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The musculoskeletal problems and psychosocial status of teachers giving online education during the COVID-19 pandemic and preventive telerehabilitation for musculoskeletal problems

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Abstract.
BACKGROUND: Musculoskeletal and psychosocial problems have tended to increase during the COVID-19 pandemic.
OBJECTIVE: To evaluate the changes in musculoskeletal problems and psychosocial status of teachers during the COVID-19 pandemic due to online education and to investigate the effects of preventive telerehabilitation applications for musculoskeletal problems.
METHODS: Forty teachers who conducted online education during the pandemic volunteered to participate in the study. All assessments were performed via online methods. The Cornell Musculoskeletal Discomfort Questionnaire (CMDQ), ProFitMap-Neck questionnaire, Oswestry Disability Index (ODI), and Upper Extremity Functional Index (UEFI) were used to evaluate musculoskeletal problems; the Beck Anxiety Inventory (BAI) and the Beck Depression Inventory (BDI) were used to evaluate anxiety and depression, respectively; and the Work–Life Balance Scale (WLBS) was used to evaluate how well individuals achieve this balance. Information about before online education, during online education, and after training was obtained with the assessments. After the first assessment, telerehabilitation, which involved presentations and brochures, was applied to 18 participants willing to participate in the training.
RESULTS: The ProFitMap, UEFI, and WLBS scores during the online education decreased significantly, while the scores of the CMDQ, ODI, BDI, and BAI during the online education increased significantly compared to the pre-online education scores ($p < 0.05$). In addition, the total CMDQ, ProFitMap, and ODI scores improved significantly after the training ($p < 0.05$).
CONCLUSIONS: Musculoskeletal and psychosocial problems increased in teachers during online education. Preventive telerehabilitation methods will be beneficial for individuals who do not have access to face-to-face physiotherapy.

Keywords: Musculoskeletal disorders, telehealth approaches, ergonomics

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1. Introduction

Coronavirus disease 2019 (COVID-19) first appeared at the end of 2019, spread throughout the world at the beginning of 2020 and was then declared a pandemic by World Health Organization (WHO) [1]. Countries affected by the COVID-19 pandemic were forced to impose wide restrictions on public and private life. Restrictive precautions based on social distancing rules were applied to prevent human-to-human transmission and spread of the virus. The regulations introduced covered all areas of life such as social life and included the education system [2]. In order to ensure social isolation during the pandemic, all formal education has been suspended and distance (online) education has been implemented in many schools, with the assumption that the pandemic will be prolonged. Online education is a training system in which live video and audio lessons are carried out in a completely virtual environment through existing computer technologies without the obligation of the student and teacher to come to school, completely independent of time and space [3]. In the distance education system, the use of online education tools such as computers is greater than it is in the traditional education system.

Many studies involving office workers who use computers have shown that prolonged work in a sitting position and using computers have created musculoskeletal problems and exacerbated existing problems [4, 5]. It is known that the main reason for this is the frequent repetitive movements of the upper extremities, as well as the prolonged computer working times, and therefore increased loads on the musculoskeletal system [6]. An examination of the literature reveals that postural imbalances caused by personal and work-related factors such as long working hours, inappropriate rest breaks, increased and inappropriate use of smart devices, wearing of glasses, stress and anxiety, and factors related to the work environment such as poor placement of the computer screen and keyboard and/or mouse, poor chair and table selection, and the physical and environmental conditions of the room appear to increase musculoskeletal disorders in employees using computers [4, 7]. At the same time, it is stated in the literature that in the individuals working in jobs that require excessive use of computers, mental loads increase, anxiety and depression occur, physical activity levels decrease, and in a vicious cycle these situations have negative effects on the musculoskeletal system and general health status [8–10].

Examination of the normal working conditions of teachers showed that the bad posture caused by standing in front of the board for long periods, communicating with the students and evaluating their classroom activities while bending over, and carrying heavy books and equipment causes musculoskeletal system problems, especially in the upper and lower extremities [11, 12]. For elementary and secondary school teachers working in the distance education system implemented during the pandemic, it might also be supposed that musculoskeletal system and psychosocial problems may be experienced, as seen in studies conducted with people working at computers for a long time.

In studies conducted in 2020 during the COVID-19 pandemic, it is reported that in people who had to stay at home as a result of restrictions applied to ensure social isolation musculoskeletal system and psychosocial status problems emerged due to immobility, poor working conditions, and anxiety and depression that developed in parallel with fear of the pandemic. In addition, it has been stated that employers and employees do not have time to adapt to this situation personally and environmentally, as the transition to compulsory home work is very sudden [13–15]. Similarly, it can be expected that teachers who conduct online education activities may develop musculoskeletal system and psychosocial problems and existing ones may become more serious. Preventive rehabilitation is needed in these situations, but face-to-face applications cannot be performed due to the pandemic. This has directed clinicians and researchers towards the use of telerehabilitation methods, which include using technology such as phones, e-mail, and video conferences to provide suggestions, applications, or information exchange [16–18]. The World Confederation for Physical Therapy (WCPT) published reports in April 2020 about the application of these digital physiotherapy and rehabilitation methods during the pandemic, which have existed since the 2000s but not been widely used [19,20].

