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Factors associated with musculoskeletal pain among teachers working remotely during the COVID-19 pandemic

Fatores associados às dores musculoesqueléticas entre docentes durante o trabalho remoto na pandemia da covid-19

Abstract

Objective: To evaluate the factors associated with musculoskeletal pain (MSP) among teachers in the private education system working remotely during the COVID-19 pandemic. **Methods:** Cross-sectional study, carried out with teachers from all levels of education in the private education system, in Bahia. Data were collected using an electronic form. Crude and adjusted analyses were performed, stratified by sex. **Results:** 1,144 teachers participated, 76.5% of whom were female. The prevalence of pain in the upper limbs was 70.6%, and in the spine or back, 69.9%, being higher in females (74.0% upper limbs and 74.1% spine or back). There were differences between the sexes regarding the associated factors. In females, there was an association between MSP in both body segments and increased time dedicated to work; pain in the spine or back was associated with unpreparedness for the new demands and domestic overload. In males, upper limb pain was associated with difficulties with students and a weekly workload greater than 20 hours; while back or spine pain was associated with noise and difficulty organizing the schedule. **Conclusion:** The prevalence of MSP was high among teachers during remote activities. The accumulation of tasks and an inadequate home environment may have been potential factors for MSP.

Keywords: Teacher; Remote Work; Pandemic; COVID-19; Musculoskeletal Pain; Occupational Health.

Resumo

Objetivo: Avaliar os fatores associados à dor musculoesquelética (DME) entre docentes da rede privada de ensino, durante o trabalho remoto na pandemia da covid-19. **Métodos:** Estudo transversal, realizado com docentes de todos os níveis de ensino na rede privada, na Bahia. Os dados foram coletados por meio de formulário eletrônico. Foram realizadas análises brutas e ajustadas, estratificadas por sexo. **Resultados:** Participaram 1.144 docentes, 76,5% do sexo feminino. A prevalência de dor em membros superiores foi 70,6%, e em coluna ou costas, 69,9%, sendo superior no sexo feminino (74,0% membros superiores e 74,1% coluna ou costas). Verificou-se diferenças entre os sexos quanto aos fatores associados. No feminino, houve associação entre DME em ambos os segmentos corporais e aumento do tempo dedicado ao trabalho; dor em coluna ou costas associou-se ao despreparo para as novas demandas e à sobrecarga doméstica. No masculino, a dor em membros superiores associou-se a dificuldades com alunos e carga horária semanal maior que 20 horas; enquanto dor em coluna ou costas associou-se ao ruído e à dificuldade para organizar a agenda. **Conclusão:** As prevalências de DME foram elevadas entre os docentes durante as atividades remotas. O acúmulo de tarefas e o ambiente doméstico inadequado podem ter sido potencializadores da DME.

Palavras-chave: Professor; Trabalho Remoto; Pandemia; Covid-19; Dor Musculoesquelética; Saúde do Trabalhador.

Introduction

The COVID-19 pandemic has changed the way people live all over the world, especially in collective activities, the education sector has had to implement emergency remote education (ERE) as a strategy for continuing classes due to the suspension of face-to-face activities[1,2]. The private education network was the one that most widely and promptly adopted ERE. Thus, teachers in the private school system had to deal with a context of greater exposure to occupational risk factors, since there was an almost immediate increase in the demands and requirements of work without there being enough time to prepare and adapt to the virtual environment[3].

In this new scenario, teachers have had to adapt quickly to the use of new technological tools, often without training to teach distance classes. According to the report published by the Study Group on Educational Policy and Teaching Work[4], based on a nationwide study conducted during the pandemic in Brazil, only 28.9% of those surveyed said they had the facility to use technological tools, and more than half (53.6%) were not prepared to teach remote classes.

Teachers, students, and families have had to adapt quickly and unexpectedly to the virtual teaching model. The classroom had to be moved to the home environment and teachers had to incorporate the use of Information and Communication Technologies (ICT) as their main working tool, as well as having to create methodological and pedagogical strategies to maintain the routine of classes and student attention, with the aim of minimizing the damage to the school calendar and student performance[5].

Studies carried out during this period strengthen the hypothesis that remote working (RW) contributed to the increase in musculoskeletal pain (MSP) complaints among teachers[6]. The implementation of RW took place in an improvised way in the home environment and exposed teachers to precarious working conditions, characterized by a lack of suitable furniture, long hours in a seated position, repetitive movements, and a lack of rest breaks. These factors influenced the onset or aggravation of MSP in different body regions, with an increase in complaints in the upper limbs, back, spine, and knee joint, symptoms related to long hours in a sitting position and lack of suitable furniture[7].

In summary, in the context of the pandemic, private school teachers have been faced with aspects that have had a direct impact on their physical health and have exposed them to greater ergonomic risk. This study aimed to assess the factors associated with MSP among private school teachers during the COVID-19 pandemic.

Methods

Study design and context

This is a cross-sectional epidemiological study, of the websurvey type[8], carried out with teachers from all levels of education in the private school network of the state of Bahia, Brazil, during the first wave of the COVID-19 pandemic. Data was collected using an online form in June and July 2020.

Participants

The sample was by convenience and teachers were invited to take part in the study based on data obtained from the records of the Bahia Private School Teachers' Union (SINPRO-BA). The inclusion criteria were: being an active teacher in any educational segment in the private network, teaching in Bahia, being registered on the SINPRO-BA institutional mailing list (around 5,000) or on the @sinprobahia Instagram social network (approximately 2,400 followers)[9].

Data collection

Data was collected in June and July 2020 using an online form. The survey form was structured and made available on the free online Google Forms platform. The link (https://forms.gle/mHijkTCaZiQUS5Vk7) to access the form also contained the Informed Consent Form (ICF) for the survey.

