Association between musculoskeletal disorders and healthcare expenditures among patients from the Brazilian public healthcare system

Associação entre desordens musculoesqueléticas e gastos com cuidado à saúde entre pacientes do Sistema Único de Saúde

Jamile Sanches Codogno[1,2], Bruna Camilo Turi[1], Rômulo Araújo Fernandes[1,2], Mariana Rotta Bonfim[1], Carlos Marcelo Pastre[3], Henrique Luiz Monteiro[1,4]

ABSTRACT

Study Design: Cross-sectional.

Objectives: (i) To identify the prevalence of musculoskeletal disorders, (ii) to identify musculoskeletal disorders correlates and (iii) to identify the existence of relationship between musculoskeletal disorders and healthcare expenditures in adults attended to by the public healthcare system. **Methods:** Cross-sectional study involving 963 adults (over 50 years of age and of both sexes) treated in basic healthcare units (BHU). The participants answered questionnaires about self-reported morbidity, economic condition, musculoskeletal symptoms, occupational activity behavior, physical therapy consultation and prescription drugs purchased. Weight and height were obtained for body mass index computation. Healthcare expenditures in the last 12 months were computed. **Results:** The prevalence of musculoskeletal symptoms was 65%. Patients diagnosed with musculoskeletal system/connective tissue diseases (OR= 4.11 [2.98 – 5.67]) and people who needed to lift loads at work (OR= 1.45 [1.27 – 1.66]) presented higher likelihood to report the outcome. Moreover, occurrence of musculoskeletal symptoms in shoulders, low back, knees and ankles/feet were positively related to increased prescription drugs used and medical consultations. **Conclusion:** There is a high occurrence of musculoskeletal symptoms in Brazilian patients, which is affected by sex and occupational activity, and is positively related to increased healthcare expenditures.

Key Words: Musculoskeletal Pain; Costs and Cost Analysis; Motor Activity; Public Health.

1. PhD. Graduate Program in Movement's Sciences. UNESP – Univ Estadual Paulista, Rio Claro, Brazil.
2. PhD. Professor. Department of Physical Education. UNESP, Presidente Prudente, Brazil.
3. PhD. Professor. Department of Physical Therapy. UNESP, Presidente Prudente, Brazil.
4. PhD. Professor. Department of Physical Education. UNESP, Bauru, Brazil.

Corresponding author:
Jamile Sanches Codogno, PhD.
UNESP – Universidade Estadual Paulista.
Rua Roberto Simonsen, 305.
ZIP Code: 19060-900. Presidente Prudente, SP, Brazil.
jamile@fct.unesp.br

Conflict of interest: The authors declare that there is no conflict of interest.

RESUMO

Delineamento: transversal.

Objetivos: (i) Identificar a ocorrência de desordens musculoesqueléticas, (ii) identificar seus determinantes e (iii) suas relações com gastos com saúde em adultos atendidos pelo Sistema Único de Saúde. **Métodos:** Estudo transversal com 963 adultos, com 50 anos e de ambos os sexos tratados em unidades básicas de saúde. Participantes responderam questionários sobre doenças, condição econômica, desordens musculoesqueléticas, atividade ocupacional, consultas de fisioterapia e compra de medicamentos; peso e estatura foram mensurados para calcular o índice de massa corporal. Custos com saúde foram computados retroagindo 12 meses. **Resultados:** A prevalência de desordens musculoesqueléticas foi 65%, sendo maior em pacientes com doenças do tecido conjuntivo (OR=4,11 [2,98-5,67]) e pessoas que levantam cargas no trabalho (OR=1,45 [1,27-1,66]). Além disso, a ocorrência de desordens musculoesqueléticas nos ombros, região lombar, joelhos e tornozelos/pés foram relacionados a maiores gastos com medicamentos e consultas médicas. **Conclusão:** A ocorrência de desordens musculoesqueléticas foi elevada entre estes pacientes, é afetada por sexo e atividade ocupacional e positivamente relacionada com gastos com saúde.

Palavras-chave: Dor Musculoesquelética; Custos e Análise de Custo; Atividade Motora; Saúde Pública.