Therefore, by examining the effects of online education methods on teachers during the COVID-19 pandemic, it was considered necessary to determine whether preventive programs are necessary for the health of individuals in such cases. For this purpose, the present study was planned to make necessary evaluations, to provide telerehabilitation applications including information about posture and ergonomics, and to guide further protective rehabilitation programs that can be applied to teachers working in online education by evaluating the effects of telerehabilitation during extraordinary situations such as pandemics.

2. Materials and methods

Forty teachers who applied distance education methods online at primary and secondary schools volunteered to participate in our study, which was conducted in a quasi-experimental order in a single group between May 2020 and July 2020. Due to the pandemic, all of the data collection and applications were conducted online. Ethics committee approval of the study was obtained by the decision of Nevşehir HacıBektaş Veli University Non-Interventional Clinical Research Ethics Committee dated 30.04.2020 and numbered 2020.10.97. All individuals participating in the study provided informed consent.

The inclusion criteria were as follows: age between 20 and 65 years, working as a teacher for at least 1 year, teaching via online education methods for at least 4 weeks during the pandemic, and using visual display terminals (VDTs) for at least 10 hours a week. Individuals with a history of traumatic injury, any neurological conditions, or who underwent spinal or other musculoskeletal operations were excluded.

2.1. Sociodemographic information

The sociodemographic information obtained included age, body mass index, marital status, occupation duration, duration of online education, duration of daily use of computers and other technological devices, and attention to body alignment.

2.2. Assessments

The questionnaires used for evaluations were sent to the participants electronically and were fillable PDF files (Acrobat Reader DC) or Google forms. In the first evaluation, after the informed consent form was received individuals were requested to fill out a questionnaire about their demographic information. The Cornell Musculoskeletal Discomfort Questionnaire (CMDQ), ProFitMap-Neck Questionnaire, Oswestry Disability Index (ODI), and Upper Extremity Functional Index (UEFI) were used to evaluate musculoskeletal problems; the Beck Anxiety Inventory (BAI) and the Beck Depression Inventory (BDI) were used to evaluate anxiety and depression, respectively; and the Work–Life Balance Scale (WLBS) was used to evaluate how well this balance is achieved. In the first assessment, individuals were asked to fill out questionnaires considering both their pre-online and online education status (first and second assessment). Then the telerehabilitation training about posture and ergonomics was given online. Four weeks after the telerehabilitation program, individuals were asked to complete the same questionnaires again (third assessment).

In addition to these evaluations, information about the number of painful days and the severity of pain during the day was obtained from individuals if they had pain. A visual analogue scale (VAS) was used to evaluate the severity of pain between 0 (no pain) and 10 (unbearable pain) [21].

2.2.1. Cornell musculoskeletal discomfort questionnaire

During the working period, the frequency and intensity of musculoskeletal aches, pain, or discomfort and the complaints with work-related impairments in 18 body regions were evaluated. In this survey, for each body region, the scores of the options selected from the areas of the frequency, the intensity, and the complaints with work-related impairments are multiplied and the weighted score of that body region is calculated, and the total score is calculated by adding these weighted scores together. An increased score shows that pain frequency, intensity, and effect on work performance have increased. A study on the cultural adaptation of this questionnaire into Turkish confirmed its validity and reliability [22].

2.2.2. Profitmap-neck questionnaire

This was used for evaluating the symptoms and functional limitations in individuals who had neck pain. The questionnaire consists of a total of 47 items in two subscales containing questions about the frequency and intensity of symptoms (symptom scale, 27 items) and functional limitations (functional limitation scale, 20 items). Low scores indicate more symptoms and functional limitations. A study confirmed the validity and reliability of the Turkish adaptation of this questionnaire as well [23].

2.2.3. Oswestry disability index

This was used to evaluate low back pain and related problems that occur during daily life activities. The survey consists of 10 sections and the total score ranges from 0 to 50 points. A high score indicates increased disability. The validity and reliability of this index in Turkish have been confirmed [24].

2.2.4. Upper extremity functional index

It was aimed to evaluate the upper extremity functions of individuals with the Upper Extremity Functional Index, which consists of 20 items. The lowest score that can be obtained from the survey is 0, while the highest score is 80. A low score indicates that the person has more restrictions in daily living functions due to upper extremity problems. The validity and reliability of this index in Turkish have also been confirmed [25].