The online questionnaire was 28 pages long and contained 80 questions, divided into five blocks of questions. Block I: sociodemographic and work characteristics; block II: characteristics of teachers' work in the COVID-19 pandemic, including psychosocial aspects and work organization; block III: aspects relating to the family and the adoption of social distancing measures; block IV: teachers' health situation; and block V: lifestyle habits and sleep during social distancing.

When filling in the form, the participant had the option of going back to an answered question and rephrasing it before sending it off. No automatic checking system was used to verify that the form had been filled in**.** To obtain the data from the answers, a spreadsheet was generated using the link on the platform itself. This information was stored on password-protected computers, with exclusive access for the research team. Teachers who did not agree to take part in the survey were shown an automatic message that they were not taking part in the survey due to a personal decision and the form was blocked.

Recruitment process

The survey was closed to active teachers who taught in the state of Bahia, Brazil, and were registered with the Bahia Teachers' Union (SINPRO-BA). Teachers were invited to take part in the survey via an individual e-mail containing a link to the form.

Bias control

To guarantee the quality of the survey, the procedures recommended in the Checklist for Reporting Results of Internet E-Surveys (CHERRIES)[10] were followed. The process of drawing up all the stages the form and its dissemination was carried out in a participatory manner by the survey's coordinators and executing team. In the planning stage, online meetings were held with union representatives to identify relevant aspects of remote working. Priority topics were defined, and the team drew up the first version of the form, which was widely discussed, revised and tested in a pilot study. Validated instruments were also used to investigate other variables of interest, in addition to remote working.

Although the research team considered the institutional email database to the most appropriate way of accessing the study population, in this research, in addition to including the option of using social networks (Instagram and Facebook), the use of other communication tools (WhatsApp and YouTube) with teachers was also added as a capture strategy, in order to broaden the scope of the study and enable the largest number of participants in the research.

The teacher could interrupt the form and resume it later. The questions had to be completed, and the form could only be sent once all the questions had been answered. There was no control of the respondent's internet protocol (IP) or the use of cookies. Participants were recorded by the initials of their name and e-mail address, which allowed duplicate answers to be identified. Teachers were instructed to answer the questionnaire only once. When data collection was complete, duplicate answers were deleted.

Variables

The outcome variable in this study was self-reported MSP in the upper limbs (arms, forearms, shoulders, and hands) and spine or back, investigated using the following questions: "Have you experienced frequent pain in your arms, forearms, shoulders, and hands?" and "Have you experienced frequent pain in your spine or back?".

The independent variables were: (i) sociodemographic characteristics: sex (male, female); age (in years, categorized as: less than 40 years and 40 years or more); marital status (with a partner and without a partner); race/color (white and black); (ii) aspects of work: length of time in the profession (in years, categorized as:

up to 10 years or more than 10 years); weekly workload (in hours, categorized as: up to 20 hours, between 21-40 hours, and more than 40 hours) and whether they have another employment relationship (yes, no); (iii) aspects relating to teacher RW in the pandemic: carrying out the RW (yes, no); how the activities carried out were chosen (joint decision, decided alone, the institution indicated); feelings regarding preparation for carrying out the tasks (yes, partially, no); training in the use of digital tools (yes, no) and conditions of the home environment considering the aspects of internet, computer, furniture, headphones and microphone, physical space, noise level, and interruptions (adequate, inadequate); (iv) characteristics of remote work: change in the time dedicated to work each week (none, reduced, increased); how do you feel about the new demands of remote activity (prepared, partially prepared, unprepared); invasion of time dedicated to other work (yes, no); invasion of new work demands on time dedicated to rest or relaxation (yes, no), sleep, eating (yes, no), and looking after yourself (yes, no); level of difficulty in carrying out teaching activities in the context of social distancing in relation to communication with students (has difficulty, does not have difficulty), planning and carrying out distance activities (has difficulty, does not have difficulty), using the tools required to carry out the work (has difficulty, does not have difficulty), and organizing an activity schedule in the home environment (has difficulty, does not have difficulty); aspects relating to job satisfaction - satisfaction with work ability, satisfaction with interpersonal relationships, satisfaction with oneself (satisfied, dissatisfied) and lifestyle habits - physical activity; leisure activities; smoking; and alcohol consumption (yes, no).

Data analysis

The overall prevalence of MSP was estimated for the upper limbs (arms, forearms, shoulders, and hands) and spine or back based on the positive report of the presence of pain (yes). Prevalence rates were then estimated according to the variables of interest: 1. sociodemographic and work characteristics; 2. work characteristics during the COVID-19 pandemic; 3. remote work characteristics and conditions; and 4. lifestyle habits (physical activity and leisure time, smoking and alcohol consumption), household burden, and levels of satisfaction with work ability, personal relationships, and self.

The domestic overload indicator (DO) was obtained from the sum of the four basic domestic tasks, weighted by the number of residents in the household, following the formula: Domestic Overload = [(washing+ ironing+cleaning+cooking) x (number of residents - 1)][11-13]. The analysis considered the indicator in tertiles, with the first tertile being used as the cut-off point for dichotomizing the variable into low DO and medium/high DO.

Descriptive, bivariable, and multivariable analyses were carried out. In the crude analysis, prevalence ratios (PR) and 95% confidence intervals (CI) were calculated. Considering the differences in prevalence of MSP between the sexes, the multiple analysis was conducted by sex stratum (male and female), following the recommendations in the literature[14]. To carry out the analysis, the missing data contained in the variables was removed.

