E-LEARNING AND BODY ACHES AMONG PALESTINIAN UNIVERSITY STUDENTS DURING COVID-19 PANDEMIC: THE EFFECTS OF SEVERAL BEHAVIOURAL CHANGES

Heba Salah [1*], Qais B. Yaseen[2]

[1]Department pf physiology, pharmacology and toxicology, Division of Biomedical Sciences, An-Najah National University, Nablus, Palestine.

* (Corresponding author)

https://orcid.org/0000-0003-0608-9264

Heba.salah@najah.edu

[2]Department of physical education, An-Najah National University, Nablus, Palestine.

https://orcid.org/0000-0001-8380-1441

q.yaseen@najah.edu

Abstract

Background/Objective: COVID-19 pandemic has changed our lives in the current century. During the COVID-19 lockdown, most countries switched their education methods to e-learning. The use of different electronic devices for e-learning for long hours is associated with several musculoskeletal pain that varies based on the sitting position the students use during e-learning. The aim of our study is to examine the association between different body position used during the e-learning and the different body aches experienced by the students. We also aimed to examine if several types of behavioral modifications and/or exercise practices by the students might minimize body aches associated with e-learning.

Methods: The subjects of this study were students from An-Najah university in Palestine. 385 questionnaires were filled using Google forms questionnaire and all subjects were using e-learning due to COVID-19 pandemic.

Results: Our study showed that a large percentage of participants experienced musculoskeletal pain during the use of electronic devices for e-learning. The location and severity of pain was correlated with the sitting position used during e-learning. Furthermore, behavioral changes during e-learning like taking breaks and changing sitting position minimized the experienced pain during e-learning but no significant decrease in pain was observed by engaging in several exercise practices.

Conclusion: The university students that participated in this study had an increase in body aches during the e-learning process that is associated with their sitting position.

Awareness programs should be lunched to university students to help them minimize this pain based on behavioral changes and proper exercise training during the e-learning.

Keywords: e-learning, pain, COVID-19, electronic devices, exercise, breaks
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Introduction

Physical activity is defined as the energy production through skeletal muscle contraction in the daily life of individuals and the body movements that require more energy than the baseline level [1].

In the last years, several studies have revealed a high prevalence of immobility in population. A review article published in 2005 showed that about 40% to 50% of college students are physically inactive [2]. Moreover, a recent study on university students reported that 64% of students have inadequate physical activity levels. The negative effects of inadequate physical activity levels on health are huge as it affects body circulation [3], metabolism [4] and mental health [5]. It was also seen that there is a negative relationship between students' physical activity levels and their perceived stress.

COVID-19 pandemic has changed our lives in the current century. The change affects our social, economic, and educational habits. The quarantines proposed by all countries around the world to minimize the spread of the pandemic have also changed our lifestyles and daily activities. Although the quarantine was an effective technique for containing the outbreak, the lockdown may have a substantial impact on other elements of individuals' life as travel restrictions and decreasing outdoor activities. As a result, more people were more likely to have insufficient physical exercise and increased immobility, which can put their health and well-being at risk [6].

In addition, the life changes caused by the lockdown includes spending extended periods in front of touch screens, tablets and computers leading to bad posture and repetitive movements in individuals. This caused increase in pain among individuals in several body regions including back and neck pain [7]. Several studies in the literature have focused on pain associated with the use of electronic devices and tried to minimize it. For instance, posture training and boosting ergonomics awareness are among the solutions that reduced musculoskeletal problems [8].

Due to the pandemic lockdown, several countries have shifted their learning methods to the use of existing technology in remote education in order to proceed with the education process and at the same time remove the

barriers between learners and educators. During the pandemic, this offered several benefits, but also had negative and learning resource consequences. For instance, individual who continue their education with computers may develop musculoskeletal system problems as a result of repetitive actions such as using a keyboard, clicking on a mouse, and putting their bodies in inappropriate positions as well as poor ergonomic circumstances during study [9]

Both the stress levels and the physical activities were highly affected by the COVID-19 pandemic. Distance learning and the changes of the conventional learning methods also added more stress levels and affected the physical habits of students. Several students have more pain compared to prior to COVID-19 e-learning experience.

Our study aims to evaluate several factors that increased body aches associated with e-learning on university students and find a link between the degree of sports activities practice and the amount of pain that the students experienced during e-learning.