2.2.5. Assessment of anxiety and depression

Anxiety and depression in individuals were evaluated with the BAI and BDI, respectively. The BAI, developed by Beck in 1988, is used to determine the frequency of anxiety symptoms experienced by individuals. An increase in the score obtained from the survey, consisting of 21 items and scored between 0 and 63 points, indicates that the level of anxiety has increased. The validity and reliability of the Turkish version were confirmed by Ulusoy et al. [26]. The BDI, developed by Beck in 1961, is used to determine the symptoms of depression experienced by individuals. An increase in the score obtained from the survey, consisting of 21 items and scored between 0 and 63 points, indicates that the level of depression has increased. The cultural adaptation, validity, and reliability of the Turkish version of this index have been confirmed [27, 28].

2.2.6. Work–life balance scale

The WLBS, developed by Taşdelen-Karçkay and Bakalım, was used to evaluate the balance between individuals' work life and private life. The eight-item questionnaire is scored between 8 and 56 points and a low score indicates a deterioration in the work–life balance [29].

2.3. Posture and ergonomics training by the tele-assistance method

One of the most useful telerehabilitation methods is tele-assistance, whose popularity is increasing with support from the WCPT about digital physiotherapy. Tele-assistance enables physiotherapists to communicate with individuals who want to get advice about their health by phone, teleconference, and e-mail. With tele-assistance it is aimed to use advice instead of clinical methods such as exercise [16, 17, 30]. In our study, tele-assistance was used to enable social isolation due to the COVID-19 pandemic. The presentation, which was prepared by physiotherapists who are experts in the field and included recommendations on posture and ergonomics, was given as online training via the software Zoom in order to protect the health of the musculoskeletal system of the teachers during the online education period. The training started with information about the problems that can occur during a pandemic, and individuals were informed about why musculoskeletal problems may occur during this period. At the same time, the training included recommendations such as regulating the duration of VDT use, the suitability of the table and chair, the position of the person according to the computer/phone/tablet/keyboard/mouse, the suitable use of smartphones, and how to protect the musculoskeletal system. In addition, a brochure, prepared to ensure that individuals can access this information at any time, was sent via e-mail. At the same time, all the participants in the study were given telephone numbers that would allow them to contact specialist physiotherapists in order to ask any questions they might have after the online training as well.

2.4. Statistical analysis

The descriptive statistics are presented as both mean $\pm$ standard deviation and median (minimum value–maximum value) for numerical variables. Frequencies and percentages were given as descriptive statistics for categorical variables.

To compare two dependent groups (pre-online education and during online education) in terms of numerical data, when the parametric test assumptions were met the paired samples t test was used. Otherwise the Wilcoxon signed rank test was used as an alternative. Normality of the numerical variables was assessed with the Shapiro–Wilk normality test. McNemar's test was used to determine significant differences between the pre-online education and during online education proportions. Repeated measures ANOVA was used when comparing three dependent groups (pre-online education, during online education, and after training) in terms of numerical data if the assumptions were met and after a significant difference was found pairwise comparisons were made with Bonferroni adjustment. The normality assumption was assessed by the Shapiro–Wilk normality test. Homogeneity of variance was assessed by Levene's test and the sphericity assumption was evaluated using Mauchly's sphericity test. Otherwise, Friedman's test was used and after a significant difference was found the Dunn–Bonferroni *post hoc* test was used to evaluate the difference pairwise. To compare the three groups (pre-online education, during online education, and after training) in terms of dependent proportions Cochran's Q test was used with the Dunn–Bonferroni *post hoc* test after a significant difference was found. IBM SPSS Statistics version 23 was used for all analysis. The significance level was set at 0.05.

3. Results

Forty teachers who gave online education during the COVID-19 pandemic participated in the study. Their sociodemographic characteristics are shown in Table 1.

Table 1
Sociodemographic information of the participants (total sample size = 40)

Characteristics		$\bar{X} \pm S$	$\tilde{X}$(Min-Max)
Age (years)		39.85 ± 11.78	35.50 (25–61)
Height (cm)		165.13 ± 5.75	165 (155–178)
Weight (kg)		65.23 ± 13.83	65 (45–115)
Body mass index (kg/cm^2)		23.83 ± 4.39	23.62 (17.57–38.87)
Occupation duration (years)		16.79 ± 12.97	10 (1–40)
Online education duration (days)		53.80 ± 15.17	60 (30–90)
		n	%
Sex	Female	31	77.5
	Male	9	22.5
Marital status	Married	25	62.5
	Single	15	37.5

$\bar{X} \pm S$: mean ± standard deviation, $\tilde{X}$: Median, min: Minimum, max: Maximum.

Technological device use times of the participants are given in Table 2. It was found that the use periods of technological devices for educational and noneducational purposes during the online education period of the participants increased significantly compared to the pre-online education period ($p < 0.05$) (Table 2).

The total score from the CMDQ and the other scores including neck, right shoulder, left shoulder, back, right forearm, right wrist, left wrist, lower back, and hip scores during the online education period were significantly higher compared to the pre-online education period ($p < 0.05$). Similarly, it was determined that the scores from the ODI, BDI, and BAI during the online education period were significantly higher compared to the pre-online education period ($p < 0.05$). In addition, the scores from the ProFit Map (total and subscale), UEFI, and WLBS during the online education were significantly lower compared to the pre-online education period ($p < 0.05$) (Table 3).