Poisson regression with robust variance was used to estimate PR, 95% CI, and p-values in the multivariable analysis[15,16]. Pearson's chi-squared test (X^2) was used to select the variables for the adjusted model, considering all the variables in an unconditional way. The significance level for entering the multivariable model was 25%, using the likelihood ratio test. The backward method was used to select the variables, adopting a p-value cut-off point of 5% to remain in the final model. The final regression model was adjusted by the physical activity variable. The analysis was carried out using the statistical program *Stata* version 12.0 and the software R version 4.2.3 commander packages.

This research followed Resolutions 466/12 and 510/2016 of the National Health Council and was approved by the Research Ethics Committee of the Federal University of Recôncavo da Bahia (UFRB) under protocol number (CAAE/CEP 32004620.8.1001.0056) on June 3, 2020.

Results

A total of 1,473 questionnaires were answered, representing approximately 29% of the 5,000 teachers with e-mail addresses registered with SIMPRO-BA. Duplicate questionnaires (n= 8) and those answered by teachers who taught outside the state of Bahia (n= 21) were excluded, resulting in a sample of 1,444 teachers.

The sample was made up mostly of female teachers (76.5%), under 40 years of age (57.5%), with a partner (60.2%), who declared themselves black (72.1%) (23.6% black, 48.5% brown). Regarding work characteristics, the following predominated among teachers: working between 20 and 40 hours a week (49.6%), having been in the profession for more than ten years (56.9%), and having a work relationship with just one school (50.3%) (**Table 1**).

During the COVID-19 pandemic, almost all teachers reported carrying out RW (98.4%). The choice of tool used for remote activities was mostly indicated by school management (81.7%). More than a third (38.8%) reported that they were not trained to use the tool chosen, while almost half (43.1%) reported that the educational institution did not provide training in the use of the tool indicated. Inadequate working conditions at home were reported: physical space (43.4%), furniture (37.3%), headset and microphone (22.2%), computer (13.2%), internet (13.1%), while 33.9% reported noise and 29.0% interruptions in the working environment (**Table 1**).

When asked about potential changes in the time spent at work, 76.8% said they had been working more hours since classes became remote, and almost a third of teachers (30.5%) said they felt unprepared for the new demands generated by remote activities. Teachers also reported that the demands required by their employers for remote activities were invading the time they would have used to devote to: rest and relaxation (80.3%), self-care (70.2%), sleep (64.4%), another job (49.8%), and food (47.4%) (**Table 1**).

In general, teachers reported difficulties in working remotely, which were related to: organizing the work schedule (76.8%); communicating with students (73.6%); planning activities (73.8%); and using tools 69.9%) (**Table 1**).

As for lifestyle habits, more than half of the teachers (53.8%) reported drinking alcohol, 4.2% reported smoking, 40.8% reported regular physical activity, and 39.5% reported leisure activities. DO was reported by 36.4% of teachers. The majority reported: dissatisfaction with their ability to work (59.1%), dissatisfaction with personal relationships (58.6%), and dissatisfaction with themselves (56.9%) (**Table 1**).

Table 1 Sociodemographic and work characteristics and lifestyle habits of teachers at all levels of education in the private sector. Bahia, Brazil, 2020 (n = 1,444)

Variable	n	(%)	Female (1,099)		Male (338)	
			n	(%)	n	(%)
Age group (1,444)						
Under 40	830	57.5	643	58.5	184	54.4
40 years or older	614	42.5	456	41.5	154	45.6
Marital status (1,444)						
With a partner	870	60.2	659	60.0	207	61.2
No partner	574	39.8	440	40.0	131	38.8
Race/color (1,440)*						
White	402	27.9	297	27.0	100	29.9
Black	1,038	72.1	801	73.0	235	70.1

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Time in the profession (1,437)*						
Up to 10 years	620	43.1	480	43.9	140	41.5
More than 10 years	817	56.9	613	56.1	197	58.5
Weekly workload (1,444)						
< 20 hours	605	41.9	488	44.4	116	34.3
21-40 hours	716	49.6	538	49.0	173	51.2
> 40 hours	123	8.5	73	6.6	49	14.5
Has another job (1,444)						
No	726	50.3	618	56.2	104	30.8
Yes	718	49.7	481	43.8	234	69.2
Does remote work (1,444)						
No	23	1.6	21	1.9	2	0.6
Yes	1,421	98.4	1078	98.1	336	99.4
How the choice of tool was made (1,444)						
Joint decision	216	15.2	158	14.7	55	16.4
Decided alone	44	3.0	39	3.6	5	1.5
The institution indicated	1,161	81.7	881	81.7	276	82.1
They felt prepared to use the chosen tool (1,421)*						
Yes	151	10.6	90	8.3	61	18.2
Partially	718	50.5	545	50.6	169	50.3
No	552	38.8	443	41.1	106	31.5
Training in the use of digital tools (1,416)*						
Yes	806	56.9	602	56.1	201	60.0
No	610	43.1	472	43.9	134	40.0
Internet (1,410)*						
Suitable	1,225	86.9	926	86.7	292	87.2
Inadequate	185	13.1	142	13.3	43	12.8
Computer (1,407)*						
Suitable	1,221	86.8	913	85.6	301	90.1
Inadequate	186	13.2	153	14.4	33	9.9
Headset and microphone (1.393)*						
Suitable	1,084	77.8	804	76.2	275	83.1
Inadequate	309	22.2	251	23.8	56	16.9