Introduction

Musculoskeletal disorders constitute a group of complications which affect health perception[1], mobility and quality of life. Therefore, preventative actions targeting to identify its correlates constitute a relevant action for health professionals.[1,2,3] Previous studies have identified some risk factors related to these diseases, such as gender, age and occupational activity.[4,5,6]

One of the most prevalent musculoskeletal disorders among middle-aged adults is low back pain, and hence is widely investigated[1-3]. In Brazil, where a large percentage of the population is attended to by the public healthcare system[7,8,9], low back pain and other musculoskeletal disorders are common reasons for sick leave and disability pension[3], which generate high costs to government and significant healthcare expenditure.

So, due to the population ageing and changes in the level of income in Brazil, the demand for health care services and expenditures are expected to grow substantially[4]. And in spite of the fact that musculoskeletal disorders are so frequent, there is limited knowledge about the percentage of patients affected by these symptoms within public healthcare system and its relationship with healthcare expenditures.

The purposes of this study were (i) to identify the prevalence of musculoskeletal disorders, (ii) to identify musculoskeletal disorders correlates and (iii) to identify the existence of relationship between musculoskeletal disorders and healthcare expenditures among adults attended to by the Brazilian public healthcare system.

Methods

Sample

This project was a cross-sectional study conducted from August 2010 to December 2010 in the city of Bauru. The study was previously approved by the Ethics Committee Group from Sao Paulo State University (UNESP), Bauru campus (Process number 1046/46/01/10) and all subjects signed a standard written consent form. The sample size was estimated based on the percentage of Brazilian population that are covered only by the public health system (60%)[8] and using parameters as 3.8% error (arbitrary because there are no other similar studies), 5% statistical significance and design effect of 50%. A sample size of 960 participants was estimated to be representative (minimum of 192 in each Basic Healthcare Unit [BHU]). The city was stratified into five geographical regions (south, west, north, east and center) and the major BHU from each geographical region was selected to the study (Municipality Secretariat chosen the BHU). As inclusion criteria, the patients should: i) be aged 50 years old or more; ii) have at least one appointment in the last six months in the BHU, iii) don't have restriction to the practice of physical activity. The medical records of all patients who attended in the last six months were compiled into a list and, at least, 250-500 patients were randomly selected for an interview from each BHU.

After phone contact an interview was scheduled and, after data collection, the final sample size was 963 patients.

Medicina (Ribeirão Preto) 2015;48(2):143-50
http://revista.fmrp.usp.br

Codogno JS, Turi BC, Fernandes RA, Bonfim MR, Pastre CM,
Monteiro HL. Musculoskeletal disorders and expenditures.

Independent variables

In all patients, the medical records and the self-report were used to determine their diseases. The International Statistical Classification of Diseases and Related Health Problems (ICD-10, released in 2008) was used both to identify and cluster diseases of the musculoskeletal system and connective tissue (code ICD M00-M99) (dichotomized in either presence or absence of any disease related to ICD M00-M99). Economic condition was assessed through the questionnaire previously validated by the Brazilian Criterion for Economic Classification - ABEP[11], which estimates the family income taking into account: educational level, number of home appliances, number of cars in the house, as well the presence of domestic servants. In this questionnaire, individuals are classified into five categories from A (highest socioeconomic level) to E (lowest) and in our study the sample was stratifies as follow: High economic condition (categories: A and B) and Low economic condition (categories: C, D and E).

The medical records (self-report was used as supplementary data) were used to identify both the number of physical therapy consultations and prescription drugs purchased in the month immediately prior to the study (only prescription drugs used regularly were taken into account: dichotomized into either presence or absence). Moreover, sex and age (either <65 years or e"65 years) were treated as potential confounders.

Outcome

The "standardized Nordic questionnaire for the analysis of musculoskeletal symptoms" proposed by Kuorinka et al.[12] was used to assess the presence of musculoskeletal symptoms (ache, pain, discomfort and numbness) in different anatomical areas (neck, shoulders, upper back, elbows, shoulders, low back, wrists / hands, hips / thighs, knees and ankles / feet). The questionnaire provides four dichotomized questions (either yes or no) for each anatomical area: (i) "Have you at any time during the last 12 months had trouble in…"; (ii) "During the last 12 months have you been prevented from carrying out normal activities (e.g. job, housework, hobbies) because of this trouble in…"; (iii) "during the last 12 months have you seen a physician for this condition…"; (iv) "During the last 7 days have you had trouble in…". The presence of the outcome was the positive response to all four questions in any of the nine anatomical areas.