Only 18 individuals participated in the telerehabilitation training we prepared in line with the information obtained from the individuals participating in the study in the first assessment. The other individuals did not want to participate in telererehabilitation training. However, we continued the study with 18 participants. When the results from the three assessments of the participants (pre-online education, during the online education, and after training) were compared, the scores from the CMDQ (total scores and other scores from it including neck, back, lower back, right forearm, right wrist, and hip) and the scores from the ProFitMap (total and subscales), ODI, UEFI, BDI, BAI, and the WLBS were significantly different ($p < 0.05$). *Post-hoc* comparisons of

Table 2
The daily durations of technological device use ($n = 40$)

	Pre-online education period		During online education period		*p*
	$\bar{X} \pm S$	$\tilde{X}$(Min-Max)	$\bar{X} \pm S$	$\tilde{X}$(Min-Max)	
Computer use (educational purposes) (hours)	2.1 ± 1.4	2 (0–5)	5.2 ± 2.5	5 (3–10)	**<0.001**[a]
Computer use (noneducational purposes) (hours)	1.5 ± 1.3	1 (0–6)	2.3 ± 2.1	1 (0–8)	**0.001**[a]
Use of other VDTs (educational purposes) (hours)	1.2 ± 1.1	1 (0–5)	2.3 ± 2.1	2 (0–10)	**<0.001**[a]
Use of other VDTs (noneducational purposes) (hours)	1.7 ± 1.0	1 (0–4)	1.9 ± 1.1	2 (0–4)	**0.027**[a]
Total use of technological devices (hours)	6.5 ± 2.7	6 (2–13)	11.8 ± 3.5	11.5 (5–20)	**<0.001**[b]

a: Wilcoxon signed rank test, b: Paired samples *t* test. $\bar{X} \pm S$: mean ± standard deviation, VDT: visual display terminal $\tilde{X}$: Median, min: Minimum, max: Maximum.

Table 3
Comparisons of clinical assessments between the pre-online education and during online educations periods ($n = 40$)

	Pre-online education period		During online education period		p
	$\bar{X} \pm S$	$\tilde{X}$(Min-Max)	$\bar{X} \pm S$	$\tilde{X}$(Min-Max)	
CMDQ Total	44.98 ± 97.97	0 (0–440)	101.35 ± 113.37	0 (0–460)	**<0.001[a]**
Neck	5.98 ± 10.64	0 (0–40)	20.66 ± 26.58	8.5 (0–90)	**<0.001[a]**
Right shoulder	4.55 ± 15.64	0 (0–90)	9.26 ± 22.09	0 (0–90)	**0.002[a]**
Left shoulder	1.80 ± 6.67	0 (0–40)	7.18 ± 18.53	0 (0–90)	**0.004[a]**
Back	5.83 ± 15.58	0.75 (0–90)	19.15 ± 24.84	8.5 (0–90)	**<0.001[a]**
Right upper arm	1.75 ± 6.99	0 (0–40)	2.52 ± 7.55	0 (0–40)	0.159[a]
Left upper arm	1.07 ± 6.32	0 (0–40)	2.57 ± 14.23	0 (0–90)	0.121[a]
Right forearm	0.45 ± 1.72	0 (0–10)	3.78 ± 11.57	0 (0–60)	**0.009[a]**
Left forearm	0.66 ± 3.21	0 (0–20)	0.91 ± 3.40	0 (0–20)	0.102[a]
Right wrist	1.92 ± 4.48	0 (0–20)	6.22 ± 11.40	0 (0–40)	**0.001[a]**
Left wrist	0.36 ± 1.64	0 (0–10)	2.00 ± 4.96	0 (0–20)	**0.007[a]**
Lower back	8.83 ± 20.67	0 (0–90)	15.21 ± 22.71	4.25 (0–90)	**0.001[a]**
Hips	0.72 ± 3.19	0 (0–20)	3.97 ± 8.17	0 (0–40)	**0.004[a]**
Right upper leg	2.30 ± 7.37	0 (0–40)	1.85 ± 9.47	0 (0–60)	0.766[a]
Left upper leg	1.82 ± 7.11	0 (0–40)	0.50 ± 1.59	0 (0–90)	0.673[a]
Right knee	0.78 ± 3.32	0 (0–20)	1.91 ± 4.76	0 (0–20)	0.115[a]
Left knee	2.25 ± 9.93	0 (0–60)	1.56 ± 5.03	0 (0–30)	0.598[a]
Right lower leg	2.13 ± 7.36	0 (0–40)	2.18 ± 9.90	0 (0–60)	0.859[a]
Left lower leg	1.82 ± 7.10	0 (0–40)	1.18 ± 4.42	0 (0–20)	0.953[a]
ProFitMap Neck Total	887.71 ± 83.0	917 (694–973)	770.75 ± 142.88	792 (422–973)	**<0.001[a]**
ProFitMap frequency	322.19 ± 29.37	334 (254–349)	279.43 ± 51.83	287 (158–349)	**<0.001[a]**
ProFitMap intensity	323.71 ± 26.19	331 (259–350)	275.92 ± 53.79	276 (116–349)	**<0.001[a]**
ProFitMap limitations	244.84 ± 38.06	256 (89–275)	215.12 ± 49.85	226 (87–275)	**<0.001[a]**
Oswestry Disability Index	4.25 ± 5.82	2 (0–20)	10.45 ± 10.77	8 (0–46)	**<0.001[a]**
Upper Extremity Functional Index	72.68 ± 14.71	78.5 (0–80)	66.23 ± 18.33	75 (0–80)	**<0.001[a]**
Beck Depression Inventory	2.45 ± 3.41	1 (0–11)	8.75 ± 6.40	7 (1–27)	**<0.001[a]**
Beck Anxiety Inventory	4.38 ± 5.30	2.5 (0–24)	9.78 ± 7.93	8 (0–31)	**<0.001[a]**
Work–Life Balance Scale	47.78 ± 7.86	48 (20–56)	41.88 ± 10.84	44.5 (16–56)	**<0.001[b]**

