles/feet	49	9.3 (6.9–12.0)

n = absolute frequency (relative frequency); CI95% = Confidence intervals of 95%; * = During the previous 12 months.

The factors associated with musculoskeletal symptoms during the previous 12 months are described in Table 2. Length of employment ≥20 years (PR = 1.41), and physical activity (PR = 0.80) were associated with musculoskeletal symptoms in the upper limbs. High stress and perception of inappropriate infrastructure of schools were positively associated with musculoskeletal symptoms in the upper limbs (PR = 1.16 and 1.21) and back/neck (PR = 1.23 and 1.16), respectively. Teachers with common mental disorders (PR = 1.14 to 1.30) and diagnosed musculoskeletal disease (PR = 1.19–1.62) presented a higher likelihood of presenting musculoskeletal symptoms in all regions of the body. The variables, income, marital status, number of children, work shift, overweight, strength and flexibility activities, sports practice, sitting time, computer use, and standing time are not described in Table 2 as they were not associated with musculoskeletal symptoms during the previous 12 months ($P > 0.20$) in the bivariate analysis.

Table 3 describes the analysis of disability due to musculoskeletal problems. Diagnosed musculoskeletal disease and perception of inappropriate infrastructure of schools increased the likelihood of being disabled in the upper limbs (PR = 2.90 and 1.53), lower limbs (PR = 3.37 and 1.95), and back and neck (PR = 2.46 and 1.67), respectively. The association was also observed in the upper limbs

Table 2
Factors associated with musculoskeletal symptoms during the previous 12 months in elementary school teachers.

Variables	Musculoskeletal symptoms according to body regions:					
	Upper limbs		Lower limbs		Back and neck	
	%	Adjusted PR (CI95%)	%	Adjusted PR (CI95%)	%	Adjusted PR (CI95%)
Level 1						
Gender						
Male	30.8	1.00	42.3	1.00	38.5	1.00
Female	66.1[a]	1.91(0.98–3.62)	55.1[c]	1.18(0.74–1.89)	69.4[a]	1.72(0.99–2.93)
Age						
<40 years	60.5	1.00	50.9	1.00	66.2	–
≥40 years	68.3[b]	0.89(0.73–1.09)	57.6[c]	1.18(0.96–1.46)	70.2	–
Length of employment						
Up to 9 years	54.1	1.00	52.0	–	67.6	–
10 to 19 years	63.9	1.20(0.95–1.53)	52.1	–	64.6	–
≥20 years	71.9[a]	**1.41(1.09–1.82)**	58.7	–	71.5	–
Perception of school infrastructure						
Adequate	60.7	1.00	51.4	1.00	65.4	1.00
Not adequate	76.3[a]	**1.21(1.05–1.39)**	64.7[b]	1.07(0.88–1.31)	75.7[b]	**1.16(1.00–1.34)**
Level 2						
Physical activity						
<150 min/week	67.0	1.00	55.2	–	69.5	1.00
≥150 min week	54.9[b]	**0.80(0.64–0.99)**	52.5	–	62.3[c]	0.99(0.85–1.15)
TV viewing time (day)						
0 to 119 min	62.2	–	51.2	1.00	65.4	1.00
≥120 min	67.2	–	58.2[c]	1.13(0.93–1.37)	71.2[c]	1.03(0.88–1.21)
High stress						
No	59.0	1.00	50.7	1.00	62.0	1.00
Yes	78.3[a]	**1.16(1.02–1.33)**	64.5[a]	1.07(0.89–1.28)	83.1[a]	**1.23(1.09–1.39)**
Common mental disorder						
No	58.1	1.00	48.5	1.00	63.1	1.00
Yes	79.2[a]	**1.20(1.04–1.38)**	68.5[a]	**1.30(1.09–1.54)**	79.2[a]	**1.14(1.01–1.29)**
Diagnosed musculoskeletal disease						
No	58.2	1.00	45.6	1.00	62.4	1.00
Yes	78.3[a]	**1.19(1.03–1.38)**	74.1[a]	**1.62(1.36–1.94)**	80.0[a]	**1.28(1.11–1.45)**

% = relative frequency; PR = prevalence ratio; CI95% = confidence interval of 95%.
[a] $P < 0.001$.
[b] $P < 0.05$.
[c] $P \leq 0.20$ in Chi Squared test; Bold denotes statistical significance; - variable that was not inserted in multivariate analysis.