There is a previously validated version of this questionnaire for the Brazilian language.[13,14]

Behaviors related to occupational activity and being overweight

Behavior related to occupational activity was assessed by four questions in section 1 of Baecke's Questionnaire[15]. Behavior at work was assessed as follows: (i) "At work I sit", (ii) "At work I stand", (iii) "At work I walk" and (iv) "At work I lift heavy loads". For each behavior the patient provided a response based on the Likert scale (never, seldom, sometimes, often or always [score 1, 2, 3, 4 and 5, respectively]). Patients with no formal job received a score of zero. To calculate body mass index (BMI [in kg/m^2]), body mass was measured with a Filizola electronic scale (precision 0.1 kg) (Filizola PL 150, Filizola Ltda) and the height with a wall-mounted stadiometer [precision 0.1 cm (Sanny®, São Paulo, Brazil)] with the subjects in standing position, breathing normally and with arms relaxed beside the trunk. The record was made at the end of a normal expiration. All anthropometric measurements were made following the recommendations proposed by Lohman et al.[16]. Overweight and obesity were identified as values ranging from 25 to $29.9kg/m^2$ and e"$30kg/m^2$, respectively.[17]

Healthcare expenditures

The procedures to estimate healthcare expenditures are described in previous publication[18]. Briefly, the period of time considered to assess expenditures was one year prior to the interview. Expenditures due were estimated including all items registered in the medical records from each patient [laboratory tests performed in private laboratories paid by BHU; medical consultations (e.g. dentists, gynecologist, obstetrician, general practitioner and psychiatrist); prescription drugs discharged]. A specific standard table, including public healthcare reimbursement values, were provided by BHU offices and used in order to compute monetary values of laboratory tests and medical specialist consultations. Invoices obtained from BHUs were used to compute the dosage and the market prices of medication used by patients. All expenditures were computed in the Brazilian currency (Real) and converted to US dollar using the average value of the dollar against the Brazilian currency in the 12 months of 2009. In the study, healthcare expenditures were presented as: medical consultations, prescription drugs and overall.

Codogno JS, Turi BC, Fernandes RA, Bonfim MR, Pastre CM,
Monteiro HL. Musculoskeletal disorders and expenditures.

Medicina (Ribeirão Preto) 2015;48(2):143-50
http://revista.fmrp.usp.br

Statistical analysis

For numerical variables, descriptive statistics were composed of values of mean, median, 95% confidence interval (95%CI), standard-deviation (SD) and interquartile range. The Spearman correlation was used to assess the relationship between the dependent and several independent variables. Categorical data were expressed as rates and its 95%CI. Chi-square test ($\div^2$) analyzed the existence of association (Yates' correction was applied in 2 x 2 contingence tables), as well as, binary logistic regression (presented as values of odds ratio [OR] and its 95%CI [$OR_{95\%CI}$]) indicated the magnitude of these associations. In binary logistic regression, all independent variables with *p*-value <0.05 in $\div^2$ were inserted simultaneously in the multivariable model. Statistical procedures were performed by the software BioEstat (release 5.0) and all statistical analyzes were set at *p*-value < 0.05.

Results

The sample was composed of 963 patients of both genders (707 women [73.4%]) and their age ranged from 50 to 96 years (mean 64.7 years). The prevalence of musculoskeletal symptoms was 65% (95%CI: 61.9% – 68.1% [n= 626]), in addition, there was a high occurrence of diseases of the musculoskeletal system and connective tissue in this sample (72.1% [95%CI: 69.2% – 74.9%]). Twelve different diseases were diagnosed in this group; those of higher occurrence were as follows: low back pain (55.6%), arthritis / osteoarthritis (38.1%), scoliosis (23%) and osteoporosis (20.6%). Similarly, the prevalence of overweight/obesity was high (80%). During the month prior to the study, only 8% (95%CI: 6.2-9.7%) and 35% (IC95%: 31.9% - 38%) of the patients had physical therapy consultations and bought prescription drugs, respectively (**Table 1**).