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Furniture (1,398)*						
Suitable	876	62.7	657	62.1	215	64.6
Inadequate	522	37.3	401	37.9	118	35.4
Physical space for work (1,410)*						
Suitable	798	56.6	598	55.9	195	58.6
Inadequate	612	43.4	472	44.1	138	41.4
Noise level (1.411)*						
Suitable	933	66.1	686	64.2	242	72.2
Inadequate	478	33.9	383	35.8	93	27.8
Interruptions (1,405)*						
Suitable	998	71.0	735	69.1	257	76.7
Inadequate	407	29.0	328	30.9	78	23.3
Change in weekly time spent at work (1,418)*						
None	132	9.3	97	9.0	34	10.1
Reduced	197	13.9	141	13.1	55	16.4
Increased	1,089	75.4	838	77.9	246	73.4
How do you feel about the new demands of remote activity (1,419)*						
Prepared	189	13.3	105	9.8	82	24.4
Partially prepared	797	56.2	612	56.9	183	54.5
Unprepared	433	30.5	359	33.4	71	21.1
New work demands invading time devoted to other jobs (1,420)*						
No	202	14.2	134	12.4	67	19.9
Yes	707	49.8	496	46.1	208	61.9
Only works one job	511	36.0	447	41.5	61	18.2
The new demands of work invade the time dedicated to daily activities, such as:						
Rest or relaxation (1,405)*						
No	277	19.7	204	19.2	72	21.5
Yes	1,128	80.3	859	80.8	263	78.5
Sleep (1,345)*						
No	479	35.6	346	33.9	132	41.8
Yes	866	64.4	676	66.1	184	58.2
Food (1,307)*						
No	688	52.6	500	50.6	185	59.1
Yes	620	47.4	488	49.4	128	40.9

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Looking after yourself (1,373)*						
No	409	29.8	289	27.7	119	37.0
Yes	964	70.2	755	72.3	203	63.0
Level of difficulty in carrying out teaching activities in the context of social distancing:						
Communication with students (1,444)						
Has no difficulty	381	26.4	280	25.5	99	29.3
Has difficulty	1,063	73.6	819	74.5	239	70.7
Planning and execution of distance activities (1,444)						
Has no difficulty	378	26.2	269	24.5	108	32.0
Has difficulty	1,066	73.8	830	75.5	230	68.0
Use of the tools required to carry out the work (1,444)						
Has no difficulty	434	30.1	301	27.4	132	39.1
Has difficulty	1,010	69.9	798	72.6	206	60.9
Organizing a schedule of activities in the home environment (1,444)						
Has no difficulty	335	23.2	245	22.3	90	26.6
Has difficulty	1,109	76.8	854	77.7	248	73.4
Physical activity						
Yes	589	40.8	419	38.1	167	49.4
No	855	59.2	680	61.9	171	50.6
Leisure activities						
Yes	571	39.5	381	34.7	185	54.7
No	873	60.5	718	65.3	153	45.3
Smokes (1,444)						
No	1,384	95.8	1066	97.0	314	92.9
Yes	60	4.2	33	3.0	24	7.1
Consume alcoholic beverages (1,444)						
No	667	46.2	556	50.6	110	32.5
Yes	777	53.8	543	49.4	228	67.5
Domestic overload (1,444)						
Low	919	63.6	634	57.7	279	82.5
High	525	36.4	465	42.3	59	17.5

Continue

Continuation

Satisfaction with ability to work (1,444)						
Satisfied	590	40.9	427	38.9	160	47.3
Dissatisfied	854	59.1	672	61.1	178	52.7
Satisfaction with interpersonal relationships (1,444)						
Satisfied	598	41.4	462	42.0	134	39.6
Dissatisfied	846	58.6	637	58.0	204	60.4
Satisfaction with oneself (1,444)						
Satisfied	623	43.1	465	42.3	155	45.9
Dissatisfied	821	56.9	634	57.7	183	54.1

*Response rates varied due to loss of information for the variables analyzed. Lost data was excluded from the analysis.

There was a high prevalence of MSP: 70.6% of upper limb pain and 69.9% of back pain. Women had the highest prevalence of upper limb pain (74.0%) and back pain (74.1%) when compared to men (59.5% and 56.2% respectively). The female sex was associated with increased complaints of pain in the upper limbs (PR = 1.24, 95%CI: 1.13-1.36) and spine or back (PR = 1.32, 95%CI: 1.19-1.46). None of the general work characteristics were significantly associated with MSP complaints (**Table 2**).

About work aspects (**Table 2**), it was observed that teachers who chose their digital work tool together with their teaching institution had a lower prevalence of MSP than those who decided on their own (PR = 1.16; 95%CI: 1.04-1.29) and those whose choice of work tool was determined by their institution (PR = 1.25; 95%CI:1.04-1.52).

Not feeling prepared to use digital tools influenced the occurrence of MSP in the spine or back. Considering the training process for the use of digital tools, it was observed that among teachers who had no training there was a higher prevalence of pain in the upper limbs (74.8%) and spine or back (75.9%), with a positive association for both segments (**Table 2**).

Almost all the inadequate working conditions in the home environment were associated with MSP in the body segments assessed. For complaints of MSP in the upper limbs, inadequate internet conditions had the highest prevalence (78.9%), followed by headphones and microphones (77.7%), noise levels (76.8%), and furniture (76.6%). For complaints of MSP in the back and spine, the highest prevalence rates were reported for inadequate headset and microphone conditions (83.5%), noise level (82.4%), and interruptions (81.6%) (**Table 2**). For both body segments, the items relating to inadequate working conditions in the home environment were positively associated with the complaint of MSP in both body segments, with statistical significance. Only the computer item was not significantly associated with MSP in the upper limbs (**Table 2**).