$\bar{X} \pm S$: mean ± standard deviation, $\tilde{X}$: Median, min: Minimum, max: Maximum, a: Wilcoxon signed rank test, b: Paired samples t test.

these differences are shown in Table 4. No statistically significant difference was found in the other parameters ($p > 0.05$). Overall, the results differed between the pre-online education period and during online education, and between during online education and after training ($p < 0.05$). The participants' results after training were similar to those pre-online education (Table 4). There were statistically significant differences when comparing the percentages of people with pain (prevalence) in the neck, back, right wrist, lower back, and hip regions between the pre-online education period, during the online education period, and after the training ($p < 0.05$). No statistically significant difference was observed in the number of participants with pain in all parts of the right and left lower extremities except for the hip regions and in the right and left shoulders, upper arms, forearms, and left wrist regions ($p > 0.05$) (Table 5).

4. Discussion

With the COVID-19 pandemic, individuals have remained inactive at home due to the restrictions and quarantine, and because they have had to continue with their intensive work schedules in an unergonomic and unfamiliar environment musculoskeletal system problems have arisen. Furthermore, musculoskeletal problems caused by this intense period, combined with the effect of the pandemic provoking anxiety and depression, have affected individuals' psychosocial status [14]. In our study, teachers who, without preparation, had to begin giving online education during this period were examined and in agreement with the literature it was seen that musculoskeletal problems and depression and anxiety increased significantly. It has been determined that the duration of using VDTs increased due to the transition of teachers to online education, and this situation is accompanied by an increase in the intensity and duration of pain and related limitations. All these changes have caused the work–life balance to deteriorate. After the posture and ergonomics training given via tele-assistance, there were significant improvements in the musculoskeletal system problems. However, the increased anxiety and depression experienced during the pandemic did not improve as much as the musculoskeletal system did.

Table 4
Comparisons of clinical assessments between pre-online education, during online education periods and after training ($n = 18$)