Table 1. General characteristics of the analyzed patients (Brazil, n= 963).

Variables	Descriptive Statistic (n= 963)		
	Mean ± SD (95%CI)	Median (IR)	K-S
Numerical			
Age (years)	64.7±9.1 (64.1 – 65.3)	63.7 (13.6)	0.001
Body weight (kg)	72.8±15.5 (71.8 – 73.8)	71.3 (19.3)	0.001
Height (m)	1.57±0.08 (1.56 – 1.57)	1.56 (0.11)	0.001
BMI (kg/m^2)	29.4±5.8 (29.1 – 29.8)	28.6 (7)	0.001
Categorical	*n (% [95%CI])*		
Diseases (%)			
ICD M00-M99	694 (72.1 [69.2 – 74.9])		
Overweight / Obesity (%)			
Normal	193 (20 [17.5 – 22.5])		
Overweight	380 (39.5 [36.3 – 42.5])		
Obesity	390 (40.5 [37.4 – 43.6])		
Physical Therapy (%)			
Yes	77 (08 [6.2 – 9.7])		
No	886 (92 [90.2 – 93.7])		
Prescription Drugs Purchased (%)			
Yes	337 (35 [31.9 - 38])		
No	626 (65 [61.9 - 68])		
Economic condition (%)			
High	162 (16.8 [14.4 – 19.1])		
Low	801 (83.2 [80.8 – 85.5])		

SD= standard-deviation; K-S= Kolmogorov-Smirnov's test; IR= interquartile range; BMI= body mass index; ICD M00-M99= diseases of the musculoskeletal system and connective tissue.

Medicina (Ribeirão Preto) 2015;48(2):143-50
http://revista.fmrp.usp.br

Codogno JS, Turi BC, Fernandes RA, Bonfim MR, Pastre CM,
Monteiro HL. Musculoskeletal disorders and expenditures.

The self-report of musculoskeletal symptoms was significantly associated with the female gender (*p*-value= 0.001), overweight/obesity (*p*-value= 0.031), lower economic condition (*p*-value= 0.013), physical therapy consultation (*p*-value= 0.004), prescription drugs used (*p*-value= 0.029) and diagnosis of some diseases of the musculoskeletal system and connective tissue (*p*-value= 0.001). On the other hand, age was not significantly associated (*p*-value= 0.279) (**Table 2**). Spearman correlation analyzed the relationship between the score for occupational activity related behavior (walk [rho= 0.003; *p*-value= 0.935];

sit position [rho= 0.026; *p*-value= 0.423]; standing position [rho= 0.038; *p*-value= 0.238]; lift heavy load walk [rho= 0.178; *p*-value= 0.001]) and the presence of musculoskeletal symptoms.

After adjustment (all independent variables inserted simultaneously), the female gender (OR= 1.86 [$OR_{95\%CI}$: 1.53 – 2.57]), diagnosis of some disease of the musculoskeletal system and connective tissue (OR= 4.35 [$OR_{95\%CI}$: 3.18 – 5.95]) and physical therapy consultation in the last month (OR= 2.01 [$OR_{95\%CI}$: 1.08 – 3.75]) still associated with musculoskeletal symptoms. Patients who have to lift heavy

Table 2. Chi-square test and multivariate association between musculoskeletal symptoms and independent variables among patients of the Brazilian Public Healthcare system (Brazil, n= 963).

Independent Variables		%	OR $_{Crude}$ ($OR_{95\%CI}$)	OR $_{Adjusted}$ ($OR_{95\%CI}$)
			Binary Logistic Regression	
Gender*	Male	48	1.00	1.00
	Female	71.1	**2.66 (1.98 – 3.57)**	**1.89 (1.35 – 2.64)**
Age (years)	<65	66.7	1.00	—-
	e"65	63.1	0.85 (0.65 – 1.11)	—-
EC*	High	56.2	**0.63 (0.45 – 0.89)**	0.79 (0.53 – 1.18)
	Low	66.8	1.00	1.00
Prescription drugs purchased*	No	61.2	1.00	1.00
	Yes	70.6	**1.52 (1.15 – 2.00)**	1.10 (0.80 – 1.52)
Physical Therapy*	No	63.7	1.00	1.00
	Yes	80.5	**2.36 (1.32 – 4.21)**	**2.00 (1.05 – 3.78)**
ICDM00-M99*	No	37.2	1.00	1.00
	Yes	75.8	**5.29 (3.91 – 7.15)**	**4.11 (2.98 – 5.67)**
BMI*	Normal	64.2	1.00	—-
	OW	59.5	0.81 (0.57 – 1.16)	—-
	OB	70.8	1.34 (0.93 – 1.94)	—-
Sit at work§		—-	—-	0.95 (0.82 – 1.09)
Standing at work§		—-	—-	1.06 (0.85 – 1.32)
Walk at work§		—-	—-	0.82 (0.65 – 1.03)
Lift heavy load§		—-	—-	**1.45 (1.27 – 1.66)**

