DOI: 10.1590/1809-2950/21020229012022EN



ORIGINAL RESEARCH

# COVID-19 pandemic and remote teaching activities: ergonomic risks and musculoskeletal symptoms of professors at Instituto Federal Catarinense

*Pandemia de COVID-19 e as atividades de ensino remotas: riscos ergonômicos e sintomas musculoesqueléticos dos docentes do Instituto Federal Catarinense*

*La pandemia del COVID-19 y las actividades de enseñanza remota: riesgos ergonómicos y síntomas musculoesqueléticos de los docentes del Instituto Federal Catarinense*

**Bruno Guimarães[1], Tiago Chimenez[2], Diego Munhoz[3], Heloísa Minikovski[4]**

**ABSTRACT |** This study aimed to evaluate the musculoskeletal symptoms and the ergonomic risks in the workplaces of the professors of the *Instituto Federal Catarinense* (IFC). 140 professors participated by answering an online questionnaire on sociodemographic information, task performance, work environment, and musculoskeletal pain. Data were analyzed using binary logistic regression for each outcome separately, using neck, right shoulder, and low back pain as dependent variables. The prevalence of pain among professors was 94.7% and the most frequent regions were the neck, lumbar spine, and right shoulder. The main ergonomic risks were mental overload (stress) and inadequate worktable and monitor. An association between neck pain and professors who had greater mental overload (stress), who do not engage in physical activity, and who use the computer for more than 20 hours a week was observed; also, between pain in the right shoulder and the professors who do not engage in physical activity, who use the computer for more than 20 hours a week, who had an inadequate workspace. Low back pain was associated with women, weekly course workload greater than 15 hours, and chronic disease. The results found indicate the need to adapt the workplace of the professors with in order to prevent pain and improve the quality of life and the quality of teaching.

Keywords | COVID-19; Faculty; Ergonomics; Musculoskeletal Pain; Occupational Health.

**RESUMO |** O objetivo da pesquisa foi avaliar os sintomas osteomusculares e os riscos ergonômicos dos ambientes de trabalho dos docentes do Instituto Federal Catarinense (IFC). Participaram 140 docentes, que responderam a um questionário online sobre informações sociodemográficas, realização de tarefas, ambiente de trabalho e dor musculoesquelética. Os dados foram analisados por meio de uma regressão logística binária separadamente para cada desfecho, utilizando como variáveis dependentes: dores no pescoço, no ombro direito e na coluna lombar. A prevalência de dor entre os professores foi de 94,7%, e as regiões mais frequentes foram o pescoço, a coluna lombar e o ombro direito. Os principais riscos ergonômicos observados foram: sobrecarga mental (estresse), mesa de trabalho e monitor inadequados. Foi observada associação entre dor no pescoço e docentes que apresentaram maior sobrecarga mental (estresse), não fazem atividade física e usam o computador por mais de 20 horas por semana; dor no ombro direito e docentes que não fazem atividade física, usam o computador por mais de 20 horas por semana, cuja mesa de trabalho não estava ao nível do cotovelo e sem espaço para apoiar os antebraços. Ainda, a dor na coluna lombar foi associada ao grupo de mulheres com carga horária de aula semanal maior que 15 horas e com doença crônica. Os resultados encontrados possibilitam a adaptação dos ambientes de trabalho dos docentes para a prevenção de dor, a melhoria da qualidade de vida e do ensino.

Descritores | COVID-19; Docente; Ergonomia; Dor Musculoesquelética; Saúde do Trabalhador.

[1]Instituto Federal Catarinense (IFC) – São Bento do Sul (SC), Brazil. E-mail: bruno.guimaraes@ifc.edu.br. ORCID-0000-0002-4957-4502
[2]Instituto Federal Catarinense (IFC) – São Bento do Sul (SC), Brazil. E-mail: tiago.chimenez@ifc.edu.br. ORCID-0000-0002-4501-6570
[3]Instituto Federal Catarinense (IFC) – São Bento do Sul (SC), Brazil. E-mail: diego.munhoz.ifc@gmail.com. ORCID-0000-0002-8472-9434
[4]Instituto Federal Catarinense (IFC) – São Bento do Sul (SC), Brazil. E-mail: heloisa.minikovski.ifc@gmail.com. ORCID-0000-0001-5477-0682

Corresponding address: Bruno Guimarães– Rua Paulo Chapiewski, 931 – São Bento do Sul (SC), Brazil – Zip Code: 89283-064 – E-mail: bruno.guimaraes@ifc.edu.br –
Financing source: Instituto Federal Catarinense (IFC) campus São Bento do Sul – Conflict of interests: nothing to declare – Presentation: Sep. 21st, 2021 –
Accepted for publication: Jan. 15th, 2022 – Approved by the Research Ethics Committee: Opinion No. 34028020.9.0000.8049.

