ORIGINALES

Factors associated with symptoms of musculoskeletal disorders in public school teachers in Cuiabá-MT, Brazil

Fatores associados à sintomas de distúrbios osteomusculares em professores da rede pública municipal de Cuiabá-MT

Factores asociados a síntomas de trastornos musculoesqueléticos en profesores de la red pública municipal de Cuiabá-MT, Brasil

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ABSTRACT:
Introduction: Work-related musculoskeletal disorders are injuries resulting from the excessive use of the musculoskeletal system. This study analyzed musculoskeletal symptoms and associated factors in primary school teachers in the municipal public network in Cuiabá, Mato Grosso.
Methods: A cross-sectional study was conducted with 326 teachers. Data collection instruments included the Vocal Production Condition, Self-Reporting Questionnaire, and Nordic Musculoskeletal Questionnaire. The dependent variable was the presence or absence of musculoskeletal symptoms. Bivariate analysis using chi-square test and prevalence ratios with 95% confidence intervals, as well as multiple analysis using Poisson regression model, were performed.
Results: In the multiple analysis, it was found that the presence of musculoskeletal symptoms was significantly associated (p<0.05) with the following risk factors: common mental disorders (PRa=1.45), regularly lifting weights (PRa=1.26), and performing intense physical effort (PRa=1.22). Additionally, a significant association was identified between these symptoms and contracted teachers (PRa=0.82), as well as an interaction between performing intense physical effort and regularly lifting weights (PRa=0.75), which acted as protective factors for symptom presence.
Conclusion: It is concluded that work characteristics were important risk factors for the development of musculoskeletal symptoms in the last twelve months. The results of this study are believed to provide a basis for decision-making by managers and stakeholders in implementing preventive measures in the work environment of these teachers.

Keywords: Occupational health; Musculoskeletal symptoms; Teachers.

RESUMO:
Introdução: Os distúrbios osteomusculares relacionados ao trabalho são lesões relacionadas a danos do uso excessivo do sistema musculoesquelético. O objetivo foi analisar os sintomas osteomusculares e os fatores associados em professores do ensino fundamental da rede pública municipal na cidade de Cuiabá, Mato Grosso.
Metodologia: Estudo transversal, a amostra foi de 326 professores. Para coleta de dados foram utilizados os instrumentos: Condição de Produção Vocal, *Self-Reporting Questionnaire* e o *Nordic Musculoskeletal Questionnaire.* A variável dependente foi à presença ou não de sintomas osteomusculares. Foi realizada uma análise bivariada, utilizando teste qui-quadrado e razões de prevalências com intervalos de confianças 95% e uma análise múltipla com o modelo de regressão de Poisson.
Resultados: Na análise múltipla, foi evidenciado que a presença de sintomas osteomusculares, foi significativamente associada (p<0,05) com os seguintes fatores de risco: possuir transtornos mentais comuns (RPa=1,45), carregar peso com frequência (RPa=1,26) e realizar esforço físico intenso (RP$_a$= 1,22). Além disso, foi identificada associação significativa, entre estes sintomas e professores contratados (RPa= 0,82), assim como para a interação realizar esforço físico intenso e carregar peso com frequência (RPa=0,75), sendo estes, fatores de proteção para a presença de sintomas.
Conclusão: Conclui-se que as características de trabalho demostraram ser importantes fatores de risco para o acometimento dos sintomas osteomusculares nos últimos doze meses. E acredita-se que, os resultados deste estudo podem subsidiar gestores e responsáveis para ações preventivas no ambiente laboral destes professores.

Palavras- chaves: Saúde Ocupacional; Sintomas osteomusculares; professores.