Methods:

Subjects:

The subjects of this study were students from An-Najah university in Palestine. The data collection was from 10/11/2020 to 10/2/2021. The data was collected from October 11, 2020 until October 2, 2021. 385 surveys were filled out using Google forms as a web-based questionnaire during this time period (Supplement 1 File). Students received questionnaires by posting them in groups on social media sites such as Facebook. Almost all of the university's faculties were represented in this study. All the subjects were using e-learning teaching approach due to COVID-19 pandemic.

Questionnaire design:

At the beginning of the questionnaire, general demographics data, such as age, gender, and faculty of the participants were examined. In addition, general conditions for using electronic devices during e-learning, such as handedness and sitting position, were studied. Students' experience of neck, back and shoulder pain associated with e-learning use of electronic devices was also evaluated; students were asked about their sitting position when using the electronic devices for e-learning and weather they had pain in the affected body area before the e-learning experience. later, the students were asked if they did any behavioral changes or engaged in sport activities to minimize their pain.

Pain severity was also analyzed in the study. The pain severity was analyzed using NRS-11; students were asked to rate their pain on a scale from 0 to 10, where zero represents "no pain at all" and 10 represents "the worst pain they have ever experienced," using whole numbers. Later, the pain severity was

categorized into two categories with mild-moderate category representing pain severity from 1 to 5, while moderate to severe pain representing pain severity from 6-10.

Ethical approval:

Ethical approval for our study entitled **" E-learning and body aches among Palestinian university students during COVID-19 pandemic: the effects of several behavioral changes"** was obtained from An–Najah National University IRB committee on 27th of October 2020 (OTH 10/2020/21) and all methods were carried out in accordance with relevant guidelines and regulations.

An informed consent was obtained in the first page of the study's questionnaire, and it was written in Arabic, the official language in Palestine. The consent also explained the aims of the study and emphasized the confidentiality of the filled information. Participants were able to withdraw from the questionnaire at any point. No identifying information were obtained through the questionnaire, and all collected data were solely used for statistical analysis.

Statistical analysis:

SPSS (version 21.0, Chicago, USA) was used in analysis of the data. Descriptive statistics were used to study the sample. Correlation statistics with Pearson coefficient was used to assess the correlation between sitting positions and variable body aches, and behavioral changes or engaging in sport activity with minimizing the experienced pain. Fisher exact test was also used in testing the effect of changing body position and engaging in exercise on pain severity. A p value of 0.05 was adopted as a threshold for significance.

Results:

Characteristics of the subjects:

During COVID-19 pandemic several students increased their complains about various body aches during the e-learning experience. In an attempt to understand the different methods used by the students to minimize this pain we used questionnaires that were distributed to several faculties at AN-Najah national university. A total of 385 students were included in the study. Most participants in this study were from faculty of Medicine and health sciences (29.6%). The participant from faculty of Engineering and information technology were 28.3% of the total participants while the participants of faculty of educational sciences and teachers' training were 20% of the total participants. Participants from other faculties were of lower percentages as shown in figure 1.

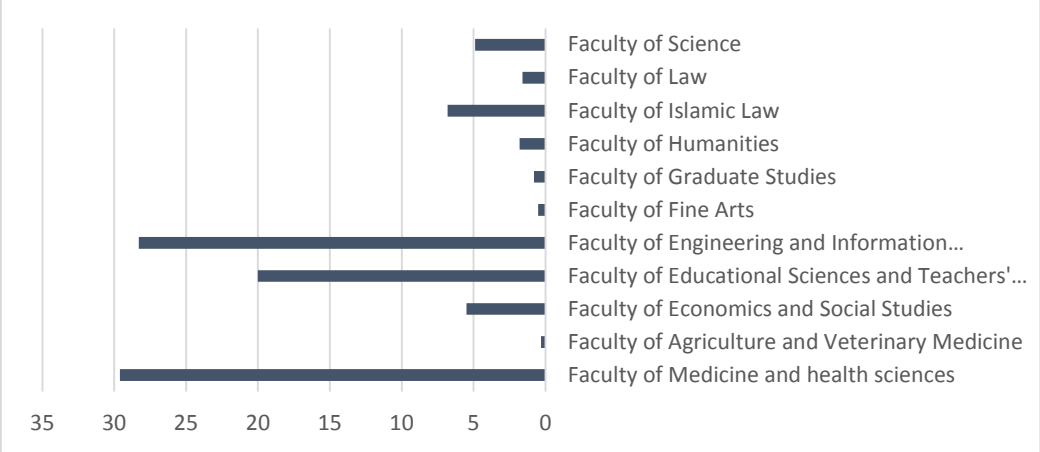

Figure 1. Percentage of student participation from several faculties.