§= numerical variable (score ranging from 0 to 5); *= chi-square test with *p*-value < 0.05%; OR $_{Crude}$= odds ratio without adjust; OR $_{Adjusted}$= odds ratio adjusted by all independent variables with chi-square *p*-value < 0.05%; 95%CI= 95% confidence interval; BMI= body mass index; OW= overweight; OB= obesity; EC= economic condition; ICD M00-M99= diseases of the musculoskeletal system and connective tissue.

Codogno JS, Turi BC, Fernandes RA, Bonfim MR, Pastre CM,
Monteiro HL. Musculoskeletal disorders and expenditures.

Medicina (Ribeirão Preto) 2015;48(2):143-50
http://revista.fmrp.usp.br

loads at work presented an increased occurrence of musculoskeletal symptoms too (OR= 1.45 [$OR_{95\%CI}$: 1.27 – 1.66]).

Musculoskeletal symptoms in shoulders, low back, knees and ankles/feet were positively related to increased expenditures related to prescription drugs discharged and medical consultation (**Table 3**).

Discussion

This cross-sectional study was developed with patients of the Brazilian public healthcare system and found elevated occurrences of musculoskeletal symptoms, which seems significant related to higher healthcare expenditures.

There was a high occurrence of musculoskeletal symptoms among the analyzed patients (65%). A large research in US showed that low back pain (24.3%) and neck pain (10.5%) are the highest prevalent musculoskeletal symptoms among agricultural workers[19]. In Taiwan, a nationwide study found that 37% of the workers had musculoskeletal disorders[20]. An explanation for the highest prevalence of musculoskeletal symptoms found in our study may be fact of the target population been located within Basic Healthcare Units, which nevertheless should be considered a relevant concern by public health administers, because worldwide this outcome is related to absenteeism / lower productivity, increased healthcare costs and a lower quality of life generated by pain.[21-24]

It was found a positive relationship between musculoskeletal symptoms and higher healthcare expenditures. In fact, low back pain is an outcome widely observed among adult population[1,2,3] and its relationship with increased prescription drugs discharged it is not a surprise, because adults with low back pain have the medication use as a tool to decrease pain and to possibility the maintenance of daily activities, such as occupational activities. On the other hand, surprisingly, our findings identified that musculoskeletal symptoms in lower limb articulations were positively related to prescription drugs discharged and medical consultations. Apparently, this finding could be supported by the negative effect of these symptoms over human gait, which is a fundamental human action related to most human behaviors.

In this sample, lifting heavy loads at work was related to the presence of the outcome. Musculoskeletal symptoms have a high burden among the disorders classified as "occupational diseases"[25] and its presence has a relevant range according to different types of occupational activity.[27,28,29] It is noteworthy to identify that a lower economic condition was associated with musculoskeletal symptoms, but only in crude analysis. In fact, occupational activities of higher physical effort are observed more frequently in groups of lower economic condition and, therefore, the association observed in crude analysis could be explained, at least in part, by this relationship between physical effort at work and economic condition. Agreeing with such idea, a recent study found association between stress level and several musculoskeletal outcomes, with higher ratio of musculoskeletal disorders among workers with high demand job.[30]

In our study, musculoskeletal symptoms were more frequent among women and this finding is similar to previous data.[6] A large variety of hypothesis could be postulated to explain this result. Firstly, in modern society, women have double the activities (job

Table 3. Relationship between musculoskeletal symptoms in different anatomical regions and healthcare expenditures among adults.