(PR = 1.53) and back and neck (PR = 1.47) for common mental disorders. Teachers that reported sitting time >120 min/day during work were protected from being disabled in the lower limbs (PR = 0.64), while length of employment ≥20 years (PR = 2.06) increased the likelihood of presenting disability in the upper limbs.

The variables gender, income, marital status, number of children, work shift, current physical activity, strength and flexibility activities, sports practice, TV viewing time, computer use, and standing time are not described in Table 3 as they were not associated with disability ($P > 0.20$) in the bivariate analysis.

Table 4 describes the associations between teacher exposure variables and diagnosed musculoskeletal disease. In the multivariate analysis, variables that increased the likelihood of diagnosed musculoskeletal disease were length of employment ≥20 years (PR = 1.97), perception of inappropriate infrastructure of schools (PR = 1.57), strength and flexibility activities (PR = 1.66), TV viewing time ≥ 120 min a day (PR = 1.37), and common mental disorders (PR = 1.39). Sports practice (PR = 0.39) presented a negative association with musculoskeletal disease. The variables, marital status, income, number of children, work shift, current physical activity, and sitting time are not described in Table 4 as they were not associated with diagnosed musculoskeletal disease in the bivariate analysis ($P > 0.20$).

4. Discussion

The results demonstrated that the prevalence of MSD is high and despite the exposure variables varying according to the outcome, diagnosed musculoskeletal disease, common mental disorders, length of employment, high stress, and perception of inappropriate infrastructure of schools are the main predictors of MSD and disability in elementary teachers.

The present study analyzed a variety of sociodemographic variables of which none were associated with MSD. Our results are contrary to others that described positive associations between older age and female gender with MSD (Ceballos and Santos, 2015; Erick and Smith, 2011, 2014; Zamri et al., 2017). These data suggest that the prevalence of MSD occurs independently of sociodemographic characteristics in the investigated sample of teachers.

Studies have demonstrated that teachers who perform physical activity in leisure time are protected from MSD in the neck, shoulders, and back compared to those who are inactive (Bandpei et al., 2014; Ehsani et al., 2018; Erick and Smith, 2014; Yue et al., 2012). Our results partially corroborate previous data as current physical activity was inversely associated with musculoskeletal symptoms only in the upper limbs. This result could be due to higher functional capacity in active teachers which protect them from workload on shoulders, elbows, wrists and hands. However, no associations were found between physical activity and other regions of the body. The differences between the present study and previous studies can be explained by the amount of physical activity adopted as the cut-off. Some researchers have used cut-offs varying from 2 h/week to 7 h/week (Erick and Smith, 2014; Ehsani et al., 2018; Yue et al., 2012) while others did not report the amount of physical activity used (Bandpei et al., 2014). The present study adopted the current Global recommendations on physical activity for health (World Health Organization, 2010), but the document does not propose a cut-off specific to MSD. This

Table 3
Factors associated with disability during the previous 12 months in elementary school teachers.