Table 2 Prevalence of musculoskeletal pain, according to sociodemographic and work characteristics during the COVID-19 pandemic among teachers at all levels of education in the private network. Bahia, Brazil, 2020 (n = 1,144)

Variable	Upper limb pain				Back pain			
	n	P(%)	PR	95%CI	n	P(%)	PR	95%CI
Gender								
Male	201	59.5	1.00	-	190	56.2	1.00	-
Female	813	74.0	1.24	1.13;1.36	814	74.1	1.32	1.19;1.46

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Age group								
Under 40	576	69.4	1.00	-	625	75.3	1.00	-
40 years or older	444	72.3	1.04	0.97;1.11	384	62.5	0.83	0.77;0.89
Marital status								
With a partner	613	70.5	1.00	-	610	70.1	1.00	-
No partner	407	70.9	1.01	0.94;1.07	399	69.5	0.99	0.92;1,06
Race/color								
White	274	68.2	1.00	-	282	70.1	1.00	-
Black	742	71.5	1.06	0.98;1.14	725	69.8	0.99	0.92;1,07
Time in the profession								
Up to 10 years	430	69.4	1.00	-	456	73.5	1.00	-
More than 10 years	584	71,5	1.03	0.96;1.10	547	67,0	0.91	0.85;0.97
Weekly workload								
< 20 hours	425	70.2	1.00	-	425	70.2	1.00	-
21-40 hours	516	72.1	1.03	0.96;1.09	505	70.5	1.01	0.94;1.07
> 40 hours	79	64.2	0.91	0.79;1.05	79	64.2	0.91	0.79;1.05
Has another job								
No	503	69.3	1.00	-	517	71.2	1.00	-
Yes	517	72.0	1.04	0.97;1.11	492	68.5	0.96	0.89;1.03
Does remote work								
No	16	69.6	1.00	-	12	52.2	1.00	-
Yes	1,004	70.7	1.02	0.77;1.33	997	70.2	1.35	0.91;1.99
How the choice of tool was made								
Joint decision	150	69.4	1.00	-	133	61.6	1.00	-
Decided alone	33	75.0	1.08	0.89;1.31	34	77.3	1.25	1.04;1.52
The institution indicated	821	70.7	1.02	0.93;1.12	830	71.5	1.16	1.04;1.29
I felt prepared to use the tool								
Yes	99	65.6	1.00	-	87	57.6	1.00	-
Partially	496	69.1	1.05	0.93;1.19	488	68.0	1.18	1.02;1.36
No	409	74.1	1.13	0.99;1.28	422	76.4	1.33	1.15;1.53
Training in the use of tools								
Yes	545	67.6	1.00	-	531	65.9	1.00	-
No	456	74.8	1.11	1.04;1.18	436	75.9	1.15	1.08;1.23

Continue

Continuation

Internet								
Suitable	851	69.5	1.00	-	841	68.7	1.00	-
Inadequate	146	78.9	1.14	1.06;1.24	149	80.5	1.17	1.08;1.27
Computer								
Suitable	856	70.1	1.00	-	839	68.7	1.00	-
Inadequate	139	74.7	1.06	0.97;1.17	149	80.1	1.16	1.75;1.26
Headset and microphone								
Suitable	747	68.9	1.00	-	722	66.6	1.00	-
Inadequate	240	77.7	1.13	1.05;1.21	258	83.5	1.25	1.18;1.34
Furniture								
Suitable	587	67,0	1.00	-	562	64.2	1.00	-
Inadequate	400	76.6	1.14	1.07;1.22	419	80.3	1.25	1.17;1.34
Physical space for work								
Suitable	542	67.9	1.00	-	509	63.8	1.00	-
Inadequate	453	70.6	1.09	1.02;1.16	480	78.4	1.23	1.15;1.31
Noise level								
Suitable	630	67.5	1.00	-	597	64.0	1.00	-
Inadequate	367	76.8	1.14	1.06;1.22	394	82.4	1.28	1.21;1.37
Interruptions								
Suitable	688	68.9	1.00	-	657	65.8	1.00	-
Inadequate	308	70.9	1.09	1.02;1.18	332	81.6	1.24	1.16;1,32

*Response rates varied due to loss of information for the variables analyzed. Lost data was excluded from the analysis.

The prevalence of MSP according to the characteristics and conditions of RW are shown in **Table 3**. There was a higher prevalence of MSP in the upper limbs and spine or back for teachers who increased the amount of time they spent at work each week, when compared to those who maintained the same amount of time. There was a significant positive association for complaints of MSP in the upper limbs (PR = 1.21; 95%CI:1.05-1.39) and spine or back (PR = 1.48; 95%CI:1.25-1.76) among those who had more time. For those who felt unprepared or partially prepared to meet the demands of remote working, there was a higher prevalence of MSP in the upper limbs and spine or back (82.0% and 69.3% respectively). The invasion of RW in the time dedicated to another job was also positively associated with the complaint of MSP in both body segments (74.1% for upper limbs and 75.0% for spine or back).

Regarding the invasion of time dedicated to daily activities because of the new work demands, the highest prevalence of MSP in the upper limbs was recorded in situations of invasion of time dedicated to eating (80.0%), sleeping (77.9%), and resting (74.3%). The prevalence of MSP in the spine or back was higher when time was spent eating (82.7%), sleeping (80.0%), and taking care of oneself (77.6%). All the items were positively associated with MSP complaints in both body segments when compared to the groups who did not report having their time affected (**Table 3**).

Teachers who reported having difficulties in carrying out activities in the social distancing scenario (difficulties in communicating with students, planning and carrying out distance activities, using the tools required to carry out the work, and organizing a schedule of activities in the home environment) had higher prevalence rates of MSP in the upper limbs and spine or back (**Table 3**), at statistically significant levels, when compared to those who had no difficulties.

