

Ergonomic risks and musculoskeletal symptoms of teachers at a Federal Education Institution*

Riscos ergonômicos e sintomas osteomusculares em docentes de uma instituição federal de educação

Riesgos ergonómicos y síntomas musculoesqueléticos en docentes de una institución educativa federal

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ABSTRACT | Mental and musculoskeletal disorders are the main forms of illness among teachers. This study aimed to evaluate musculoskeletal symptoms and ergonomic risk factors in classrooms and staff rooms across the campuses of the Instituto Federal Catarinense (IFC). A total of 112 teachers answered an online questionnaire about sociodemographic information, tasks, work environment, and musculoskeletal pain. Data were analyzed using separate binary logistic regression models for each outcome. The prevalence of pain was 93.7%, and the most frequent regions were the neck, low back, and right shoulder. The main workplace ergonomic risk factors were stress, sharp edges, and a poorly adjusted desk, monitor, and chair backrest. An association was observed between low back pain, stress, the use of a data projector, overweight/obesity, inadequate monitor height, and a non-adjustable chair. There was an association between neck pain, stress, lack of physical activity, and an inadequate monitor and backrest. A relationship was found between right shoulder pain, stress, blackboard use, and standing posture during teaching. Conclusions: the results support adapting the work environment for teachers to prevent pain, improving both quality of life and teaching.

Keywords | Faculty; Ergonomics; Musculoskeletal Pain; Occupational Health.

RESUMO | Os transtornos mentais e musculoesqueléticos são as principais formas de adoecimento entre os docentes. O objetivo deste estudo é avaliar os sintomas osteomusculares e os riscos ergonômicos nas salas de aula e sala dos docentes nos campi do Instituto Federal

Catarinense (IFC). Para isso, 112 docentes responderam um questionário online sobre informações sociodemográficas, tarefas, ambiente de trabalho e dor musculoesquelética. Os dados foram analisados por meio de regressão logística binária, separadamente para cada desfecho. A prevalência de dor foi de 93,7% e as regiões mais frequentes foram pescoço, coluna lombar e ombro direito. Os principais riscos ergonômicos foram: estresse, quina viva, mesa de trabalho, monitor e encosto da cadeira inadequados. Observou-se associação entre dor na coluna e lombar, estresse, uso do *datashow*, sobrepeso/obesidade, altura inadequada do monitor e cadeira sem regulagem de altura. Houve associação entre dor no pescoço, estresse, não realização de atividade física, monitor e encosto da cadeira inadequados. Foi encontrada relação entre dor no ombro direito, estresse, uso da lousa e postura em pé em sala de aula. Os resultados propõem a adaptação do trabalho para os docentes a fim de prevenir a dor e melhorar a qualidade de vida e do ensino.

Descritores | Professor; Ergonomia; Dor Musculoesquelética; Saúde do Trabalhador.

RESUMEN | Los trastornos mentales y musculoesqueléticos son las principales causas de enfermedad entre los docentes. El objetivo de este estudio es evaluar los síntomas musculoesqueléticos y los riesgos ergonómicos en las aulas y en salas de los profesores en los campus del Instituto Federal de Santa Catarina (IFC). Para ello, 112 docentes respondieron un cuestionario en línea con preguntas sobre información sociodemográfica, tareas, entorno laboral y dolor musculoesquelético. Los datos se analizaron mediante regresión logística binaria, por

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separado para cada resultado. La prevalencia de dolor fue del 93,7%, y las regiones más frecuentes fueron cuello, columna lumbar y hombro derecho. Los principales riesgos ergonómicos fueron estrés, borde afilado, mesa de trabajo, monitor y respaldo de la silla inadecuados. Se observó una asociación entre dolor de espalda y lumbar, estrés, uso del *datashow*, sobrepeso/obesidad, altura inadecuada del monitor y de la silla sin ajuste de altura. Hubo una asociación entre el dolor de cuello, estrés, falta de

actividad física e inadecuados monitor y respaldo de la silla. Se encontró una relación entre el dolor en el hombro derecho, el estrés, el uso de la pizarra y la postura de pie en el aula. Los resultados proponen adaptar el trabajo para los docentes con el fin de prevenir el dolor y mejorar la calidad de vida y la enseñanza.

Palabras clave | Docente; Ergonomía; Dolor musculoesquelético; Salud Ocupacional.