	Pre-online education period		During online education period		After training		*p*	*Post-hoc*		
	$\bar{X} \pm S$	$\tilde{X}$(Min-Max)	$\bar{X} \pm S$	$\tilde{X}$(Min-Max)	$\bar{X} \pm S$	$\tilde{X}$(Min-Max)		PO-DO	PO-AT	DO-AT
CMDQ Total	56.8 ± 104.6	14 (0–438)	102 ± 106.8	64 (0–368)	39.5 ± 54.1	23.5 (0–218)	**0.001[a]**	**0.008[c]**	1.000[c]	**0.001[c]**
Neck	6.6 ± 11.4	0 (0–40)	20.8 ± 26.4	10.3 (0–90)	5.9 ± 6.3	4 (0–20)	**<0.001[a]**	**0.003[c]**	0.730[c]	0.091[c]
Right shoulder	8.5 ± 22.8	0 (0–90)	9.02 ± 22.6	0.8 (0–90)	6.3 ± 21	0 (0–90)	0.227[a]			
Left shoulder	0.3 ± 0.6	0 (0–1.5)	2.9 ± 9.3	0 (0–40)	3.1 ± 7.4	0 (0–30)	0.089[a]			
Back	8.3 ± 21.2	0.8 (0–90)	17.3 ± 24	5 (0–90)	8.1 ± 14.8	2 (0–60)	**0.004[a]**	**0.037[c]**	1.000[c]	0.73[c]
Right upper arm	3.9 ± 10.2	0 (0–40)	4.2 ± 10.2	0 (0–40)	0.6 ± 1.1	0 (0–3.5)	0.228[a]			
Left upper arm	0.2 ± 0.5	0 (0–1.5)	0.5 ± 1.7	0 (0–7)	0.1 ± 0.4	0 (0–1.5)	0.779[a]			
Right forearm	0.6 ± 2.4	0 (0–10)	5.3 ± 14.5	0 (0–60)	0.7 ± 2.4	0 (0–10)	0.047[a]	0.730[c]	1.000[c]	0.836[c]
Left forearm	0	0	0.4 ± 1.6	0 (0–7)	0.3 ± 1.4	0 (0–6)	0.368[a]			
Right wrist	1.6 ± 4.7	0 (0–20)	7.4 ± 13.4	1.5 (0–40)	3.3 ± 6.4	0 (0–20)	**0.018[a]**	0.287[c]	1.000[c]	1.000[c]
Left wrist	0.1 ± 0.4	0 (0–1.5)	0.6 ± 1.7	0 (0–7)	0.2 ± 0.5	0 (0–1.5)	0.116[a]			
Lower back	13.9 ± 28.5	0 (0–90)	21.0 ± 28.8	7 (0–90)	6.4 ± 8.4	3 (0–27)	**<0.001[a]**	**0.006[c]**	1.000[c]	**0.005[c]**
Hips	1.3 ± 4.7	0 (0–20)	4.2 ± 9.6	0 (0–40)	1 ± 1.7	0 (0–6)	**0.031[a]**	0.240[c]	0.952[c]	1.000[c]
Right upper leg	2.4 ± 5.9	0 (0–20)	3.6 ± 14.1	0 (0–60)	2.2 ± 6.5	0 (0–20)	0.692[a]			
Left upper leg	1.7 ± 5.1	0 (0–20)	0.3 ± 0.9	0 (0–3.5)	0	0	0.368[a]			
Right knee	1.7 ± 4.9	0 (0–20)	1.6 ± 4.9	0 (0–20)	0.2 ± 0.5	0 (0–1.5)	0.444[a]			
Left knee	1.6 ± 4.9	0 (0–20)	0.6 ± 1.7	0 (0–7)	0.2 ± 0.5	0 (0–1.5)	0.549[a]			
Right lower leg	2.5 ± 5.9	0 (0–20)	3.5 ± 14.1	0 (0–60)	1.1 ± 4.7	0 (0–20)	0.444[a]			
Left lower leg	1.8 ± 5.1	0 (0–20)	1.3 ± 4.7	0 (0–20)	0	0	0.144[a]			
ProFitMap Neck Total	874.1 ± 88.8	901.6 (694–973)	786.2 ± 112.4	754.8 (639–973)	844 ± 94	819 (711–973)	**<0.001[a]**	**0.001[c]**	1.000[c]	**0.006[c]**
ProFitMap frequency	317.7 ± 32.5	332 (262–349)	283.6 ± 49.4	287 (177–349)	311.4 ± 28.3	305.4 (239.4–349)	**0.001[a]**	**0.003[c]**	1.000[c]	**0.037[c]**
ProFitMap intensity	322.1 ± 28.1	330 (269–350)	284.9 ± 44.9	281.9 (218–349)	311.9 ± 30.5	308.7 (262–349)	**0.001[a]**	**0.008[c]**	1.000[c]	**0.008[c]**
ProFitMap limitations	240.9 ± 33.8	246.5 (176–275)	217.9 ± 40.9	219.3 (153–275)	236.4 ± 38.7	244 (154.4–275)	**0.002[a]**	**0.014[c]**	1.000[c]	**0.047[c]**
Oswestry Disability Index	4.9 ± 5.4	4 (0–18)	11.7 ± 11.0	11 (0–46)	6.1 ± 5.7	5 (0–18)	**<0.001[a]**	**0.011[c]**	1.000[c]	**0.029[c]**
Upper Extremity Functional Index	71.4 ± 19.0	79 (0–80)	65.0 ± 21.3	75 (0–80)	69.7 ± 18.6	75.5 (0–80)	**0.006[a]**	**0.029[c]**	0.470[c]	0.730[c]
Beck Depression Inventory	2.8 ± 3.9	1 (0–11)	9.7 ± 6.9	8 (1–27)	7.4 ± 5.3	7 (0–18)	**<0.001[a]**	**<0.001[c]**	**0.003[c]**	0.836[c]
Beck Anxiety Inventory	4.4 ± 4.8	2.5 (0–14)	10.4 ± 7.2	8 (0–22)	6.9 ± 4.6	6 (0–16)	**0.001[a]**	**0.001[c]**	0.137[c]	0.401[c]
Work–Life Balance Scale	48.8 ± 6.4	49 (33–56)	40.9 ± 11	42 (16–56)	43.9 ± 9.9	45.5 (16–56)	**0.002[b]**	**0.006[d]**	0.139[d]	0.262[d]

$\bar{X} \pm S$: mean ± standard deviation, $\tilde{X}$: Median, min: Minimum, max: Maximum, PO: Pre-online education period, DO: During online education period, AT: After training. a: Friedman's test, b: Repeated measures ANOVA test, c: Pairwise comparisons with Bonferroni adjustment, d: Dunn–Bonferroni *post hoc* test.