RESUMEN:
Introducción: Los trastornos musculoesqueléticos relacionados con el trabajo son lesiones relacionadas con daños por uso excesivo del sistema musculoesquelético. El objetivo fue analizar los síntomas musculo esqueléticos y los factores asociados en profesores de enseñanza básica de escuelas públicas municipales de la ciudad de Cuiabá, Mato Grosso, Brasil.
Métodos: Estudio transversal, la muestra era de 326 docentes. Para la recolección de datos se utilizaron los instrumentos: Condición de Producción Vocal, *Self-Reporting Questionnaire* y el Cuestionario Nórdico Musculoesquelético. Se realizó un análisis bivariado, mediante la prueba de chi-cuadrado y razones de prevalencia con intervalos de confianzas de 95% y un análisis múltiple con el modelo de regresión de Poisson.
Resultados: En el análisis múltiple se demostró que la presencia de síntomas musculo esqueléticos se asoció significativamente (p<0,05) con los siguientes factores de riesgo: tener trastornos mentales comunes (RPa=1,45), cargar peso con frecuencia (RPa=1,26) y realizar un esfuerzo físico intenso (RPa= 1,22). Además, se identificó asociación significativa entre estos síntomas y los docentes contratados (RPa= 0,82), así como para la interacción realizar esfuerzo físico intenso y cargar peso con frecuente (RPa=0,75), siendo estos factores protectores para la presencia de síntomas.
Conclusión: Se concluyó que las características del trabajo demostraron ser importantes factores de riesgo para el desarrollo de síntomas musculoesqueléticos en los últimos doce meses. Y se cree que los resultados de este estudio pueden subsidiar a los gestores y responsables de acciones preventivas en el ambiente de trabajo de estos docentes.

Palabras clave: Salud Ocupacional; Síntomas musculoesqueléticos; Docentes.

INTRODUCTION

Work is an integral part of social dynamics, contributing to individual participation and societal development, enabling individuals to become socially productive through their professions. Through work, individuals establish crucial relationships and connections necessary for survival [1]. Teaching, as a profession, involves the imparting of knowledge and the systematic organization of knowledge through specialized and rigorous training. It requires a complex task that encompasses technical and didactic expertise to fulfill professional responsibilities [2].

However, certain work-related conditions, such as excessive workload, are significant factors exposing these professionals to occupational risks [3]. These exposure conditions are associated with changes in the education landscape, including increased access to education and, consequently, a rise in the number of classes and students. In this context, the working conditions to which teachers are exposed can contribute to their illness due to organizational demands, excessive working hours, low remuneration, among other factors, thereby compromising their health and triggering diseases [4]. Additionally, they may experience psychological issues such as Common Mental Disorders (CMD), characterized by a set of non-psychotic symptoms including insomnia, fatigue, irritability, forgetfulness, difficulty concentrating, and somatic complaints, which can indicate mental distress [5]. All of these conditions can reduce productivity and even lead to mortality [4,5].

Thus, the work demands and environmental conditions in which teachers operate can lead to the development of various health complications, including repetitive strain injuries (RSI) and work-related musculoskeletal disorders (WMSD). These injuries are direct consequences of excessive use and insufficient recovery of the musculoskeletal system over a short period. RSI/WMSD are characterized by the occurrence of symptoms such as pain, fatigue, and tiredness, which often emerge in advanced stages of the condition and primarily affect the upper limbs [6,7].

In recent years, the prevalence of musculoskeletal disorders has been on the rise, posing a significant public health problem in many countries. These disorders constitute the most common group of occupational diseases among workers and are responsible for functional impairment. In Brazil, they are the leading cause of work absenteeism [8,9].

The presence of musculoskeletal symptoms in teachers is a matter of great concern, as they can cause significant problems that affect their quality of life. These symptoms can result from conditions affecting the spine, soft tissues, joints, ligaments, and tendons [10]. Musculoskeletal disorders are recognized as one of the most common and costly occupational problems, both in developing and developed countries. In many cases, the group of school teachers belongs to the occupational category with a high prevalence of these disorders [11].

According to data from Saúde Brasil 2018, an analysis from 2007 to 2016 showed a 184% increase in workers affected by musculoskeletal disorders such as RSI and WMSD. These are the conditions that most affect Brazilian workers, especially women aged 40 to 45. Furthermore, in 2019, approximately 39,000 workers had to take time off from their activities due to these diseases [12]. In the state of Mato Grosso, specifically in Cuiabá, public school teachers have been identified as experiencing a significant impairment in their quality of life due to the presence of musculoskeletal symptoms [13].

Given that musculoskeletal disorders constitute a significant public health issue and one of the most serious ones specifically related to teaching occupations, with considerable social, economic, and health impact, it is crucial to identify the main risk factors associated with musculoskeletal symptoms among these workers. Such recognition enables an approach focused on more efficient health prevention strategies for these professionals. Therefore, the aim of this study was to analyze

musculoskeletal symptoms and associated factors in primary school teachers in the municipal public network in Cuiabá, Mato Grosso.