**RESUMEN |** El objetivo de la investigación fue evaluar los síntomas musculoesqueléticos y los riesgos ergonómicos del trabajo de Instituto Federal Catarinense (IFC) docentes. Participaron 140 profesores que respondieron un cuestionario online sobre información sociodemográfica, desempeño de tareas, ambiente laboral y dolor musculoesquelético. Los datos se analizaron mediante regresión logística binaria por separado para cada resultado, utilizando el dolor en el cuello, el hombro derecho y la columna lumbar como variables dependientes. La prevalencia de dolor entre los docentes fue del 94,7% y las regiones más frecuentes fueron el cuello, la columna lumbar y el hombro derecho. Los principales riesgos ergonómicos fueron: sobrecarga mental (estrés), mesa de trabajo y monitor inadecuados. Se observó asociación entre el dolor de cuello y los docentes que tenían mayor sobrecarga mental (estrés), que no realizan actividad física y que usan la computadora por más de 20 horas a la semana, dolor en el hombro derecho y el grupo de docentes que sí lo hacen. no realizar actividad física, que utilizan la computadora durante más de 20 horas a la semana, que la mesa de trabajo no está a la altura de los codos y no hay espacio para apoyar los antebrazos. Aún así, el dolor en la columna lumbar se asoció con el grupo de mujeres con horas de clase semanales mayores de 15 horas y con enfermedad crónica. Los resultados encontrados permiten adecuar los puestos de trabajo a los docentes con el fin de prevenir el dolor, mejorar la calidad de vida y la docencia.

**Palabras clave |** COVID-19; Docente; Ergonomía; Dolor Musculoesquelético; Salud Laboral.

## INTRODUCTION

In March 2020, the World Health Organization (WHO) declared the COVID-19 a pandemic. As of September 13, 2021, 219 million cases of the disease and 4.55 million deaths were confirmed worldwide, while in Brazil 21 million cases and 587,000 deaths were registrered[1]. Considering that there are no effective options for pharmacological treatment[2], physical distancing has been suggested as the most significant intervention to reduce the spread of the virus[3].

In this context, the COVID-19 pandemic has affected the population's life, the environment, the economy, the technology, the institutions, and the relationships at an unprecedented rate. Moreover, the measures of social distancing imposed on citizens stimulated the extension of telework within society[4]. As a result, schools were closed as they entered the virtual world; in-person meetings became web conferences and physical classrooms became online tasks and virtual classes[5]. Employees were transferred to their homes, facing the need to set up a work area with what they had in their houses[5]. Additionally, work environments at home may not fit ergonomically to the individual, resulting in body discomfort and more serious problems in the future[5], affecting the quality of life of teachers and the quality of the teaching.

In this sense, the risk factors associated with the use of the computer include the height of table, chair, and monitor; the use of keyboard and mouse; work postures; organizational factors, such as long working hours and the time of computer use per day; and psychosocial factors, such as stress[6,7].

Work-related musculoskeletal disorders represent one of the major public health problems[8], especially for teachers, since this disorders are the main causes of absence from work[9,10]. Thus, it is necessary to deepen the knowledge about musculoskeletal pain within these professionals by exploring the ergonomic, occupational, and psychosocial mechanisms of work[11]; seeking strategies to improve work conditions and to prevent health problems; and achieving improvements in the quality of teaching[12]. The analysis of ergonomic risks helps in devising strategies toward the improvement of the work environment and the reduction of musculoskeletal disorders in workers[13].

Since March 2020, due to the COVID-19 pandemic and the closure of schools, the professors of the *Instituto Federal Catarinense* (IFC) have been placed in telework, performing remote teaching activities using computers, away from the premises of the institution, usually within the confines of their homes. These activities include administr ative and teaching activities, such as the preparation and realization of online classes; development and correction of exercises and exams via digital platform; development of research and extension projects. Considering that, we aimed to evaluate musculoskeletal symptoms and ergonomic risks in the telework environments of IFC professors. Our hypothesis for the research is that there is a high prevalence of pain and the presence of ergonomic risks in the telework environments of IFC professors.