Variables	Disability during the previous 12 months according to body regions:					
	Upper limbs		Lower limbs		Back and neck	
	%	Adjusted PR (CI95%)	%	Adjusted PR (CI95%)	%	Adjusted PR (CI95%)
Level 1						
Age						
<40 years	15.6	–	16.6	1.00	15.1	1.00
≥40 years	21.0[c]	–	23.6[b]	1.41(0.84–2.36)	26.6[a]	1.30(0.77–2.18)
Length of employment						
Up to 9 years	11.5	1.00	15.5	1.00	11.5	1.00
10 to 19 years	15.0	1.29(0.68–2.42)	18.0	0.89(0.50–1.58)	19.1	1.01(0.58–1.74)
≥20 years	25.6[a]	**2.06(1.19–3.57)**	25.2[b]	1.02(0.53–1.95)	29.4[a]	1.26(0.68–2.33)
Perception of school infrastructure						
Adequate	16.1	1.00	16.5	1.00	17.6	1.00
Not adequate	24.6[b]	**1.53(1.01–2.30)**	31.1[a]	**1.95(1.33–2.87)**	31.9[a]	**1.67(1.18–2.37)**
Time sitting						
0 to 119 min	18.6	–	22.5	1.00	20.2	–
≥120 min	18.1	–	17.4[c]	**0.64(0.43–0.94)**	22.6	–
Level 2						
Nutritional Status						
Low weight/eutrophic	15.8	1.00	19.4	–	20.1	1.00
Overweight	22.8[b]	1.25(0.88–1.77)	21.5	–	25.0[c]	1.13(0.83–1.53)
High stress						
No	17.2	–	19.1	–	18.6	1.00
Yes	21.5	–	23.3	–	28.2[a]	1.07(0.76–1.49)
Common mental disorders						
No	14.4	1.00	17.7	1.00	18.3	1.00
Yes	27.7[a]	**1.53(1.09–2.16)**	27.7[b]	1.33(0.97–1.84)	33.3[a]	**1.47(1.07–2.01)**
Diagnosed musculoskeletal disease						
No	10.6	1.00	11.1	1.00	11.6	1.00
Yes	35.5[a]	**2.90(1.98–4.24)**	40.2[a]	**3.37(2.35–4.83)**	42.4[a]	**2.46(1.80–3.38)**

% = relative frequency; PR = prevalence ratio; CI95% = confidence interval of 95%; a = P < 0.001, b = P < 0.05, c = P ≤0.20 in Chi Squared test; Bold denotes statistical significance; - variable that was not inserted in the multivariate analysis.

methodological issue in the literature exists because there is no guideline describing the amount of physical activity and other information such as volume and intensity to prevent or treat MSD (Ambrose and Golightly, 2015).

Conversely, strength and flexibility activities increased the likelihood of being diagnosed with musculoskeletal disease. These data should be analyzed with caution as in the present study three different outcomes were analyzed using a cross-sectional design. The available literature regarding the effect of strength and flexibility exercises indicates that these activities were effective in decreasing pain intensity in the shoulder, lower back, and neck (Andersen et al., 2012; Geneen et al., 2017; George et al., 2010; Kim et al., 2015). It is probable that the positive association between strength and flexibility activity and diagnosed musculoskeletal disease can be explained due to physicians' recommendations about strength and flexibility activities as a non-pharmacological treatment for MSD.

Teachers that practice sports presented a lower prevalence of diagnosed musculoskeletal disease and the reason for this association could be the high intensity required in sports compared to conventional physical activities. Thus, sports practice becomes difficult for people with diagnosed musculoskeletal disease due to their disability related to disease severity. Although physical exercise is recommended to prevent and treat MSD (Ambrose and Golightly, 2015; Geneen et al., 2017), scarce information is available on the benefits of sports practice on MSD. A cross-sectional study conducted on nurses (Abolfotouh et al., 2015) and a longitudinal study on the Finnish Defence Forces (Taanila et al., 2010) found similar results to those described in the present study. However, the different characteristics of sports practice and outcomes between the studies, as well as the lack of studies analyzing teachers prevent recommending sports practice to prevent MSD in teachers.