INTRODUCTION

Technological innovations and current work division have led to the emergence of several health issues, imposing greater emotional and musculoskeletal overload on workers. These are considered the main causes of occupational diseases, which represent one of the major public health issues worldwide¹. Among teachers, this pattern is similar, as the main health issues are mental and behavioral disorders, voice disorders, musculoskeletal disorders (MSDs) and heart problems². In a study with 6,510 primary and secondary education teachers, the prevalence of sick leave due to MSDs was 14.7%³, which highlights the importance of conducting studies on the causes, repercussions, and preventive measures of MSDs among teachers.

Musculoskeletal disorders have a multifactorial cause. Sociodemographic aspects, individual characteristics, lifestyle, and working conditions are factors that can contribute to the development or worsening of pain⁴. Risk factors for work-related musculoskeletal disorders (WMSDs) include mechanical compression, excessive force, repetitive movements, long working shifts, inadequate postures, and individual factors (such as smoking and obesity), as well as organizational and psychosocial factors⁵. In this regard, some risk factors may be associated with the impaired health of teachers, since they frequently perform repetitive movements to write on the blackboard and remain standing for long periods, in addition to performing repetitive tasks such as grading tests and exercises, and using a computer daily^{2,6}.

In this context, it is necessary to deepen our understanding of musculoskeletal pain in teachers by exploring the ergonomic, occupational, and psychosocial mechanisms of their work⁷. The goal is to seek strategies that improve working conditions, prevent health problems,

and ultimately reflect improvements in the quality of education⁸. Actions to support teachers, as well as to understand the problematic situations embedded within a broader social context, should be managed by the school management and government spheres to promote teacher empowerment. Thus, by identifying ergonomic risks and the prevalence of musculoskeletal pain, it becomes possible to adapt workstations for teachers, prevent pain, and enhance the quality of life and teaching⁹.

In light of this, few studies investigate on the occupational risks and health of teachers in professional, scientific, and technological education^{9,10}. Therefore, it is highly relevant to investigate the risks and prevalence of musculoskeletal pain among this demographic, as these educators show different performance characteristics compared to standard primary, secondary, and higher education teachers, as they teach vocational qualification courses, secondary-level technical education programs, Youth and Adult Education (EJA) modalities, and higher education and postgraduate courses, in addition to carrying out administrative, research, and outreach activities. Thus, this study aimed to evaluate musculoskeletal symptoms and ergonomic risks in classrooms and staff rooms across the campuses of the Instituto Federal Catarinense (IFC).

METHODOLOGY

This was an analytical, exploratory, and quantitative study conducted in 2022. The population consisted of 1,006 teachers from the IFC. Exclusion criteria included being on work leave and having a 20-hour work week, as this reduced workload—few teachers worked on this shift—could skew the results. Inclusion criteria required participants to be active teachers and to sign an informed consent form. The sample was selected by convenience and

consisted of 112 IFC teachers who answered an online questionnaire developed via Google Forms.

The instrument covered sociodemographic questions regarding tasks, work environments (classrooms and staff rooms), and musculoskeletal symptoms. Illustrative figures sourced from the internet were also included alongside questions related to the work environment to facilitate the understanding.

After developing the questionnaire, an online pretest was conducted via Google Forms with the participation of ten IFC teachers from the São Bento do Sul campus. They were instructed to answer the instrument and report any aspects that caused comprehension difficulties. Based on the participants' feedback, the research team made the necessary adjustments, and the final version of the instrument was validated by the pre-test respondents. Then, the IFC General Communication Coordination sent the questionnaire link via email to all teachers at the institution.

Binary logistic regression was used separately for each outcome variable, with pain in the neck, right shoulder, and low back acting as the dependent variables. Post hoc statistical power was estimated using GPower 3.1 software, achieving a 0.80 β and a 0.50 effect size. Data were analyzed using SPSS 22.0 software, and a 5% significance level ($p \leq 0.05$) was adopted for all analyses.

RESULTS

Teachers at this professional, scientific, and technological education institution conduct face-to-face classes in addition to administrative, research, and/or community outreach activities. A total of 112 teachers participated in the study, with a mean age of 43.8 ± 7.5 years. Table 1 presents data in detail.