## METHODOLOGY

This is a study with an analytical, exploratory, and quantitative approach, conducted in August 2020.

The sample was composed of IFC professors, totaling 896 individuals, after applying the following exclusion criteria: being away from work and having a work regime of 20 hours. The inclusion criteria include being a professor and signing an informed consent form. The final convenience sample consisted of 140 IFC professors who answered the questionnaire.

Based on a literature review, in which similar studies were found, an online questionnaire was elaborated via Google Forms, containing sociodemographic questions about tasks, telework environments, and musculoskeletal symptoms related to the period of remote teaching. Also, illustrative figures obtained on the Internet were included and presented in association with the questions about the telework environment to facilitate the volunteers' understanding of the questionnaire.

After developing the questionnaire, an online pre-test was conducted via Google Forms with 10 professors from the IFC campus São Bento do Sul, who were instructed to answer the instrument and to inform any issues with the understanding. After the respondents' feedback, the research team adjusted the questionnaire, and the final version of the instrument was validated by the pre-test respondents. Then, the IFC General Coordination of Communication emailed the questionnaire link to all IFC professors.

Binary logistic regression was used separately for each outcome, adopting neck, right shoulder, and low back pain as dependent variables. The power of the sample was later calculated using the GPower 3.1 software, reaching a β of 0.80 and an effect size of 0.381. The data were analyzed using software SPSS 22.0 and a 5% ($p \leq 0.05$) significance level was adopted for all analyses.

## RESULTS

A total of 140 professors participated in the study, with a mean age of 42.4±7.98 years. Table 1 shows the data.

The prevalence of pain was 94.7%. Figure 1 shows the distribution of symptoms.

The regions with the highest prevalence of pain were related to the variables of the questionnaire for statistical analysis and those with a significant relationship are indicated in Table 2.

Table 1. Descriptive statistics in absolute and relative frequency

| Characteristic | Total (N=140) | Neck pain (N=101) | Low back pain (N=92) | Pain in the right shoulder (N=67) |
|---|---|---|---|---|
| Sex | | | | |
| Male | 64 (45.7%) | 42 (41.58%) | 40 (43.5%) | 27 (40.3%) |
| Female | 76 (54.3%) | 59 (58.42%) | 52 (56.5%) | 40 (59.7%) |
| Weekly workload | | | | |
| ≤15 hours | 104 (74.3%) | 74 (73.26%) | 65 (70.64%) | 53 (79.09%) |
| >15 hours | 36 (25.7%) | 27 (26.74%) | 27 (29.36%) | 14 (20.91%) |
| Physical activity ≥3 times a week | | | | |
| Yes | 58 (41.4%) | 42 (41.58%) | 40 (43.47%) | 31 (46.26%) |
| No | 82 (58.6%) | 59 (58.41%) | 52 (56.53%) | 36 (53.74%) |
| Current mental overload (stress) in relation to the period prior to remote activities | | | | |
| less/equal | 20 (14.2%) | 9 (8.91%) | 13 (14.13%) | 8 (11.95%) |
| Higher | 120 (85.7%) | 92 (91.09%) | 79 (85.87%) | 59 (88.05%) |
| Chronic disease (diabetes and hypertension) | | | | |
| Yes | 37 (26.4%) | 27 (26.74%) | 31 (33.69%) | 19 (28.35%) |
| No | 103 (73.6%) | 74 (73.26%) | 61 (66.31%) | 48 (71.65%) |
| Time of computer use per week | | | | |
| ≤20 hours | 29 (20.7%) | 18 (17.82%) | 22 (23.9%) | 13 (19.4%) |
| >20 hours | 111 (79.3%) | 83 (82.18%) | 70 (76.1%) | 54 (80.6%) |
| Breaks ≥3 times a day | | | | |
| Yes | 98 (70%) | 72 (71.28%) | 59 (64.13%) | 44 (65.67%) |
| No | 42 (30%) | 29 (28.72%) | 33 (35.86%) | 23 (34.33%) |

(continues)