The work-related variables analyzed in this study were work shift, length of employment, standing time, sitting time, and perception of infrastructure of schools. The prevalence of MSD was independent of work shift and standing time during work in the sample studied. Work shift is an indicator of workload and teachers were categorized into those who work one or ≥ two shifts. The results corroborate previous studies that demonstrated no association between higher workload [hours/week] and MSD (Durmus and Ilhanli, 2012; Yue et al., 2012; Zamri et al., 2017). Apparently, work condition variables are determinants in MSD instead of only work shift. Likewise, standing time was not associated with MSD and comparisons with other studies are difficult as results in the literature are inconclusive (Bandpei et al., 2014; Yue et al., 2012). An aspect that could explain the absence of association between standing time and MSD is that it was analyzed as total time in a day, not considering rest breaks during work. Taking breaks between periods of prolonged standing, generally performed sitting, could attenuate pain (Capodaglio, 2017). This may be a reason that sitting time was inversely associated with MSD only for the lower limbs, since sitting is a relief for discomfort in the lower limbs as a consequence of prolonged standing (Capodaglio, 2017).

Poor posture is another work-related variable that is positively associated with MSD in teachers (Ehsani et al., 2018; Erick and Smith, 2011; Yue et al., 2012) and could be a consequence of inappropriate infrastructure of schools. The results of this study demonstrated that perception of inappropriate infrastructure of schools is an important predictor of MSD in teachers, being associated with musculoskeletal symptoms in the upper limbs, back and neck, diagnosed musculoskeletal disease, and disability in all regions of the body. However, another important aspect associated with poor posture in addition to infrastructure is ergonomic knowledge of the work environment. Making appropriate behavioral and ergonomic changes to workstations improves the

Table 4
Factors associated with diagnosed musculoskeletal disease in elementary school teachers.

Variables	Diagnosed musculoskeletal disease	
	%	Adjusted PR (CI95%)
Level 1		
Gender		
Male	22.2	1.00
Female	32.3[b]	1.31(0.86–1.99)
Age		
<40 years	22.0	1.00
≥40 years	40.5[a]	1.31(0.86–1.99)
Length of employment		
Up to 9 years	17.1	1.00
10 to 19 years	28.6	1.58(0.93–2.66)
≥20 years	43.3[a]	**1.97(1.11–3.50)**
Perception of school infrastructure		
Adequate	27.6	1.00
Not adequate	45.3[a]	**1.57(1.20–2.04)**
Standing time		
0 to 119 min	35.5	1.00
≥120 min	29.0[c]	0.86(0.64–1.14)
Level 2		
Nutritional Status		
Low weight/eutrophic	27.9	1.00
Overweight	37.1[b]	1.22(0.90–1.64)
Strength and Flexibility activities		
<2 days a week	29.6	1.00
≥2 days a week	36.9[c]	**1.66(1.25–2.21)**
Sports practice		
No	33.1	1.00
Yes	14.6[a]	**0.39(0.18–0.86)**
TV viewing time (day)		
0 to 119 min	29.2	1.00
≥120 min	35.2[c]	**1.37(1.02–1.85)**
Computer use		
0 to 119 min	34.6	1.00
≥120 min	27.9c	0.78(0.60–1.02)
High stress		
No	27.7	1.00
Yes	41.6[a]	1.07(0.80–1.43)
Common mental disorder		
No	28.4	1.00
Yes	39.1[a]	**1.39(1.04–1.85)**

% = Relative frequency; PR = Prevalence ratio; CI95% = confidence interval of 95%; a = P < 0.001, b = P < 0.05, c = P ≤ 0.20 on Chi Squared test; Bold denotes statistical significance; - variable that was not inserted in the multivariate analysis.

autonomy of workers, resulting in reduced non-neutral postures and muscular effort during work (Robertson et al., 2009). These results are alarming as there is a mismatch between furniture and anthropometry characteristics in schools for students (Castellucci et al., 2010) and possibly for teachers and other professionals.