METHODOLOGY

The present study constitutes a cross-sectional, analytical investigation conducted as part of a comprehensive research project conducted in 2017 with elementary school teachers from the regular public school system in the city of Cuiabá, the capital of Mato Grosso state. The study utilized data from the population registered in the 2017 School Census, which indicated 75 elementary schools and 1,317 teachers working in that year [14]. The sample included teachers actively engaged in their professional duties at the time of data collection, while those on leave, on leave of absence, or in a different role were excluded. A probabilistic sampling approach was employed for this research, considering simple random, systematic, and stratified sampling methods proportional to the size of the strata.

The sample size was estimated taking into account a population of 1,317 teachers, with a 95% confidence level ($z_{\alpha/2}$ = 1.96), an assumed proportion of 50% for an unknown prevalence, and a sampling error of 5%. Therefore, for this project, a minimum sample size of 298 was obtained, with an additional 35% allowance for potential losses, resulting in a total of approximately 403 teachers. In this regard, a similar study conducted among basic education teachers in the municipality of Florianópolis (SC) was also considered, wherein the refusal rate was approximately 40% of participants who did not return the completed questionnaires [15].

Since there were four administrative regions (North, South, East, West) [16] with different population sizes, they were considered as strata [17], consisting of the North, South, East, and West regions. Thus, the sample size for each stratum was determined as 80, 133, 110, and 80 participants, respectively. Subsequently, a random draw was conducted in the participating schools using simple random sampling, starting with the selection of the first school and subsequently selecting the remaining schools systematically.

After obtaining approval from the Research Ethics Committee, a pilot test was conducted in a school that would not be included in the final selection. This allowed for testing the compiled questionnaire and the operational procedures of the study. Following the pilot test, a random selection of schools was conducted, and arrangements were made through prior scheduling and contact with the school administration/coordinators. Once the appointments were confirmed, data collection took place between September and December 2017. Participating teachers signed an informed consent form, and a self-administered questionnaire was provided to them.

In the present study, three instruments were considered: the Teacher's Vocal Production Condition (VPC), which is a validated tool for use in epidemiological studies [18], the Self-Reporting Questionnaire (SRQ-20), which has been translated and validated in Brazil for use in primary healthcare settings [19], and the Nordic Musculoskeletal Questionnaire (NMQ), which has been translated and culturally adapted by Barros and Alexandre (2003) [20].

In the present study, the NMQ was considered as the main instrument. The NMQ was developed with the primary purpose of standardizing the measurement of self-reported responses regarding musculoskeletal symptoms, aiming to facilitate the comparison of results among studies. The NMQ consists of a human figure divided into nine anatomical regions, and participants are asked to report the occurrence of musculoskeletal symptoms considering the past twelve months and the preceding seven days before the interview, as well as any consultations with healthcare professionals in the past 12 months and any absences from routine activities in the last year [20, 21]. The questionnaire includes specific questions addressing pain, tingling/numbness, or musculoskeletal discomfort in nine body regions: neck, shoulders, upper back, elbows, wrists/hands, lower back, hips/thighs, knees, and ankles/feet [22].

The dependent variable or outcome in this study was the presence or absence of musculoskeletal symptoms reported in the last 12 months, regardless of the affected body region, assessed using the NMQ. This categorical variable in the instrument considers two responses (yes/no). Scores for this variable are calculated based on the total number of positive responses, ranging from 0 to 9. Scores greater than or equal to 1 (yes) indicate the presence of symptoms such as pain or tingling/numbness, while a score of zero represents the absence of symptoms (no). Essentially, higher scores indicate a worse symptom situation, while lower scores indicate a better symptom situation [21].

The independent variables analyzed in this study included sociodemographic factors, functional status, work organization, and health condition as assessed by the CPV. To assess the occurrence of CMD, the SRQ-20 instrument was used, which consists of twenty yes/no questions coded with numeric values of 1 and 0, respectively. The cutoff point used was 7/8, regardless of gender, where a sum of 8 or more "yes" responses indicated the presence of CMD symptoms in the last month, while a sum below 8 indicated the absence of CMD symptoms [23].

The data from the main study were processed using Epi Info 6.04, and the statistical analyses of the present study were performed using the Statistical Package for the Social Sciences (SPSS) software version 17.0. Initially, descriptive analysis was conducted, considering absolute and relative frequencies. Bivariate and multiple analyses were conducted to examine the association between the dependent variable and the independent variables.