Table 3 Prevalence of musculoskeletal pain, according to psychosocial characteristics of remote work, among teachers of all levels of education in the private network. Bahia, Brazil, 2020 (n = 1,144)

Variable	Upper limb pain				Back pain			
	n	P (%)	PR	95%CI	n	P (%)	PR	95%CI
Change in the amount of time spent at each week								
None	81	61.4	1.00	-	67	50.0	1.00	-
Decreased	111	56.3	0.92	0.76;1.10	110	55.8	1.10	0.89;1.35
Increased	810	74.4	1.21	1.05;1.39	819	75.2	1.48	1.25;1.76
How do you feel about the new demands of remote activity?								
Prepared	107	56.6	1.00	-	88	46.6	1.00	-
Partially prepared	554	69.5	1.23	1.07;1.40	552	69.3	1.48	1.27;1.75
Unprepared	341	78.8	1.39	1.22;1.59	355	82.0	1.76	1.50;2.06
New work demands invading time devoted to other jobs								
No	114	56.4	1.00	-	98	48.5	1.00	-
Yes	524	74.1	1.31	1.15;1.49	530	75.0	1.54	1.33;1.79
New work demands invade the time dedicated to daily activities, such as:								
Rest or relaxation								
No	154	55.6	1.00	-	141	49.1	1.00	-
Yes	838	74.3	1.34	1.19;1.49	852	75.5	1.54	1.36;1.74
Sleep								
No	278	58.0	1.00	-	264	55.1	1.00	-
Yes	675	77.9	1.34	1.23;1.46	693	80.0	1.45	1.33;1.58
Food								
No	436	63.4	1.00	-	418	60.8	1.00	-
Yes	496	80.0	1.26	1.18;1.35	513	82.7	1.36	1.27;1.46
Self-care								
No	243	75.8	1.00	-	223	54.5	1.00	-
Yes	731	59.4	1.28	1.17;1.39	748	77.6	1.42	1.29;1.56

Continue

Continuation

Level of difficulty in carrying out teaching activities in the context of social distancing:								
Communication with students								
Has no difficulty	244	64.0	1.00	-	221	58.0	1.00	-
Has difficulty	776	73.0	1.14	1.05;1.24	788	74.1	1.28	1.16;1.40
Planning and execution of activities								
Has no difficulty	245	64.8	1.00	-	221	58.5	1.00	-
Has difficulty	775	72.7	1.12	1.03;1.22	788	73.9	1.26	1.15;1.38
Use of the tools required to carry out the work								
Has no difficulty	280	64.5	1.00	-	275	63.4	1.00	-
Has difficulty	740	73.3	1.14	1.01;1,23	734	72.7	1.14	1.06;1.24
Organizing a schedule of activities in the home environment								
Has no difficulty	198	59.1	1.00	-	176	52.5	1.00	-
Has difficulty	822	74.1	1.25	1.14;1.38	833	75.1	1.43	1.28;1.59

* Response rates varied due to loss of information for the variables analyzed. Lost data was excluded from the analysis.

About lifestyle habits, the highest prevalence rates of MSP for the upper limbs and spine or back were identified for teachers who did not regularly practice physical activity (75.7% and 75.9% respectively) and among those who did not perform leisure activities (77.7% for the upper limbs and 76.1% for the spine or back) (**Table 4**). The differences observed were statistically significant. The highest prevalence rates of MSP (75.8% for upper limbs and 76.4% for spine or back) were observed in high DO condition, at significant levels.

Situations of dissatisfaction - with work ability, with interpersonal relationships, or with oneself - were statistically associated with complaints of MSP in the upper limbs and in the spine or back (**Table 4**).

Table 4 Prevalence of musculoskeletal pain, according to lifestyle habits, domestic overload, and levels of satisfaction with work, personal relationships, and oneself, among teachers at all levels of education in the private network. Bahia, Brazil, 2020 (n = 1,144)

Variable	Upper limb pain				Back pain			
	n	P (%)	PR	95%CI	n	P (%)	PR	95%CI
Physical activity								
Yes	647	63.3	1.00	-	649	61.1	1.00	-
No	373	75.7	1.19	1.11;1.28	360	75.9	1.24	1.15;1.34
Leisure activities								
Yes	678	59.9	1.00	-	664	60.4	1.00	-
No	342	77.7	1.29	1.20;1.39	345	76.1	1.26	1.17;1.36

Continue

Continuation

Smokes								
No	974	70.4	1.00	-	969	70.0	1.00	-
Yes	46	76.7	1.09	0.94;1.26	40	66.7	0.95	0.79;1.14
Consume alcoholic beverages								
No	465	69.7	1.00	-	478	71.7	1.00	-
Yes	555	71.4	1.03	0.96;1.09	531	68.3	0.95	0.89;1.02
Domestic overload								
Low	622	67.7	1.00	-	608	66.2	1.00	-
High	398	75.8	1.12	1.05;1.19	401	76.4	1.15	1.08;1.23
Satisfaction with ability to work								
Satisfied	378	64.1	1.00	-	363	61.5	1.00	-
Dissatisfied	642	75.2	1.17	1.09;1.26	646	75.6	1.23	1.14;1.32
Satisfaction with interpersonal relationships								
Satisfied	396	73.8	1.00	-	376	62.9	1.00	-
Dissatisfied	624	66.2	1.11	1.04;1.19	633	74.8	1.19	1.11;1.28
Satisfaction with oneself								
Satisfied	393	63.1	1.00	-	378	60.7	1.00	-
Dissatisfied	627	76.4	1.21	1.13;1.30	631	76.9	1.27	1.18;1.37

* Response rates varied due to loss of information for the variables analyzed. Lost data was excluded from the analysis.

In the multivariable analysis of the whole group, in the final model obtained, the following remained positively associated with MSP in upper limb pain: sex, having more time dedicated to work, having difficulty organizing one's schedule, and self-satisfaction. Leisure activity was negatively associated with MSP in the upper limbs. Back pain associated with the following variables: sex, increased time spent at work, difficulty organizing the schedule, difficulty with students, and DO. Physical activity, leisure activities and age > 40 years were negatively associated with complaints of MSP (**Table 4**).