Length of employment (≥20 years) was positively associated with diagnosed musculoskeletal disease, musculoskeletal symptoms, and disability in the upper limbs as described previously for musculoskeletal pain in other regions of the body (Bandpei et al., 2014; Cheng et al., 2016; Durmus and Ilhanli, 2012; Ehsani et al., 2018). This association cannot be attributed to higher age of teachers that have longer employment length since in the multivariate analysis age was not significantly associated with any outcome. A plausible hypothesis is that the higher likelihood of presenting MSD in teachers with length of employment ≥20 years is a consequence of a longer time exposed to occupational risk factors compared to those who have less employment length.

Diagnosed musculoskeletal disease and common mental disorders were variables that best predicted the outcomes analyzed. It was expected that diagnosed musculoskeletal disease would be associated with musculoskeletal symptoms and disability and this variable was important to adjust analysis as it is certainly a causal exposure. However, this procedure was not commonly adopted in previous studies (Bandpei et al., 2014; Cheng et al., 2016; Darwish and Al-Zuhair, 2013; Ehsani et al., 2018; Erick and Smith, 2014; Yue et al., 2012). With regard to common mental disorders, which include depression, anxiety states, and somatoform disorders, the results corroborate other studies (Ceballos and Santos, 2015; Erick and Smith, 2013; Zamri et al., 2017). The cross-sectional design of this study prevents description of the direction of the relationship between variables. Previous longitudinal data suggest a bidirectional relationship, with psychological factors and MSD influencing each other (Haukkal et al., 2011; Kroenke et al., 2011). Although data from the present study do not indicate the direction of the association, they support the need to monitor both common mental disorders and MSD in teachers.

Another psychosocial variable that presented a positive association with musculoskeletal symptoms in the upper limbs and back and neck in the present study was high stress. Our results corroborate both a cross-sectional study (Cardoso et al., 2011) and a review (Erick and Smith, 2013) that demonstrated a positive association between stress and MSD, but is contrary to a recent study that reported no association between work stress and musculoskeletal pain in teachers (Zamri et al., 2017). Positive associations between different indicators of work stress and MSD were also revealed in a systematic review of longitudinal studies conducted on industrial workers (Lang et al., 2012). The literature indicates two hypotheses for these associations: the emergence of stress results in MSD (Lang et al., 2012) or people with MSD are more likely to develop subsequent perception of stress and become less tolerant to the psychological demands of work (Bonzini et al., 2015). Although the present study confirmed the positive association between the variables, it was not possible to discern which variable is the cause of the other. For these reasons, the results suggest that both stress and MSD should be monitored in teachers.

It has been extensively described that excessive sedentary behaviour is a risk for cardiovascular disease, type 2 diabetes, metabolic syndrome, and mortality in adults (Rezende et al., 2014). Although there is no information about the association between sedentary behavior and MSD in teachers, a recent longitudinal study (Amorim et al., 2017) and a systematic review (Rezende et al., 2014) conducted in adults demonstrated that sedentary behaviour is not a cause of musculoskeletal pain. These data are corroborated by the results of the present study as there was no association between sedentary behaviour analyzed by TV viewing and musculoskeletal symptoms in any region of the body. On the other hand, TV viewing was associated with diagnosed musculoskeletal disease, probably because teachers with chronic conditions opt to occupy their leisure-time with sedentary activities due to limitations imposed by disease. Other information from the present study that reinforces this affirmation is the higher prevalence of teachers with diagnosed musculoskeletal disease on those who do not practice sports.

Some limitations of this study should be highlighted to better understand and generalize the results. As extensively discussed above, the cross-sectional design prevents establishing the direction and causality of the associations. Another limitation is that the study did not control for the healthy worker effect since all teachers in the sample were working at the time of data collection. In addition, the questionnaire adopted does not discriminate work-related from general musculoskeletal disorders. Both limitations may have influenced the outcome prevalence and prevalence ratios. Work seasonality was also not considered. Data collection was performed from July to December. Generally in Brazil, the school year is divided into two semesters: First semester, February to July, with a 15 day recess at the end of the first semester; Second semester, August to December with school holidays from December 20 to January 31. Commonly, near the end of the semester teachers'

work increases due to test applications and bureaucratic work. Despite the limitations mentioned above, the study presents practical applications since exposure variables that can guide intervention programs to prevent MSD among elementary teachers were described. The sample representativeness enables generalization of the results to teachers from other countries with similar characteristics to those analyzed in the present study. Other strengths include the use of major outcomes on MSD and multivariate analysis adjusted for main risk variables to which teachers are often exposed.