Table 5
Comparisons of pain-related assessments between the pre-online education, during online education periods, and after training ($n = 18$)

	Pre-online education period		During online education period		After training		p^a	*Post-hoc*		
	Pain n (%)	No pain n (%)	Pain n (%)	No pain n (%)	Pain n (%)	No pain n (%)		PO-DO	PO-AT	DO-AT
Neck	8 (44.4)	10 (55.6)	3 (16.7)	15 (83.3)	4 (22.2)	14 (77.8)	**0.002**	**0.004** [c]	**0.016** [c]	1.000 [c]
Right shoulder	5 (72.7)	13 (27.3)	9 (50)	9 (50)	8 (44.4)	10 (55.6)	0.156			
Left shoulder	4 (22.2)	14 (77.8)	7 (38.9)	11 (61.1)	6 (33.3)	12 (66.7)	0.311			
Back	9 (50)	9 (50)	15 (83.3)	3 (16.7)	10 (55.6)	8 (44.4)	**0.032**	**0.043**[c]	1.000[c]	0.124[c]
Right upper arm	6 (33.3)	12 (66.7)	7 (38.9)	11 (61.1)	5 (72.7)	13 (27.3)	0.607			
Left upper arm	2 (11.1)	16 (88.9)	2 (11.1)	16 (88.9)	1 (5.6)	17 (94.4)	0.779			
Right forearm	2 (11.1)	16 (88.9)	5 (72.7)	13 (27.3)	3 (16.7)	15 (83.3)	0.247			
Left forearm	0	18 (100)	1 (5.6)	17 (94.4)	1 (5.6)	17 (94.4)	0.368			
Right wrist	5 (72.7)	13 (27.3)	10 (55.6)	8 (44.4)	9 (50)	9 (50)	**0.050**	0.062[c]	0.192[c]	1.000[c]
Left wrist	1 (5.6)	17 (94.4)	4 (22.2)	14 (77.8)	2 (11.1)	16 (88.9)	0.174			
Lower back	8 (44.4)	10 (55.6)	15 (83.3)	3 (16.7)	10 (55.6)	8 (44.4)	**0.008**	**0.007**[c]	1.000[c]	0.091[c]
Hips	2 (11.1)	16 (88.9)	7 (38.9)	11 (61.1)	7 (38.9)	11 (61.1)	**0.044**	**0.021**[c]	0.063[c]	1.000[c]
Right upper leg	3 (16.7)	15 (83.3)	3 (16.7)	15 (83.3)	2 (11.1)	16 (88.9)	0.819			
Left upper leg	2 (11.1)	16 (88.9)	2 (11.1)	16 (88.9)	0	18 (100)	0.368			
Right knee	4 (22.2)	14 (77.8)	3 (16.7)	15 (83.3)	2 (11.1)	16 (88.9)	0.472			
Left knee	3 (16.7)	15 (83.3)	3 (16.7)	15 (83.3)	2 (11.1)	16 (88.9)	0.779			
Right lower leg	3 (16.7)	15 (83.3)	2 (11.1)	16 (88.9)	0	18 (100)	0.174			
Left lower leg	4 (22.2)	14 (77.8)	2 (11.1)	16 (88.9)	0	18 (100)	0.091			
	$\bar{X} \pm S$	$\tilde{X}$(Min-Max)	$\bar{X} \pm S$	$\tilde{X}$(Min-Max)	$\bar{X} \pm S$	$\tilde{X}$(Min-Max)	$\mathbf{p^b}$			
Pain frequency (days a week)	2.1 ± 2.7	0 (0–7)	4.7 ± 2.3	5 (0–7)	2.7 ± 1.7	2.5 (0–7)	**<0.001**	<0.001[c]	0.003[c]	1.000[c]

$\bar{X} \pm S$: mean ± standard deviation, $\tilde{X}$: Median, min: Minimum, max: Maximum, PO: Pre-online education period, DO: During online education period, AT: After training, a: Cochran's Q test, b: Friedman's test c: Dunn–Bonferroni *post hoc* test.