In the multivariable analysis, stratified by sex, differences were observed between the factors associated with MSP. Among female teachers, the following remained positively associated with upper limb pain: increased time dedicated to work, difficulty organizing the schedule, and working in more than one school. While leisure activity was negatively associated with upper limb pain. For back pain, the final model retained: difficulty organizing the schedule, feeling unprepared for the new demands, high DO, difficulty with students, and increased time spent at work. Physical activity and age > 40 years were inversely associated with back pain (**Table 5**).

Among male teachers, the following variables were positively associated with upper limb pain: difficulty with students and weekly workload > 20 hours. Leisure time was negatively associated with upper limb pain. Back pain, in the final model, was positively associated with: difficulty organizing the schedule and noise. A negative association with back pain was observed for leisure activities, interruption in remote work and age > 40 years (**Table 5**).

Table 5 Factors associated with musculoskeletal pain, according to logistic regression models stratified by sex, among teachers of all levels of education in the private network. Bahia, Brazil, 2020 (n = 1,144, n = 1,078 female and n = 338 male)

Variable	Female		Male	
	Upper limb pain			
	RP*	95%CI	PR	95%CI
Increased time dedicated to work	1.19	1.08-1.32		
Difficulty organizing the schedule	1.14	1.03;1.26		
Works in more than one school	1.08	1.02;1.16		
Leisure activities	0.85	0.78;0.92	0.72	0.60;0.86
Difficulty with students			1.33	1.06;1.67
Weekly workload greater than 20 hours			1.28	1.05;1.56
	Back pain			
	PR	95%CI	PR	95%CI
Difficulty organizing the schedule	1.20	1.07;1.35	1.68	1.27;2.22
Noise			1.27	1.05;1.54
Interruption in remote work			0.78	0.65;0.94
Leisure activities			0.81	0.66;0.99
Age > 40 years	0.90	0.84;0.97	0.71	0.57;0.85
Feel unprepared for the new demands	1.07	1.02;1.14		
Domestic overload	1.10	1.03;1.17		
Difficulty with students	1.12	1.02;1.22		
Increased time dedicated to work	1.28	1.15;1.43		

*Analyses adjusted for the physical activity variable. Response rates varied due to loss of information for the variables analyzed. Lost data was excluded from the analysis.

Discussion

The results obtained in this study identified a high prevalence of pain in the upper limbs and in the spine or back, attesting to this increase in the occurrence of MSP during the pandemic, since the recorded prevalence of MSP was higher than in previous periods[17-19]. Observing differences, both in the magnitude of occurrence and in the regions most affected, in relation to MSP compared to periods prior to the pandemic, it was noted that the difference observed in these contexts (face-to-face and virtual) strengthens the hypothesis that the way work is carried out has an impact on teachers' health. Different bodily demands, different regions affected by MSP.

There was a higher prevalence of pain in the upper limbs related to the changes in posture adopted during teaching work in the pandemic, with more time spent sitting and in front of screens[20], in contrast to results in the literature[17] which identified pain in the lower limbs as the main complaint reported by teachers during face-to-face classes. However, the prevalence of back pain was similar to that observed in another study[17].

Moving on to discuss the factors associated with MSP, three variables were relevant for both sexes: difficulties in organizing the schedule contributed to an increase in the prevalence of back pain, leisure activities were a factor in reducing pain in the upper limbs, and age > 40 years was associated with a reduction in back pain.

The association between the difficulty in organizing the schedule and MSP is related to work overload and the large volume of activities required of teachers during remote teaching, such as: creating new strategies, handling new digital tools without prior training, short deadlines for preparing lessons, as well as household chores and caring for the family. The teachers involved in the RW complained about: the increase in the number of meetings outside of working hours, the lack of training in handling digital tools, messages and calls to private phones with no restrictions on the time and day of the week, short deadlines for handing in activities, as well as the lack of remuneration for excess hours worked[6]. All these aspects make it difficult to draw up a schedule of activities and result in increased demands on the body and, consequently, an increase in MSP complaints.

Still considering the general aspect, the elements that were shown to be a protective factor were leisure activities, which were associated with a reduction in MSP in the upper limbs for both sexes and back pain among men. Collaborating with this finding, the study by Morais et al.[21] stated that practicing leisure activities is an important tool for relieving tension and promoting health, which is reflected in the prevention of MSP.

Another factor associated with both sexes refers to complaints of back pain being negatively associated with older age, a fact that differs from what was expected based on the literature. According to the studies, age is an important factor to consider, as the aging process causes wear and tear on the musculoskeletal structures and, with this, an increase in pain complaints, which can be intensified when exposed to an exacerbated workload[22-24]. However, a possible justification for the reduction in pain complaints in this group may be related to greater concern for health in older individuals[25]. It should be emphasized that these topics are justifications provided in the literature, and, for this study, it was not possible to state which factors influenced the negative association with age > over 40, making other approaches with different methodology on the subject necessary.

There were differences in the frequency of MSP according to sex, with both body segments being more prevalent among female teachers. Among these teachers, pain in the upper limbs was positively associated with difficulty organizing a schedule, an increase in the time dedicated to work, and working in more than one school. Pain in the spine or back was also positively associated with difficulty in organizing the schedule and increased time spent at work, plus feelings of unpreparedness for the new demands and high DO.