5. Conclusions

The prevalence of MSD in different regions of the body is high in elementary teachers. Neck, shoulders, lower and upper back were the four most affected regions (>45%) and 31.6% of teachers reported diagnosed musculoskeletal disease. Disability was higher in the shoulders, lower back, upper back, and knees (≥11%). Diagnosed musculoskeletal disease, common mental disorders, perception of inappropriate infrastructure of schools, and high stress were the major predictors of musculoskeletal symptoms and disability. Length of employment >20 years, perception of inappropriate infrastructure of schools, and common mental disorders were the variables that presented higher associations with diagnosed musculoskeletal disease. Sedentary behavior, sports practice, and physical activity presented occasional associations while sociodemographic aspects did not play an important role in the outcomes analyzed. Intervention programs aiming to prevent MSD in teachers should focus on mental, behavioral, and work-related conditions.

Financial support

None.

Conflicts of interest

None.

Acknowledgements

The authors would like to thank the Municipal Department of Education of Londrina, Paraná, Brazil, as well as the principals and teachers who agreed to participate in this study.

References

Abolfotouh, S.M., Mahmoud, K., Faraj, K., Moammer, G., ElSayed, A., Abolfotouh, M.A., 2015. Prevalence, consequences and predictors of low back pain among nurses in a tertiary care setting. Int. Orthop. 39, 2439–2449.

Ambrose, K.R., Golightly, Y.M., 2015. Physical exercise as non-pharmacological treatment of chronic pain: why and when. Best Pract. Res. Clin. Rheumatol. 29, 120–130.

Amorim, A.B., Levy, G.M., Pérez-Riquelme, F., Simic, M., Pappas, E., Dario, A.B., Ferreira, M.L., Carrillo, E., Luque-Suarez, A., Ordoñana, J.R., Ferreira, P.H., 2017. Does sedentary behavior increase the risk of low back pain? A population-based co-twin study of Spanish twins. Spine J. 17, 933–942.

Andersen, C.H., Andersen, L.L., Gram, B., Pedersen, M.T., Mortensen, O.S., Zebis, M.K., Sjøgaard, G., 2012. Influence of frequency and duration of strength training for effective management of neck and shoulder pain: a randomised controlled trial. Br. J. Sports Med. 46, 1004–1010.

Bandpei, M.A.M., Ehsani, F., Behtash, H., Ghanipour, M., 2014. Occupational low back pain in primary and high school teachers: prevalence and associated factors. J. Manip. Physiol. Ther. 37, 702–708.

Barros, E.N.C., Alexandre, N.M.C., 2003. Cross-cultural adaptation of the Nordic musculoskeletal questionnaire. Int. Nurs. Rev. 50, 101–108.

Bonzini, M., Veronesi, G., Conti, M., Coggon, D., Ferrario, M.M., 2015. Is musculoskeletal pain a consequence or a cause of occupational stress? A longitudinal study. Int. Arch. Occup. Environ. Health 88, 607–612.

Brazilian Market Research Association, 2012. Critério de classificação econômica Brasil. Available in. http://www.abep.org/criterio-brasil. acessed November 3rd, 2017.

Capodaglio, E.M., 2017. Occupational risk and prolonged standing work in apparel sales assistants. Int. J. Ind. Ergon. 60, 53–59.