Healthcare Expenditures	Neck Rho	Shoulders rho	Upper back rho	Elbows rho	Wrists/ hands rho	Low back rho	Hips/ Thighs rho	Knees rho	Ankles/ Feet rho
Consultations	0.010	0.025	0.028	-0.008	-0.001	0.039	0.050	0.020	0.072*
Medication	0.013	0.077*	0.033	0.054	0.004	0.067*	0.037	0.094*	0.126*
Overall	0.007	0.045	0.022	0.005	0.003	0.040	0.040	0.035	0.089*

rho= Spearman hank order correlation; *= p-value < 0.05.

Medicina (Ribeirão Preto) 2015;48(2):143-50
http://revista.fmrp.usp.br

Codogno JS, Turi BC, Fernandes RA, Bonfim MR, Pastre CM,
Monteiro HL. Musculoskeletal disorders and expenditures.

and housework activities) and this condition could expose the female gender to physical overloads[1]. Moreover, the above mentioned double activities could act synergistically with gender differences related to females (e.g. lower muscle mass and higher body fatness)[1,31] and, therefore, could explain our findings.

The association between musculoskeletal symptoms with physical therapy consultation and diagnosis of diseases of the musculoskeletal system and connective tissue gave expected results. On the other hand, although there was a high occurrence of musculoskeletal symptoms, only a few patients had physical therapy consultations. Low rates of physical therapy consultations constitute a pattern previously observed in the Brazilian population[9], but it is noteworthy that high medication use constitutes another one[21]. Apparently, in the Brazilian public healthcare system, the use of medication has been a tool widely adopted to treat musculoskeletal symptoms, instead of non-pharmacological actions.[23] The concerns described above indicate that the promotion of non-pharmacological actions related to lower medication use and musculoskeletal symptoms (such as physical activity practice) are necessary among these patients.

Limitations should be recognized. In fact, the cross-sectional design constitutes the main limitation due to non-possibility of causality statements. Therefore, prospective studies analyzing this issue in patients of the public healthcare system are necessary.

In summary, our findings identified an elevated occurrence of musculoskeletal symptoms among the patients of the Brazilian public healthcare system, which affects negatively healthcare expenditures. In addition, our results identified that women and people with an occupational activity with higher physical effort are groups at an increased risk of presenting musculoskeletal symptoms.

References

1. Ferreira GD, Silva MC, Rombaldi AJ, Wrege ED, Siqueira FV, Hallal PC. Prevalence and associated factors of back pain in adults from southern Brazil: a population-based study. *Rev Bras Fisioter.* 2011; 15:31-6.

2. Almeida IC, Sá KN, Silva M, Baptista A, Matos MA, Lessa I. Chronic low back pain prevalence in the population of the city of Salvador. *Rev Bras Ortop.* 2008; 43:96-102.

3. Meziat Filho N, Silva GA. Disability pension from back pain among social security beneficiaries, Brazil. Rev Saude Publica. 2011;45:494-502.

4. Kilsztajn S, Rossbach A, Câmara MB, Carmo MS. Serviços de saúde, gastos e envelhecimento da população brasileira. Rev bras estud popul. 2003;20:93-108.

5. Picoloto D and Silveira ED. Prevalence of musculoskeletal symptoms and associated factors among metal industry workers in Canoas - RS. *Ciênc Saúde Coletiva.* 2008; 13:507-16.

6. Pinheiro FA, Tróccoli, BT and Paz MG. Psychosocial predictors of musculoskeletal symptoms: the relevance of mediated and moderated relationships. *Psicol Reflex Crit.* 2006; 19:142-150.

7. Bastos GA, Duca GF, Hallal PC, Santos IS. Utilization of medical services in the public health system in the Southern Brazil. *Rev Saúde Pública.* 2011; 45:475-54.

8. Kilsztajn S, Silva DF, Camara MB, Ferreira VS. Level of private health insurance coverage and regional distribution of public health expenditure. *Saude Soc.* 2001; 10:35-41.

9. Siqueira FV, Facchini LA and Hallal PC. Epidemiology of physiotherapy utilization among adults and elderly. *Rev Saúde Pública.* 2005; 39:663-8.