The context of multiple tasks to be carried out by women, with the challenge of reconciling paid work and domestic duties, directly impacting on their health status, is a potential explanation for the differences recorded. Similar results are consistent in the literature, even before the pandemic. Several studies have shown that women are more overloaded with domestic activities and have more complaints of MSP[22,26,27]. During the pandemic, domestic activities became even more pronounced: in addition to all the tasks usually carried out as routine housework, there were also those resulting from demands, for example, accompanying sons and daughters to their school activities in the domestic environment and cleaning and disinfecting everything that came into the house[28]. In general, these tasks were assumed to be women's responsibility. The women who had the most to do had the greatest difficulty in reconciling work and household chores; this may help to explain the high frequency of psychological changes, increased physical tiredness, deprivation of time dedicated to rest, leisure, food, and sleep[26,28].

Considering the positive association between women's increased time dedicated to work and working in more than one school, Araújo et al.[22] point out that teaching activities associated with high DO expose this group to more precarious health conditions; in addition, women generally have low pay compared to men, making it necessary to look for a second job, greater dedication and an overload of activities to be carried out. In summary, these studies highlight that high DO is an important factor in women becoming ill and was also a relevant issue in explaining the positive association between pain and feelings of unpreparedness, given that women had less time to invest in their professional development during the pandemic, which also had an impact on the number of

scientific outputs[29]. Our results also strengthen the hypothesis of differentiation in the frequency of pain according to sex and the association between pain and high DO among women.

Also among female teachers, it was observed that the practice of leisure activities was inversely associated with complaints of MSP in the upper limbs and physical activity for the spine or back. Considering this finding, Silva et al.[30] say that physical activity is an important factor influencing quality of life and that teachers who did not do any physical activity during the lockdown period, in addition to complaining of MSP, showed changes in their sleep patterns, mood swings, increased stress, anxiety, and depression.

Among males, noise and difficulty organizing the schedule were positively associated with back pain, while interruption in remote work, leisure activities, and age > over 40 years old were negatively associated with pain. For pain in the upper limbs, a positive association was found with pain: difficulty with students and working more than 20 hours; a negative association was observed for leisure activities.

According to Costa et al.[31], noise is a potential source of damage to teachers' health. With the inclusion of professional work in the domestic environment, teachers are exposed to a condition of continuous tension in terms of noise, both internal (in the home) and external (from the street and neighbors). The specificities of the home, such as noise caused by dogs barking, children playing, the use of electrical appliances, advertising cars, construction work in the neighborhood, among others, compromised the development of remote activities[32]. As a result, it was not uncommon for a situation favorable to professional performance (such as meetings and videoconferences) to require longer chunks of time, making meetings more tiring and stressful[33].

In addition, the noise was distracting and affected speech comprehension, performance on tasks, interaction with students, and consequently the entire teaching-learning process[32]. This was found in this study through positive association between pain and difficulty interacting with students. Several studies have pointed to noise as a negative factor in remote classes and have also linked the complaint of pain to the excessive use of digital tools such as microphones and headphones, also stating that in the home environment these factors are neither controlled nor measured[31-35]. Another factor that may help to understand why the result for this variable was only relevant among male teachers may be associated with the fact that the home environment and its surroundings are almost always far removed from the universe of difficulties faced by men daily. Thus, these noises from home and the neighborhood structured a new factor in the world of RW for men, which required adaptation and produced tension, which to some extent was expressed in MSP.

Regarding interruptions, it was observed that there was a negative association between men and complaints of MSP, because male teachers had fewer interruptions during lessons when compared to female teachers. According to Vidal[29], there were reports of students regarding the presence of children during classes among female teachers, while among male teachers, even when children were present, there were fewer breaks due to the domestic environment. This context reaffirms the situation of gender inequality experienced during remote education.

It's important to note that the new context of remote teaching is a condition that has arisen to meet teaching demands to minimize harm to students and teachers, but the legislation is still fragile and fails to incorporate aspects that can help identify and establish factors that can prevent teachers from becoming ill. Access to ICT is growing and, even after returning to school, many of the tools used during remote teaching will be part of this category's routine. Public health policies therefore need to include them in the context of occupational illness and promote health protection actions.

Disadvantages include the impossibility of guaranteeing the study's external validity (representativeness and generalization of the results), its scope being limited to people with the availability of technological resources and the ability to use them, access to the internet, and the possibility of multiple responses from the same participant[9].

Finally, the limitations of this study include convenience sampling. It is possible that the teachers who answered the questionnaire had a complaint and therefore felt more willing to take part in the research. This type of sampling also makes it impossible to guarantee the study's external validity (representativeness and generalization of the

results), and its scope is limited to people with the availability of technological resources and the ability to use and access the internet. Furthermore, data collection was carried out during the initial phase of the pandemic, when many teachers were still in the process of adapting to the new context, generating more refusals to participate, making it difficult to expand the sample.

Despite the limitations, this study reached a significant sample of teachers, strictly following recommendations to ensure the quality of the research and avoid multiple responses from the same participant. In this way, it makes valuable contributions to the relationship between teachers' working conditions during the COVID-19 pandemic and the occurrence of MSP.

Conclusion

The pandemic has significantly altered teaching activities with the introduction of remote working. The new demands have caused overload and professional strain. Remote activities have exposed teachers to an increase in complaints of MSP, both in the upper limbs and in the spine and back, and the accumulation of tasks and the unsuitable home environment may have been aggravating factors. In addition, it was possible to reflect on the panorama that teachers' health was in when the pandemic began, serving as a comparison for studies following this scenario.

It is worth pointing out that sex and gender differences need to be discussed and taken into account during the analysis process, as in this study it was clear that the accumulation of activities by female teachers may have contributed to greater exposure to MSP, considering that only in this group did domestic activity appear as a factor in accentuating the complaint. However, for male teachers, noise was one of the factors that intensified the complaint of MSP.

We stress the importance of more robust studies using other methodological approaches to the subject, as well as the need to incorporate actions and public policies that minimize the process of illness and value teachers, considering sex and gender differences.

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