Cardoso, J.P., Araújo, T.M.D., Carvalho, F.M., Oliveira, N.F.D., Reis, E.J.F.B.D., 2011. Aspectos psicossociais do trabalho e dor musculoesquelética em professores. Cad. Saúde Pública 27, 1498–1506.

Castellucci, H.I., Arezes, P.M., Viviani, C.A., 2010. Mismatch between classroom furniture and anthropometric measures in Chilean schools. Appl. Ergon. 41, 563–568.

Ceballos, A.G.C., Santos, G.B., 2015. Fatores associados a dor musculoesquelética em professores: Aspectos sociodemograficos, saude geral e bem-estar no trabalho. Rev. Bras. Epidemiol. 18, 702–715.

Cezar-Vaz, M.R., Bonow, C.A., Almeida, M.C.V.D., Rocha, L.P., Borges, A.M., 2015. Mental health of elementary schoolteachers in southern Brazil: working conditions and health consequences. Sci. World J. 825925.

Cheng, H.Y.K., Wong, M.T., Yu, Y.C., Ju, Y.Y., 2016. Work-related musculoskeletal disorders and ergonomic risk factors in special education teachers and teacher's aides. BMC Publ. Health 16, 137.

Costa, B.R., Vieira, E.R., 2010. Risk factors for work-related musculoskeletal disorders: a systematic review of recent longitudinal studies. Am. J. Ind. Med. 53, 285–323.

Darwish, M.A., Al-Zuhair, S.Z., 2013. Musculoskeletal pain disorders among secondary school Saudi female teachers. Pain Res. Treat. 878570.

Durmus, D., Ilhanli, I., 2012. Are there work-related musculoskeletal problems among teachers in Samsun, Turkey? J. Back Musculoskelet. Rehabil. 25, 5–12.

Ehsani, F., Mohseni-Bandpei, M.A., Fernández-De-Las-Peñas, C., Javanshir, K., 2018. Neck pain in Iranian school teachers: prevalence and risk factors. J. Bodyw. Mov. Ther. 22, 64–68.

Erick, P., Smith, D., 2013. Musculoskeletal disorder risk factors in the teaching profession: a critical review. OA Musculoskelet. Med. 1, 29.

Erick, P.N., Smith, D.R., 2011. A systematic review of musculoskeletal disorders among school teachers. BMC Muscoskel. Disord. 12, 260.

Erick, P.N., Smith, D.R., 2014. Low back pain among school teachers in Botswana, prevalence and risk factors. BMC Muscoskel. Disord. 15, 359.

Erick, P.N., Smith, D.R., 2015. Musculoskeletal disorders in the teaching profession: an emerging workplace hazard with significant repercussions for developing countries. Ind. Health 53, 385–386.

Gaskin, D.J., Richard, P., 2012. The economic costs of pain in the United States. J. Pain 13, 715–724.

Geneen, L.J., Moore, R.A., Clarke, C., Martin, D., Colvin, L.A., Smith, B.H., 2017. Physical activity and exercise for chronic pain in adults: an overview of Cochrane Reviews. Cochrane Database Syst. Rev. 4, CD011279.

George, S.Z., Wittmer, V.T., Fillingim, R.B., Robinson, M.E., 2010. Comparison of graded exercise and graded exposure clinical outcomes for patients with chronic low back pain. J. Orthop. Sports Phys. Ther. 40, 694–704.

Gore, M., Sadosky, A., Stacey, B.R., Tai, K.S., Leslie, D., 2012. The burden of chronic low back pain: clinical comorbidities, treatment patterns, and health care costs in usual care settings. Spine 37, E668–E677.

Haukkal, E., Leino-Arjasl, P., Ojajärvil, A., Takalal, E.P., Viikari-Juntural, E., Riihimäkil, H., 2011. Mental stress and psychosocial factors at work in relation to multiple-site musculoskeletal pain: a longitudinal study of kitchen workers. Eur. J. Pain 15, 432–438.