In the bivariate analysis, the chi-square test and crude prevalence ratios with their respective 95% confidence intervals were used. Subsequently, a multiple analysis was conducted using the multiple Poisson regression model with robust variance. In this model, independent variables with a p-value less than 0.20 ($p < 0.20$) in the bivariate analysis were included using the stepwise backward method, and in the final model, only variables with p-values less than 0.05 in the multiple analysis were retained. All inferences considered significance levels below 5% and 95% confidence intervals. The study was approved by the Research Ethics Committee of the Júlio Muller University Hospital (CEP-HUJM) (CAAE: 59503916.7.0000.5541).

RESULTS

In this study, out of the 403 participants, 332 teachers completed the questionnaires, and out of those, 326 (80.9%) instruments were adequately filled out and included in the analysis. Sociodemographic data indicated that the majority of teachers were female (87.12%), with a mean age of 43.01 years, married or in a union (62.70%), and had a postgraduate education level (73.93%). Please note that these three variables were not presented in a table.

The bivariate analysis revealed a significant association between the dependent variable and employment status, specifically in the category of contracted teachers (PR_b=0.84; p=0.005), indicating a protective factor for the presence of musculoskeletal symptoms compared to permanent teachers.

The presence of musculoskeletal symptoms in teachers also showed a statistically significant association with variables related to work organization: stressful work pace, sufficient work materials, repetitive tasks, performing intense physical effort, frequent lifting of heavy objects, and work-related stress, as shown in Table 1.

There was also a significant association between the outcome and the variable of common mental disorders in terms of health conditions, where teachers with a suggestive score for the presence of common mental disorders showed a higher risk (RP_b=1.41; p<0.001) for the presence of musculoskeletal symptoms in the last twelve months, as shown in Table 1.

Table 1: Bivariate analysis between sociodemographic variables, functional situation, work organization, and health condition with or without symptoms of musculoskeletal disorders in the last 12 months, regardless of the body region affected, in elementary school teachers. Cuiabá, Mato Grosso, 2017.

Variables	Symptoms of musculoskeletal disorders in the last 12 months				
	Yes	No	PR_b	95% CI	*p*
Sociodemographic					
Sex					
Female	221	58	1.17	0.94 - 1.47	0.096
Male	27	13	1.00	-	-
Functional situation					
Hours of teaching					
> 40 hours	28	10	1.00	0.80 - 1.23	0.964
21 to 40 hours	117	26	1.10	0.97 - 1.26	0.120
≤20 hours	97	34	1.00	-	-
Employment relationship					
Contracted	124	49	0.84	0.75 - 0.95	0.005*
Permanent	124	22	1.00	-	-
Work organization					
Stressful work pace					
Yes	213	46	1.42	1.13 - 1.79	<0.001*
No	33	24	1.00	-	-
Sufficient material to work with					
No	54	8	1.17	1.04 - 1.32	0.034*
Yes	177	61	1.00	-	-
Repetitive work					
Yes	135	26	1.16	1.03 - 1.30	0.015*

No	108	41	1.00	-	-
Time to carry out activities at school					
No	33	4	1.16	0.98 - 1.32	0.085
Yes	211	64	1.00	-	-
Brings work home					
Yes	223	58	1.21	0.94 - 1.54	0.067
No	23	12	1.00	-	-
Performs intense physical effort					
Yes	96	15	1.19	1.06 - 1.33	0.005*
No	147	55	1.00	-	-
Regularly lifting weights					
Yes	98	19	1.13	1.01 - 1.27	0.042*
No	147	52	1.00	-	-
Work-related stress					
Yes	220	55	1.30	1.01 - 1.70	0.015*
No	21	13	1.00	-	-
Health conditions					
Common Mental Disorders					
Present	92	two	1.41	1.29 – 1.55	<0.001*
Absent	156	69	1.00	-	-

PR_b: Crude prevalence ratio. 95% CI: 95% confidence interval. p: p-value considering the Chi-Square distribution. *: Significant at the 5% level.

It is noteworthy that there was no statistically significant association between the presence of musculoskeletal symptoms and the independent variables, namely gender, hours spent with students, time to perform activities at school, and bringing work home. However, in the bivariate analysis, these variables showed a p-value less than 0.20. Therefore, all variables from Table 1 were tested in the multiple regression model.

Table 2 presents the factors that demonstrated a significant association with the outcome after adjustment in the multiple regression model using Poisson regression with robust variance. The presence of musculoskeletal symptoms reported in the last 12 months was a protective factor when teachers had a "contracted" employment relationship (adjusted prevalence ratio [PR_a] = 0.82; p = 0.003) and in the interaction between performing intense physical effort at work and regularly lifting weights (PR_a = 0.75; p = 0.031). It was a risk factor when teachers had mental disorders (PR_a = 1.45; p < 0.001), regularly lifted weights (PR_a = 1.26; p = 0.017) and engaged in intense physical effort at work (PR_a = 1.22; p = 0.045).