Table 1. Continuation

| Characteristic | Total (N=140) | Neck pain (N=101) | Low back pain (N=92) | Pain in the right shoulder (N=67) |
|---|---|---|---|---|
| Feet resting on the floor/support when seated | | | | |
| Yes | 120 (85.7%) | 84 (83.16%) | 76 (83.17%) | 57 (85.07) |
| No | 20 (14.3) | 17 (16.84%) | 15 (16.33%) | 10 (14.93%) |
| Table at elbow level | | | | |
| Yes | 56 (40%) | 36 (35.64%) | 35 (38.05%) | 21 (31.34%) |
| No | 84 (60%) | 65 (64,365) | 57 (61.95%) | 46 (68.66%) |
| Space to support forearms on the table | | | | |
| Yes | 67 (47.9%) | 43 (42.57%) | 42 (45.65%) | 26 (38.8%) |
| No | 73 (52.01%) | 58 (57.435%) | 50 (54.35%) | 41 (61.2%) |
| Mouse/touchpad | | | | |
| Laptop touchpad | 46 (32.9%) | 33 (32.67%) | 33 (35.86%) | 20 (29.85%) |
| Mouse | 94 (67.1%) | 68 (67.33%) | 59 (64.14%) | 47 (70.15%) |
| Eye-level monitor | | | | |
| Yes | 43 (30.7%) | 33 (32.68%) | 28 (30.43%) | 25 (37.31%) |
| No | 97 (69.3%) | 68 (67.32%) | 64 (69.57%) | 42 (62.69%) |

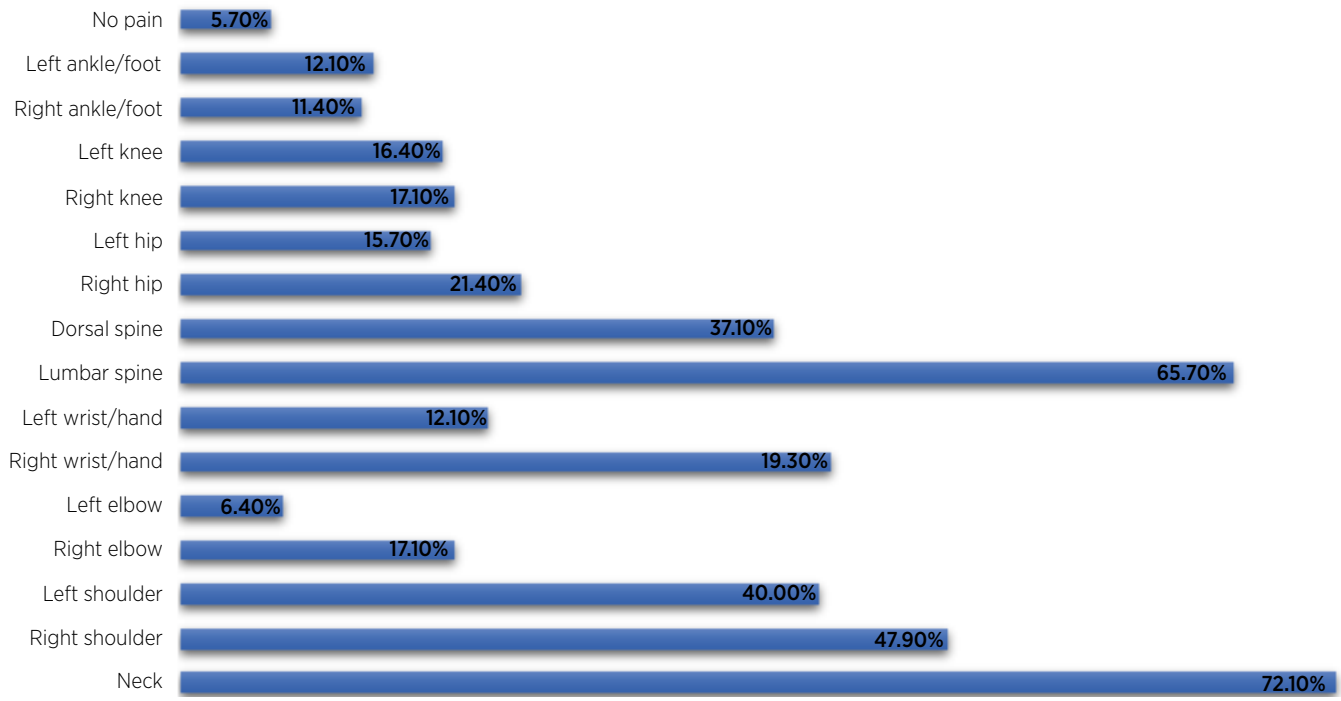


Figure 1. Prevalence of pain among the professors at the Instituto Federal Catarinense (n=140)