Instituto Brasieiro de Geografia e Estatística (IBGE), 2016. IBGE Cidades, Londrina. Available in. https://cidades.ibge.gov.br/brasil/pr/londrina/panorama. acessed November 3rd, 2017.

Kim, D., Cho, M., Park, Y., Yang, Y., 2015. Effect of an exercise program for posture correction on musculoskeletal pain. J. Phys. Ther. Sci. 27, 1791–1794.

Kroenke, K., Wu, J., Bair, M.J., Krebs, E.E., Damush, T.M., Tu, W., 2011. Reciprocal relationship between pain and depression: a 12-month longitudinal analysis in primary care. J. Pain 12, 964–973.

Kuorinka, I., Jonsson, B., Kilbom, A., Vinterberg, H., Biering-Sørensen, F., Andersson, G., Jørgensen, K., 1987. Standardised Nordic questionnaires for the analysis of musculoskeletal symptoms. Appl. Ergon. 18, 233–237.

Lang, J., Ochsmann, E., Kraus, T., Lang, J.W., 2012. Psychosocial work stressors as antecedents of musculoskeletal problems: a systematic review and meta-analysis of stability-adjusted longitudinal studies. Soc. Sci. Med. 75, 1163–1174.

Luttmann, A.J., Griefahn, M.B., 2003. Protecting Workers Health Series No 5. Preventing Musculo-skeletal Disorders in the Workplace. World Health Organization.

Matsudo, S., Araújo, T., Marsudo, V., Andrade, D., Andrade, E., Oliveira, L.C., Braggion, G., 2001. Questionário internacional de atividade física (IPAQ): estudo de validade e reprodutibilidade no Brasil. Rev. Bras. Ativ. Fís. Saúde 6, 5–18.

Oh, I.H., Yoon, S.J., Seo, H.Y., Kim, E.J., Kim, Y.A., 2011. The economic burden of musculoskeletal disease in Korea: a cross sectional study. BMC Muscoskel. Disord. 12, 157.

Rezende, L.F.M., Lopes, M.R., Rey-López, J.P., Matsudo, V.K.R., Carmo, L.O., 2014. Sedentary behavior and health outcomes: an overview of systematic reviews. PLoS One 9, e105620.

Robertson, M., Amick III, B.C., DeRango, K., Rooney, T., Bazzani, L., Harrist, R., Moore, A., 2009. The effects of an office ergonomics training and chair intervention on worker knowledge, behavior and musculoskeletal risk. Appl. Ergon. 40, 124–135.

Santos, K.O.B., Araújo, T.M., Oliveira, N.F., 2009. Estrutura fatorial e consistência interna do Self-Reporting Questionnaire (SRQ-20) em população urbana. Cad.

Saúde Pública 25, 214–222.
Taanila, H., Suni, J., Pihlajamäki, H., Mattila, V.M., Ohrankämmen, O., Vuorinen, P., Parkkari, J., 2010. Aetiology and risk factors of musculoskeletal disorders in physically active conscripts: a follow-up study in the Finnish Defence Forces. BMC Muscoskel. Disord. 11, 146.
Vos, T., Flaxman, A.D., Naghavi, M., Lozano, R., Michaud, C., Ezzati, M., et al., 2012. Years lived with disability (YLDs) for 1160 sequelae of 289 diseases and injuries 1990–2010: a systematic analysis for the Global Burden of Disease Study 2010. Lancet 380, 2163–2196.
World Health Organization, 2010. Global Recommendations on Physical Activity for Health. World Health Organization, Geneva.
Yue, P., Liu, F., Li, L., 2012. Neck/shoulder pain and low back pain among school teachers in China, prevalence and risk factors. BMC Publ. Health 12, 789.
Zamri, E.N., Moy, F.M., Hoe, V.C.W., 2017. Association of psychological distress and work psychosocial factors with self-reported musculoskeletal pain among secondary school teachers in Malaysia. PLoS One 12, e0172195.