Table 1. Descriptive statistics in absolute and relative frequencies

Parameter		All (N=112)	Male (N=63)	Female (N=49)
Time at the institution	≤15 years	100 (89.3)	58 (92.1)	42 (85.7)
	>15 years	12 (10.7)	5 (7.9)	7 (14.3)
BMI	Underweight	1 (0.9)	1 (1.6)	0 (0.0)
	Normal weight	44 (39.3)	19 (30.2)	25 (51.0)
	Overweight	46 (41.1)	31 (49.2)	15 (30.6)
	Obese	18 (16.1)	9 (14.3)	9 (18.4)
Regular physical activity	Yes	59 (52.7)	39 (61.9)	20 (40.8)
	No	52 (46.4)	23 (36.5)	29 (59.2)
Stress at work	Always	9 (8.0)	5 (7.9)	4 (8.2)
	Frequently	66 (58.9)	35 (55.6)	31 (63.3)
	Rarely	35 (31.3)	22 (34.9)	13 (26.5)
	Never	2 (1.8)	1 (1.6)	1 (2.0)
Household chores	Yes	72 (64.3)	39 (61.9)	33 (67.3)
	No	40 (35.7)	24 (38.1)	16 (32.7)
Weekly teaching hours	>15 hours	58 (51.8)	28 (44.4)	30 (61.2)
	≤15 hours	54 (48.2)	35 (55.6)	19 (38.8)
Knowledge of ergonomics	Yes	84 (75.0)	46 (73.0)	38 (77.6)
	No	28 (25)	17 (27.0)	11 (22.4)
Monitor at eye level	Yes	41 (36.6)	27 (42.9)	14 (28.6)
	No	71 (63.4)	36 (57.1)	35 (71.4)
Feet supported on floor/footrest when seated	Yes	99 (88.4)	61 (96.8)	38 (77.6)
	No	12 (10.7)	2 (3.2)	10 (20.4)
Chair with height adjustment	Yes	90 (80.4)	54 (85.7)	36 (73.5)
	No	21 (18.8)	8 (12.7)	13 (26.5)
Inadequate backrest	Yes	45 (40.2)	27 (42.9)	18 (36.7)
	No	67 (59.8)	36 (57.1)	31 (63.3)
Desk at elbow level	Yes	60 (53.6)	40 (63.5)	20 (40.8)
	No	52 (46.4)	23 (36.5)	29 (59.2)
Wrist rest for keyboard	Yes	9 (8.0)	4 (6.3)	5 (10.2)

(continues)

Table 1. Continuation

Parameter		All (N=112)	Male (N=63)	Female (N=49)
Type of keyboard used	No	103 (92)	59 (93.7)	44 (89.8)
	External keyboard	41 (36.6)	22 (34.9)	14 (28.6)
	Laptop keyboard	75 (67)	41 (65.1)	34 (69.4)
Mouse or touchpad	Mouse	80 (71.4)	46 (73)	34 (69.4)
	Touchpad	31 (27.7)	16 (25.4)	15 (30.6)
Posture in classroom	Standing	85 (75.9)	49 (77.8)	36 (73.5)
	Alternating	26 (23.2)	14 (22.2)	12 (24.5)
	Sitting	1 (0.9)	0 (0.0)	1 (2.0)
Blackboard or data projector	Blackboard	39 (34.8)	21 (33.3)	18 (36.7)
	Data projector	73 (65.2)	42 (66.7)	31 (63.3)
Sharp edges	Yes	68 (60.7)	36 (57.1)	32 (65.3)
	No	44 (39.3)	27 (42.9)	17 (34.7)

*Percentages are shown in parentheses.

The prevalence of pain was 93.7%, and the distribution of symptoms is shown in Figure 1.