Table 2. Crude and adjusted logistic regression models for the variables of neck, right shoulder, and lumbar spine pain

| | | Gross OR | 95%CI | p-value | Adjusted OR | 95%CI | p-value | p |
|---|---|---|---|---|---|---|---|---|
| **Neck pain** | Mental overload (stress) | | | | | | | |
| | less/equal | 1 | | | 1 | | | |
| | Higher | 3.83 | 1.45-10.17 | 0.01 | 4.08 | 1.51-10.97 | 0.00 | |
| | Physical activity | | | | | | | |
| | Yes | 1 | | | 1 | | | 0.02 |
| | No | 0.92 | 0.44-1.94 | 0.83 | 0.88 | 0.88-0.40 | 0.74 | |
| | Time of computer use per week | | | | | | | |
| | ≤20 hours | 1 | | | 1 | | | |
| | >20 hours | 1.73 | 0.73-4.09 | 0.23 | 1.99 | 0.80-4.94 | 0.14 | |

(continues)

Table 2. Continuation

| | | Gross OR | 95%CI | p-value | Adjusted OR | 95%CI | p-value | p |
|---|---|---|---|---|---|---|---|---|
| Pain in the right shoulder | Physical activity | | | | | | | |
| | Yes | 1 | | | 1 | | | |
| | No | 0.72 | 0.36-1.41 | 0.33 | 0.48 | 0.23-1.03 | 0.06 | |
| | Time of computer use per week | | | | | | | |
| | ≤20 hours | 1 | | | 1 | | | |
| | >20 hours | 1.21 | 0.53-2.75 | 0.65 | 1.54 | 0.64-3.71 | 0.33 | 0.03 |
| | Table at elbow level | | | | | | | |
| | Yes | 1 | | | 1 | | | |
| | No | 1.87 | 0.94-3.72 | 0.07 | 1.78 | 0.85-3.72 | 0.12 | |
| | Space to support forearms | | | | | | | |
| | Yes | 1 | | | 1 | | | |
| | No | 0.47 | 0.24-0.92 | 0.03 | 2.28 | 1.09-4.77 | 0.03 | |
| Low back pain | Sex | | | | | | | |
| | Male | 1 | | | 1 | | | |
| | Female | 1.31 | 0.65-2.62 | 0.45 | 1.51 | 0.73-3.11 | 0.26 | |
| | Weekly course workload | | | | | | | |
| | ≤15 hours | 1 | | | 1 | | | 0.03 |
| | >15 hours | 1.62 | 0.71-3.72 | 0.25 | 1.58 | 0.67-3.71 | 0.29 | |
| | Chronic disease | | | | | | | |
| | No | 1 | | | 1 | | | |
| | Yes | 0.33 | 0.13-0.91 | 0.02 | 0.32 | 0.13-0.80 | 0.01 | |

*: Adjusted for the variables neck pain, right shoulder pain, and lumbar spine pain.

## DISCUSSION

The main ergonomic risks found were increased mental overload (stress), inadequate monitor height (upper edge of the monitor was not at eye level), and inadequate worktable (inadequate height, i.e., higher or lower than elbow level and lack of space to support the forearm). Our outcome was similar to that found in a study with university employees[5] who were in telework due to the COVID-19 pandemic, in which 75% of the monitors were below eye level and 43% of the chairs were at an incorrect height[5]. The ergonomic problems observed in our study may be due to the sudden way the IFC transferred the professors to remote work; many of them did not have time to organize, since not all had a chair, table, equipment, and an adequate office environment[5,14]. Moreover, such inadequacies may be the result of employee's lack of knowledge about ergonomics and the lack of IFC guidelines.

The 94.77% prevalence of pain is higher than that of two other studies with primary school teachers, which showed prevalence of 73.5%[11] and 55%[9]. However, in a study conducted with 194 workers who were in telework due to the COVID-19 pandemic, only 5% did not present musculoskeletal pain[14]. The most affected regions were neck (72.1%), lumbar spine (65.7%), and right shoulder (47.9%). These results are similar to those found in a study with professors from the IFC campus São Bento do Sul, in which the highest prevalence of pain was in the low back pain (60%), neck (56%), and shoulders (48%)[15], and in another study with university professors, in which the highest occurrence of pain was reported in the neck (70%) and lumbar region (64%)[10].