Table 2: Factors associated with symptoms of musculoskeletal disorders, reported in the last 12 months, regardless of the body region affected, in elementary school teachers. Cuiabá, Mato Grosso, 2017.

Variables	PR_a	95% CI	p
Functional situation			
Employment relationship			
Contracted	0.82	(0.72; 0.93)	0.003*
Permanent	1.00	-	-
Work organization			
Performs intense physical effort			
Yes	1.22	(1.01; 1.47)	0.045*
No	1.00	-	-
Regularly lifting weights			
Yes	1.26	(1.04; 1.51)	0.017*
No	1.00	-	-
Interaction between performing intense physical effort and regularly lifting weights			
Yes	0.75	(0.57; 0.97)	0.031*

No	1.00	-	-
Health conditions			
Common Mental Disorders			
Present	1.45	(1.30; 1.63)	<0.001*
Absent	1.00	-	-

PRₐ: Prevalence ratio adjusted by Poisson multiple regression model with a robust variance; 95% CI: 95% confidence interval; p: p-value; *: significant at the 0.05 level.

DISCUSSION

The analyses revealed statistically significant associations between the presence of musculoskeletal symptoms in the last twelve months and variables related to functional situation, work organization, and health conditions. Regarding the employment relationship variable, contracted teachers showed an association with the occurrence of musculoskeletal symptoms. In the multiple analysis, this category remained strongly associated (p=0.003) with the presence of symptoms, indicating a protective factor compared to permanent teachers. This association can be relevant when considering that permanent or tenured teachers often have a higher workload due to exclusive dedication. These findings are consistent with the study by Cesar-Vaz et al. [24], which stated that longer activity and teaching hours are associated with the development of musculoskeletal symptoms.

In this study, it was observed that a stressful work pace was a factor of higher prevalence (82.24%), reported by teachers with musculoskeletal symptoms. Similarly, the study by Rocha et al. [25] also found a high prevalence (41.6%) of work-related stress, which is one of the aspects contributing to musculoskeletal alterations.

The lack of sufficient work materials showed a statistically significant association in the bivariate analysis and may contribute to the onset of musculoskeletal disorders. This lack of materials can encompass inadequate and non-ergonomic furniture and a scarcity of basic teaching materials, which teachers often experience on a daily basis, especially in public schools [26]. This situation can be detrimental and concerning both financially and to their health, as teachers often have to purchase basic items for teaching, whereas these materials should be provided by educational institutions and responsible authorities [27]. These problems, as noted by Barros and Gradela (28), can characterize a worrisome situation faced by teachers and represent issues of demotivation or health problems, which can contribute to the development of occupational diseases.

Regarding repetitive work, a significant association with the presence of musculoskeletal symptoms was observed in the bivariate analysis. It is noteworthy that this characteristic of work is one of the main causes of musculoskeletal disorders. Similar results were demonstrated in another study, which found a significant association between this factor and musculoskeletal injuries. Repetitive movements performed by teachers over time can be a key contributing factor to the development of musculoskeletal disorders, as they impose substantial physical demands on the body [29].

The occurrence of symptoms was found among teachers who engaged in intense physical effort in their work. In the multiple analysis, after regression, this variable remained associated with musculoskeletal symptoms (p=0.045), highlighting its

significant role as a risk factor in line with findings from existing literature. According to Cardoso [30], physical effort encompasses both intellectual and emotional exertion and refers to the energy expended to complete a specific amount of work within a given timeframe and intensity. Furthermore, the author suggests that intensified work can involve increased participation and/or physical movement, which can consequently lead to musculoskeletal wear and tear. Other studies, such as those by Mango et al. [4] and Ribeiro et al. [26], also affirm that intense physical effort undertaken by teachers is considered a relevant factor in the presence of musculoskeletal symptoms.

According to the analysis, teachers who lifted heavy loads regularly in the past twelve months also reported musculoskeletal symptoms, and this association remained significant in the multiple regression model (p=0.017). Therefore, it is evident that high workloads contribute to increased strain on the musculoskeletal system and further support the emergence of symptoms, within a network of factors that contribute to complications [31]. Similarly, findings from the study conducted by Jegnie and Afework [32] demonstrated a significant association between low back pain and work-related lifting in other professional fields, and this factor remained associated when considering the overall health of workers and specifically among teachers.