10. Sistema Único de Saúde. [http://sigtap.datasus.gov.br/tabela-unificada/app/sec/consultarServicoClassificacao.jsp].

11. Associação Brasileira de Empresas de Pesquisa. Critério de classificação econômica Brasil. [http://www.abep.org/novo/Content.aspx?ContentID=302].

12. Kuorinka I, Jonsson B, Kilbom A, et al. Standardized Nordic questionnaires for the analysis of musculoskeletal symptoms. *Appl Ergon.* 1987; 18:233-7.

13. Pinheiro FA, Troccoli BT and Carvalho CV. Validity of the Nordic Musculoskeletal Questionnaire as morbidity measurement tool. *Rev Saúde Pública.* 2002; 36:307-12.

14. Barros EN and Alexandre NM. Cross-cultural adaptation of the Nordic musculoskeletal questionnaire. *Int Nurs Rev.* 2003; 50:101-8.

15. Baecke JA, Burema J and Frijters JE. A short questionnaire for the measurement of habitual physical activity in epidemiological studies. *Am J Clin Nutr.* 1982; 36:936-42.

16. Lohman TG. Anthropometric Standardization Reference Manual. Champaign: Human Kinetics Books, 1988.

17. World Health Organization. Obesity, Preventing and Managing the Global Epidemic: Report of the WHO Consultation on Obesity. World Health Organization [http://www.who.int/nutrition/publications/ obesity_executive_summary.pdf].

18 Codogno JS, Fernandes RA, Sarti FM, Freitas Junior IF, Monteiro HL. The burden of physical activity on type 2 diabetes public healthcare expenditures among adults: a retrospective study. BMC Public Health. 2011; 11:275.

19. Lee S-JJ, Tak S, Alterman T, Calvert GM. Prevalence of Musculoskeletal Symptoms Among Agricultural Workers in the United States: An Analysis of the National Health Interview Survey, 2004-2008. *J Agromedicine.* 2014; 19:268–80.

20. Guo HR, Chang YC, Yeh WY, Chen CW, Guo YL. Prevalence of musculoskeletal disorder among workers in Taiwan: a nationwide study. *J Occup Health.* 2004;46:26-36.

21. Brooks PM. The burden of musculoskeletal disease – a global perspective. *Clin Rheumatol.* 2006; 25:778-781

22. Woolf AD and Pfleger B. Burden of major musculoskeletal conditions. *Bull World Health Organ.* 2003; 81:646-56.

23 Mata MS, Costa FA, Souza TO, Mata AN, Pontes JF. Pain and functionality in primary health care. Ciênc Saúde Coletiva. 2011; 16:221-30

24. Cimmino MA, Ferrone C and Cutolo M. Epidemiology of chronic musculoskeletal pain. *Baillieres best pract. res., Clin. rheumatol.* 2011; 25:173-83.

25 Reis RJ, Pinheiro TM, Navarro A, Martin MM. Profile of occupational disease outpatients and the presence of repetitive strain injury. Rev Saúde Pública. 2000; 34:292-8.

26. Gurgueira GP, Alexandre NM and Corrêa Filho HR. Self-reported musculoskeletal symptoms among nursing personnel. *Rev Latinoam Enferm.* 2003; 11:608-13.

27. Branco JC, Guido-e-Silva F and Giusti PH. Prevalence of musculoskeletal symptoms in the faculty of public schools and the private school. *Fisioter Mov.* 2011; 24:307-14.

28. Carvalho AJ and Alexandre NM. Musculoskeletal symptoms in elementary school teachers. *Rev Bras Fisioter.* 2006; 10:35-41.

29. Brandão AG, Horta BL and Tomasi E. Signs of musculoskeletal disorders in bank workers from the city of Pelotas and region: prevalence and associated factors. *Rev Bras Epidemiol.* 2005; 8:295-305.

30. Gerr F, Fethke NB, Anton D, Merlino L, Rosecrance J, Marcus M, Jones MP. A prospective study of musculoskeletal outcomes among manufacturing workers: II. Effects of psychosocial stress and work organization factors. *Hum Factors.* 2014;56:178-90.

31. Maciel ACC, Fernandes MB and Medeiros LS. Prevalence and factors associated with pain symptoms in professionals of the textile industry. *Rev Bras Epidemiol.* 2006; 9:94-102.