There was an association between neck pain and professors who presented higher mental overload (stress), who do not practice any physical activity, and who use the computer for more than 20 hours per week. The result corroborates the literature, since the longer the time spent on the computer, the greater the risk of neck pain[7]. Furthermore, stress alters the periods of muscle activation and causes increased tension, leading to fatigue and neck pain[16]. An association has been found between neck pain, common mental disorders, and low level of well-being at work among professors[11]. This mental overload may be worsened by the fear of falling ill, uncertainties about the future, and due to the social isolation imposed by the COVID-19 pandemic, since, in the effort to protect their loved ones, workers moved away from family members, friends, and the support network in which they relied on for their daily life, generating mental suffering[17].

Right shoulder pain was significantly related to the professors who do not practice any physical activity, who use the computer for more than 20 hours a week, and whose worktable was not at elbow level and does not have room to support the forearms. This result was similar to that of Nakazawa et al.[18], who demonstrated that workers with longer time of computer use had a

higher risk of shoulder pain. This situation may have been enhanced by inadequate ergonomic conditions, since the absence of forearm support during computer use increases muscle overload in the shoulders and the incidence of musculoskeletal disorders in this region[19]. Furthermore, the use of the computer with a worktable, or arm rest, at elbow level causes less muscle activity in the shoulders than if used with a table or support above elbow level[19].

Low back pain was significantly associated with female, weekly course workload greater than 15 hours, and chronic disease. This result is in line with the research of Cardoso et al.[9], which found a relationship between low back pain in women and prolonged exposure to teaching. Furthermore, since classes were held remotely the professors with a higher workload remained seated for longer periods using the computer, both to prepare for and to give lessons. Sitting for a prolonged period is one of the risk factors for pain and injuries in the lumbar spine[20]. This position leads to prolonged support of lumbar flexion and reduction of lordosis in this region and generates static overload in the musculoskeletal tissues of the spine, factors that are related to the development of low back pain[21]. Additionally, Malta et al.[22] found a significant association between low back pain and chronic diseases (hypertension and diabetes) in women.

The results of this research are limited to IFC professors and, therefore, should not be generalized to other institutions. We future research to analyze a greater number of professors from other educational institutions.

## CONCLUSION

This study identified the ergonomic risks present in telework and the high prevalence of musculoskeletal pain among professors. It also verified the factors associated with pain in the neck, right shoulder, and low back pain in professors. Therefore, based on the identification of ergonomic risks and the prevalence of musculoskeletal pain, it is possible to adopt measures for the adaptation of the professors' workplace in order to prevent pain symptoms, as well as to improve the quality of life and the quality of teaching.