Analyzing the literature, it can be seen that one of the profession groups with the most musculoskeletal problems in normal working conditions is teachers. Ng et al. reported that the prevalence of musculoskeletal system problems was 80.1% in their sample of teachers. When these problems were analyzed in detail with the CMDQ, it was seen that the most of these problems were in the wrist, upper leg, upper arm, and lower leg regions. Spinal pain and hip pain were found in lower percentages [11]. These results were different from ours. The examination of teachers under normal working conditions in the study by Ng et al. may have caused this difference in results. During formal education, teachers are more likely to experience pain in their weight-bearing lower extremities because they mostly work standing in front of the board, and especially in their wrists and upper extremities, as they are often writing. However, during the pandemic, the working positions of the teachers changed completely and they had to spend most of their working hours in a static sitting position in front of the computer, but they had not prepared suitable work stations. As a result of this situation, as shown in our study, the pain in the neck, back, lower back, and hip joints carrying the load more in the sitting position was increased. If studies investigating office workers using computers for long periods are examined, it is seen that their findings were similar to ours [5, 6, 31]. Compared with the literature, the results obtained from our study show that during the pandemic teachers experience musculoskeletal system problems similar to those seen in office workers using computers intensively. When spinal and upper extremity musculoskeletal problems were examined in detail, it was observed that not only did the pain prevalence increase, but also the neck pain intensity, frequency, and limitations related to neck pain, low back pain, and related limitations increased as well and upper extremity functionality decreased.

In a meta-analysis examining studies planned for the prevention of musculoskeletal problems occurring in office workers, it was observed that ergonomic recommendations such as computer distance; keyboard, mouse, and screen position; and chair and desk suitability were given through face-to-face training. The office employees who had received the training had better results than those who had not [32]. In our study, similar training was given by tele-assistance, as it could not be done face-to-face due to social isolation during the pandemic. The importance of telerehabilitation methods has grown in recent years. Before the pandemic, since 2017 the WCPT has reported studies to make these methods more widespread, and during the pandemic it has recommended digital physiotherapy for musculoskeletal system physiotherapy as in all other physiotherapy areas [33]. In our study planned on this subject, even if in person training could not be provided, comparable results were obtained with tele-assistance. In a study conducted by Shuai et al. in 2014, similar to our study, teachers were informed about posture and ergonomics through presentations and posters, and it was observed that their musculoskeletal system problems began to decrease after the training and continued to decrease even after 12 months [34]. In our study, the long-term effects of training, like in the study by Shuai et al. could not be determined, but 6–12 months after the study, it is planned to contact the same individuals to re-evaluate them in order to establish the long-term effects.

Another effect of the pandemic and changing work conditions is an increase in anxiety and depression among individuals. Regardless of whether teachers give online education or not, the pandemic on its own can increase their anxiety and depression, as a result of their fear of ill health or even death [35]. In a study conducted by M.Z. Ahmed et al. in China during the pandemic, it was reported that anxiety, depression, and alcohol use increased significantly and mental well-being decreased [36]. In studies that investigated the relationship between working conditions and the musculoskeletal pain, anxiety, and depression that developed due to these working conditions, it was stated that increased pain and working times and harder working conditions cause anxiety and depression by increasing mental stress [8, 10, 37]. In our study, it was thought that the combination of increased work stress caused by giving online education and mental stress due to the pandemic may have increased the findings of anxiety and depression in teachers.

The occurrence of musculoskeletal pain, changes in psychosocial status, and changes in the usual work and lifestyle may also have led to a deterioration in teachers' work–life balance during the pandemic. The fact that all family members, including children, have to perform their daily tasks, education, and work in the home environment or that individuals living alone live all their daily lives in the same environment during the pandemic negatively affects the work–life balance [14]. In our study, in parallel with this situation, there was a deterioration in the work–life balance of teachers during the pandemic as well. However, a statistically significant difference was not found, as there were minimal changes in depression, anxiety, and work–life balance scores after training. We supposed that the main reason for this is that the training we provide mostly focuses on musculoskeletal problems. Nevertheless, minimal clinical improvements in depression, anxiety, and work–life balance may show that improvements in musculoskeletal problems affect them. At the same time, this situation may indicate the importance of psychosocial support during the pandemic.

Due to the short time between the start of the pandemic and the start of the schools' summer holiday we had limited time for our study. In addition, as teachers had a very busy working schedule due to online education some did not want to participate, resulting in the small sample size of our study. On the other hand, in our study, we had to apply the assessments, some of which were mostly applied in person normally, online due to the pandemic. These are other limitations of our study; however, the important results obtained in our study will contribute to the literature as they are statistically significant and concern public health. Further studies with more participants can be performed in the future to reinforce our results.

Consequently, it has been observed that increased musculoskeletal system problems, anxiety, depression, and deterioration in work–life balance occurred in teachers who switched to online education due to social isolation during the COVID-19 pandemic. These findings can be considered an indication that this period, which started suddenly and was not prepared for, has negatively affected the lives of individuals in many ways. In addition, our study showed that telerehabilitation that can be applied via digital tools is effective in reducing the musculoskeletal system problems of individuals in times like this period when it is not possible to implement preventive rehabilitation programs in person. Thus, whether social isolation continues or not, digital rehabilitation will be effective for individuals who do not have access to rehabilitation programs face-to-face. It is thought that our study will be a guide for professionals working in this field to use these methods. In addition, it should be noted that it will be beneficial to give this kind of training in order to prevent musculoskeletal problems that may occur in individuals working online in every field, including the public and private sectors.

Conflict of interest

The authors declare no potential conflict of interest.

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