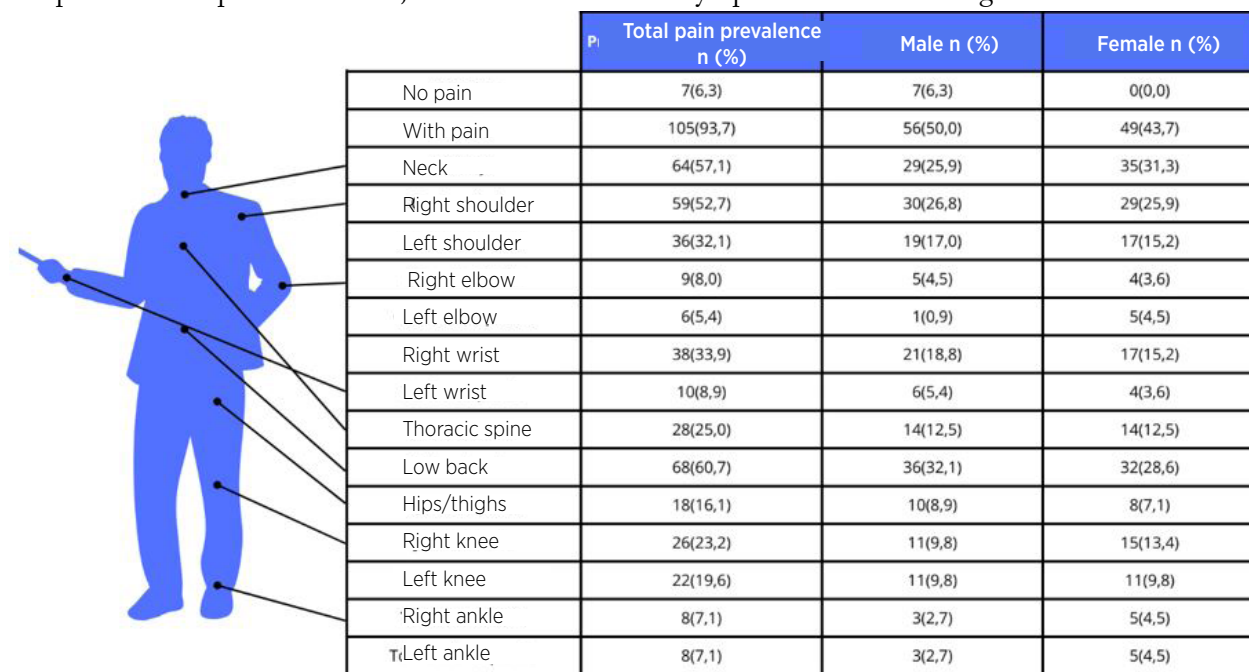


Figure 1. Prevalence of pain for the studied subjects (n=112)

The regions with the highest prevalence of pain were correlated with the questionnaire variables for statistical analysis, and those demonstrating a significant relationship are detailed in Table 2.

Table 2. Crude and adjusted logistic regression models for variables of neck pain, right shoulder pain, and low back pain

		Crude OR	95% CI	p-value	Adjusted OR	95% CI	p-value	P
Neck pain	<i>Stress</i>	1			1			
	Rarely/never	0.25	0.46-0.07	0.01	0.34	0.15-0.78	0.01	
	Always/frequently							
	<i>Physical activity</i>	1			1			
	Yes	0.12	0.31-0.07	0.20	0.70	0.75-3.83	0.20	0.04
	No							
	<i>Monitor at eye level</i>	1			1			
	Yes	0.05	0.142-0.25	0.55	0.64	0.27-1.51	0.31	
	No							
	<i>Inadequate backrest</i>	1			1			
	Yes	0.06	0.25-0.13	0.52	1.55	0.69-3.51	0.29	
	No							
Right shoulder pain	<i>Stress</i>	1			1			
	Rarely/never	0.34	0.15-0.77	0.01	0.37	0.16-0.86	0.02	
	Always/frequently							
	<i>Blackboard or data projector</i>	1			1			
	Data projector	2.42	1.08-5.45	0.03	2.17	0.94-4.98	0.07	0.02
	Blackboard							
	<i>Posture in classroom</i>	1			1			
	Alternating	1.00	0.64-1.54	0.99	1.02	0.64-1.61	0.89	
	Standing							
	<i>Stress</i>	1			1			
Low back pain	Rarely/never	0.56	0.25-1.25	0.16	0.41	0.17-0.99	0.05	
	Always/frequently							
	<i>Blackboard or data projector</i>	1			1			
	Blackboard	0.65	0.29-1.42	0.28	0.42	0.17-1.01	0.05	0.05
	Data projector							
	<i>BMI</i>	1			1			
	Underweight/normal weight	1.20	0.55-2.62	0.64	1.17	0.51-2.69	0.71	
	Overweight/obese							
	<i>Monitor at eye level</i>	1			1			
	Yes	0.46	0.21-1.00	0.05	0.41	0.18-0.96	0.04	
	No							
	<i>Chair with height adjustment</i>	1			1			
	Yes	0.57	0.20-1.61	0.29	0.46	0.15-1.41	0.18	
	No							

OR: odds ratio; 95%CI: 95% confidence interval; *Adjusted for neck pain, right shoulder pain, and low back pain.

DISCUSSION

The prevalence of pain was 93.7% among the surveyed teachers. This finding corroborates other studies involving educators, which identified the presence of MSDs at 91%¹¹ and 82%¹² prevalence. The body regions with the highest prevalence were the low back (60.7%), neck (57.1%), and right shoulder (52.7%). These results align with a study conducted among professors, in which the highest

frequency of pain was reported in the neck (70%) and low back (64%)¹³, as well as with technical education teachers, who experienced a higher occurrence of pain in the low back (60%), neck (56%), and shoulders (48%)¹⁰. Regarding gender, the highest occurrence was observed among women participants, as all of them reported MSDs. This corroborates the existing literature^{14,15} and may be attributed to women disproportionately assume the majority of household chores and childcare responsibilities.