In the adjusted multiple analysis, an association was also observed between engaging in intense physical effort and frequently lifting heavy loads at work, as well as the interaction between these variables, which was statistically significant (p=0.031) and acted as a protective factor (RP$_a$=0.75) for the presence of musculoskeletal symptoms among these teachers. While no studies have addressed this specific interaction, it could be attributed to the potential assistance of physical effort under favorable conditions in lifting heavy loads. Additionally, exploring other variables not considered in this study could shed light on this interaction. Therefore, further research is warranted to gain a deeper understanding and explanation of this association.

Another characteristic that showed a significant association with musculoskeletal symptoms was the presence of work-related stress. Numerous studies have identified that high prevalence of stress can lead to mental exhaustion and subsequently impair the physical well-being of workers. It is evident that the existence of work-related stress is a relevant factor in determining mental health. Similar implications have been identified in various countries, demonstrating significant results for work-related stress, which plays a crucial role in the etiology of musculoskeletal symptoms, particularly among early childhood educators. These findings highlight that both physical and psychological stress at work among teachers are significantly associated with musculoskeletal disorders and depressive disorders [25,33].

Regarding the health conditions, teachers with symptoms suggestive of common mental disorders also experienced musculoskeletal symptoms, which remained statistically significant in the final regression model (p<0.001). Mental health plays a crucial role in the well-being of teachers, as these disorders can lead to work absences due to limitations imposed by musculoskeletal issues. Moreover, stressful conditions contribute to absenteeism and can potentially worsen mental health. Corbière et al. [34] found that symptoms reported by workers on leave due to depression closely resemble those of stress.

Based on the presented analyses, it is evident that health and work are inseparable. Therefore, it is necessary to provide workers with appropriate working conditions and a

conducive work environment to promote better health outcomes for these professionals and prevent high prevalences of musculoskeletal symptoms among teachers.

The results of this study should be interpreted considering certain limitations, including potential biases related to simultaneous measurements using self-administered questionnaires and uncontrolled factors. There may also be a selection bias in occupational studies, as individuals actively working in the profession tend to be healthier compared to those on leave during the research period. Furthermore, it should be noted that the NMQ questionnaire used as the main instrument for the outcome variable does not allow for the identification of the possible causes of symptoms. It is necessary to combine it with other instruments to obtain additional data and variables to investigate this association further.

However, it should be emphasized that the results of this study were representative of the teacher population in the city of Cuiabá, as a random sample was used. Additionally, these findings can be important in informing improvements in public policies and occupational health interventions aimed at ensuring appropriate working conditions for teaching professionals. Since these factors are modifiable, having knowledge about them can help prevent the occurrence of symptoms and the development of musculoskeletal disorders.

Finally, further research on this topic is recommended to stimulate and deepen discussions on musculoskeletal symptoms among teachers, aiming to corroborate or challenge the results of this study. It is worth noting that there is a scarcity of studies focusing on this professional group. Additional research will contribute to a better understanding of the topic and provide a broader knowledge base for addressing musculoskeletal symptoms in teachers.

CONCLUSION

In the present study, a high prevalence of musculoskeletal symptoms in the last twelve months was observed among teachers in the public school system, regardless of the affected body region. The variables of work-related stress, insufficient materials to work with, repetitive work, intense physical effort, frequent lifting of heavy loads, and suggestive symptoms of common mental disorders were statistically associated with the outcome. However, the "contracted" employment relationship acted as a protective factor, with statistical significance.

When considering the variables together in the adjusted multiple analysis, it was evident that the following factors remained in the final model as risk factors for musculoskeletal symptoms: intense physical effort, regular lifting weights, and common mental disorders. These factors were statistically significant and associated with the presence of musculoskeletal symptoms. The employment status variable also remained in the final model, as did the interaction between intense physical effort and regular lifting weights. However, these factors acted as protective factors against the presence of musculoskeletal symptoms. This novel finding suggests the need for further research to better understand the interaction of musculoskeletal symptoms among teachers.

In conclusion, the analyzed work characteristics were shown to be important risk factors for the occurrence of musculoskeletal symptoms in the last twelve months, regardless of the affected body region. Therefore, the results of this study can provide support to managers and stakeholders in implementing preventive actions in the workplace, aiming to improve the overall health conditions of teachers.

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