## REFERENCES


1. World Health Organization. WHO Coronavirus Disease (COVID-19) Dashboard [Internet]. Geneva: WHO; 2021 [cited 2021 Set 13]. Available from: https://covid19.who.int/.
2. Palmeira VA, Costa LB, Perez LG, Ribeiro VT, Lanza K, Silva ACS. Do we have enough evidence to use chloroquine/hydroxychloroquine as a public health panacea for COVID-19? Clinics (Sao Paulo). 2020;75:e1928. doi: 10.6061/clinics/2020/e1928.
3. Duprat IP, Melo GC. Análise de casos e óbitos pela COVID-19 em profissionais de enfermagem no Brasil. Rev Bras Saude Ocup. 2020;45:e30. doi: 10.1590/2317-6369000018220.
4. Antunes ED, Fischer FM. A justiça não pode parar?! Os impactos da COVID-19 na trajetória da política de teletrabalho do Judiciário Federal. Rev Bras Saude Ocup. 2020;45:e38. doi: 10.1590/2317-6369000025920.
5. Davis KG, Kotowski SE, Daniel D, Gerding T, Naylor J, Syck M. The home office: ergonomic lessons from the "new normal". Ergon Des. 2020;28(4):4-10. doi: 10.1177/1064804620937907.
6. Cook C, Burgess-Limerick R, Papalia S. The effect of upper extremity support on upper extremity posture and muscle activity during keyboard use. Appl Ergon. 2004;35(3):285-92. doi: 10.1016/j.apergo.2003.12.005.
7. Klussmann A, Gebhardt H, Liebers F, Rieger MA. Musculoskeletal symptoms of the upper extremities and the neck: a cross-sectional study on prevalence and symptom-predicting factors at visual display terminal (VDT) workstations. BMC Musculoskelet Disord. 2008;9:9. doi: 10.1186/1471-2474-9-96.
8. Sultan-Taïeb H, Parent-Lamarche A, Gaillard A, Stock S, Nicolakakis N, Hong QN, et al. Economic evaluations of ergonomic interventions preventing work-related musculoskeletal disorders: a systematic review of organizational-level interventions. BMC Public Health. 2017;17:935. doi: 10.1186/s12889-017-4935-y.
9. Cardoso JP, Ribeiro IQB, Araújo TM, Carvalho FM, Reis EJFB. Prevalência de dor musculoesquelética em professores. Rev Bras Epidemiol. 2009;12(4):604-14. doi: 10.1590/S1415-790X2009000400010.
10. Suda EY, Coelho AT, Bertaci AC, Santos BB. Relação entre nível geral de saúde, dor musculoesquelética e síndrome de burnout em professores universitários. Fisioter Pesqui. 2011;18(3):270-4. doi: 10.1590/S1809-29502011000300012.
11. Ceballos AGC, Santos GB. Factors associated with musculoskeletal pain among teachers: sociodemographics aspects, general health and well-being at work. Rev Bras Epidemiol. 2015;18(3):702-15. doi: 10.1590/1980-5497201500030015.
12. Machado LC, Limongi JE. Prevalência e fatores relacionados a transtornos mentais comuns entre professores da rede municipal de ensino, Uberlândia, Minas Gerais, Brasil. Rev Bras Med Trab. 2019;17(3):325-34. doi: 10.5327/Z1679443520190424.
13. Comper MLC, Padula RS. Avaliação do risco ergonômico em trabalhadores da indústria têxtil por dois instrumentos: quick exposure check e job factors questionnaire. Fisioter Pesqui. 2013;20(3):215-21. doi: 10.1590/S1809-29502013000300004.
14. Oliveira M, Keine S. Aspectos e comportamentos ergonômicos no teletrabalho. Revista Produçao Online. 2020;20(4):1405-34. doi: 10.14488/1676-1901.v20i4.4146.
15. Kraemer K, Moreira MF, Guimarães B. Dor musculoesquelética e riscos ergonômicos em docentes de uma instituição federal. Rev Bras Med Trab. 2020;18(3):343-51. doi: 10.47626/1679-4435-2020-608.

16. Magnavita N, Elovainio M, De Nardis I, Heponiemi T, Bergamaschi A. Environmental discomfort and musculoskeletal disorders. Occup Med (Lond). 2011;61(3):196-201. doi: 10.1093/occmed/kqr024.

17. Almeida IM. Proteção da saúde dos trabalhadores da saúde em tempos de COVID-19 e respostas à pandemia. Rev Bras Saude Ocup. 2020;45:e17. doi: 10.1590/scielopreprints.140.

18. Nakazawa T, Okubo Y, Suwazono Y, Kobayashi E, Komine S, Kato N, et. al. Association between duration of daily VDT use and subjective symptoms. Am J Ind Med. 2002;42(5):421-6. doi: 10.1002/ajim.10133.

19. Zhu X, Shin G. Shoulder and neck muscle activities during typing with articulating forearm support at different heights. Ergonomics 2012;55(11):1412-9. doi: 10.1080/00140139.2012.709541.

20. Marques NR, Hallal CZ, Gonçalves M. Características biomecânicas, ergonômicas e clínicas da postura sentada: uma revisão. Fisioter Pesqui. 2010;17(3):270-6. doi: 10.1590/S1809-29502010000300015.

21. Makhous M, Lin F, Hendrix RW, Hepler M, Zang LQ. Sitting with adjustable ischial and back supports: biomechanical changes. Spine (Phila Pa 1976). 2003;28(11):1113-21. doi: 10.1097/01.BRS.0000068243.63203.A8.

22. Malta DC, Oliveira MM, Andrade SSCA, Caiaffa WT, Souza MFM, Bernal RTI. Fatores associados à dor crônica na coluna em adultos no Brasil. Rev Saude Publica. 2017;51(Supl 1):9s. doi: 10.1590/S1518-8787.2017051000052.