Stress, inadequate monitor height (the top edge of the monitor not aligning with the teachers' eye level), an inadequate desk (desk higher or lower than elbow level), an inadequate backrest, and sharp edges were identified as the primary ergonomic risks. This outcome is comparable to findings reported by Kraemer et al.¹⁰, in which the main ergonomic risks among teachers were the presence of sharp edges on work desks, reliance on a laptop touchpad, and inadequate computer screen height. In terms of stress, other studies have similarly identified this as a risk factor among teachers^{2,9}. It can be triggered by high work overload, a lack of control over time, student behavioral issues, excessive bureaucracy, a lack of recognition, the implementation of new pedagogical models, and difficulties in a healthy relationship with education supervisors¹⁶.

Low back pain was positively associated with teachers who reported stress, the use of a data projector, those with overweight/obesity, inadequate monitor height, and a chair without height adjustment. This result reinforces literature that links low back pain to overweight and obesity⁵, as well as to stress¹⁷. Regarding the use of a data projector, this may correlate with increased time spent sitting at a computer to prepare for classes. Remaining seated for prolonged periods is an established risk factor for low back pain¹⁸, as the position leads to prolonged lumbar flexion and a reduction of lordosis in the region, generating static overload on the musculoskeletal tissues of the spine—factors directly tied to the development of low back pain¹⁹. Other studies highlight the relationship between the ergonomic inadequacies of equipment and furniture and low back pain in teachers^{9,10}.

Neck pain was associated with teachers experiencing stress, a lack of physical activity, inadequate monitor height, and inadequate backrest. This mirrors findings in the literature, which have verified a relationship between neck pain, common mental disorders, and a low level of well-being at work⁷, as well as stress⁹ among teachers. Stress alters muscle activation periods and induces increased tension, leading to fatigue and pain in the neck and shoulders²⁰. Inadequate monitor height forces teachers into cervical flexion to view the screen during computer use, increasing the gravitational load on the cervical extensor muscles and causing localized pain²¹. Furthermore, regular physical activity is beneficial for health preservation, helping to prevent musculoskeletal pain while promoting psychological well-being and reducing stress, anxiety, and depression²².

A significant relationship was found between right shoulder pain and the group of teachers who reported stress, use of the blackboard, and standing during classes. Other studies have also drawn connections between shoulder pain and stress⁵, common mental disorders and low workplace well-being⁷, and the use of a blackboard²³. The greater the angle of shoulder elevation and/or abduction, the more discomfort is generated when writing on a blackboard, due to an increase in intramuscular pressure in the infraspinatus and supraspinatus muscles^{23,24}, which can precipitate shoulder pain.

Given these results, it is highly recommended that the institution implement health prevention initiatives targeting ergonomic risks, musculoskeletal pain symptoms, and stress. Such measures could include the ergonomic adaptation of furniture and equipment, training on adopting proper postures when writing on the blackboard or using a computer, disseminating information regarding the importance of regular physical activity, and promoting stress-reduction activities among these professionals. Ideally, these prevention protocols should be guided by a physical therapist and have the potential to yield substantial improvements in the teachers' quality of life and, consequently, in the overall quality of education.

The findings of this research are limited to IFC teachers and, as such, should not be generalized to teaching staff at other institutions. The authors recommend further studies that evaluate a larger cohort of teachers across diverse educational settings.

CONCLUSION

This study identified the prevailing ergonomic risks in the classrooms and staff rooms at the IFC. The most frequently observed issues were stress, inadequate monitor height (the top edge of the monitor not aligning with the teachers' eye level), an inadequate desk (desk higher or lower than elbow level), an inadequate backrest, and sharp edges. Moreover, a high prevalence of musculoskeletal pain was recorded, with the most affected regions being the low back, neck, and shoulders.

Binary logistic regression revealed an association between low back pain and the group of teachers experiencing stress, the use of a data projector, overweight/obesity, inadequate monitor height, and chairs lacking height adjustment. Neck pain was associated with teachers experiencing stress, a lack of physical activity, inadequate monitor height, and inadequate backrest. Finally, a

relationship was found between right shoulder pain and teachers who reported stress, the use of the blackboard, and standing during classes. Notably, stress emerged as the only variable consistently correlated with pain symptoms across all three anatomical regions.

Therefore, based on these findings, it is recommended that the institution actively pursue health prevention strategies to address ergonomic risks, musculoskeletal pain symptoms, and stress. Doing so may lead to improvements in the teachers' quality of life and, consequently, in the overall quality of education.

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DATA AVAILABILITY

The entire dataset supporting the results of this study is available within the article.

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