The mean age for study participants was 19.91 (SD = 9.8). The sample included 148 men and 237 women and most of the subjects were right handedness regardless of the gender (Table 1).

Handedness			Age			Total
			below than 19 years	20-21 year	22 year and more	
Right Hand	Gender	Male	57	53	23	133
		Female	114	74	28	216
	Total		171	127	51	349
Left Hand	Gender	Male	2	2	1	5
		Female	4	7	0	11
	Total		6	9	1	16
both hands	Gender	Male	4	4	2	10
		Female	5	5	0	10
	Total		9	9	2	20
Total	Gender	Male	63	59	26	148
		Female	123	86	28	237
	Total		186	145	54	385

Table 1. Distribution of the study sample according to gender, handedness and age.

Neck and back pain and associated factors:

Upon analyzing predictors for pain during e-learning experience, our results showed a significant correlation ($p<0.05$) between the presence of pain among participants and the sitting positions the participants used. In this analysis, more than 50 % of the students that sit on the ground or chair with spine slopping forward or sit on the ground with straight supine had more body aches compared to before the start of e-learning (Fig. 2).

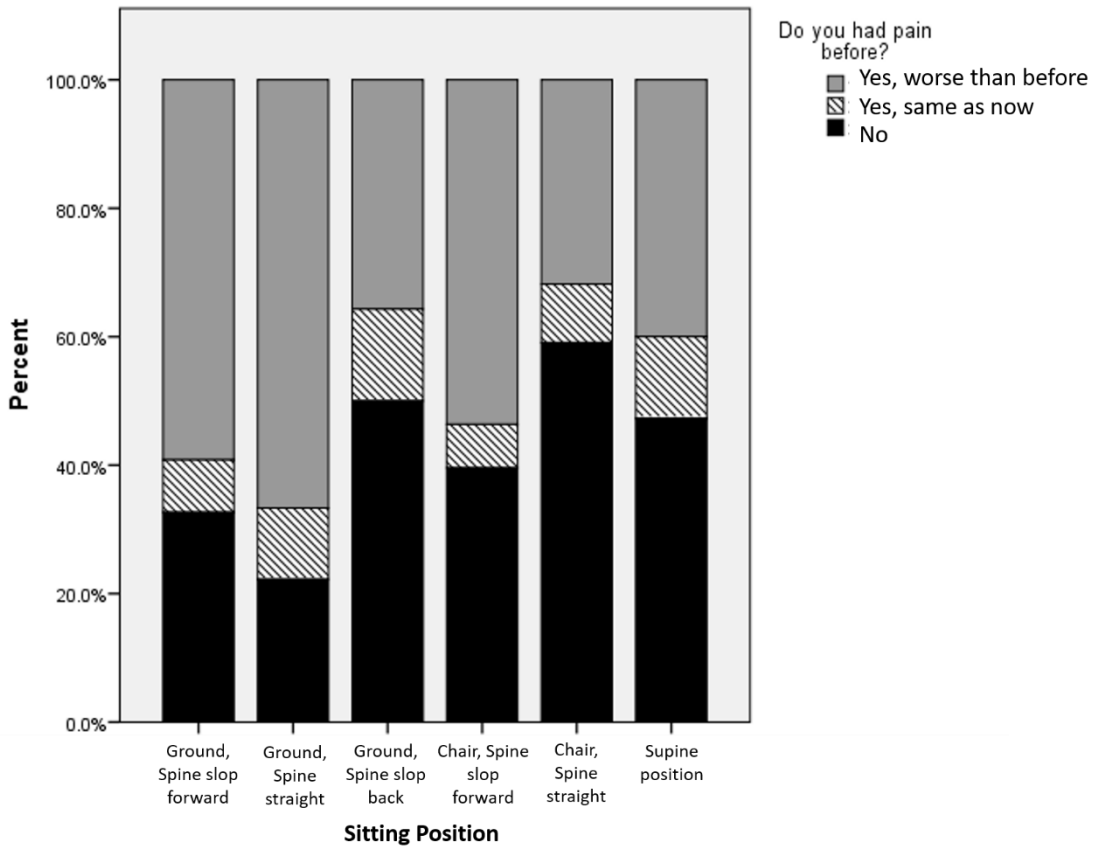

Figure 2: The presence of pain during different sitting positions while using electronic devices.

Furthermore, our analysis showed that sitting position is strongly correlated ($P< 0.05$) with the location of pain experienced during the e-learning experience. For instance, the highest percentage of neck and shoulder pain was among students that usually sit on the ground with straight position, while the highest percentages of back pain were among students that use the supine position (fig.3).

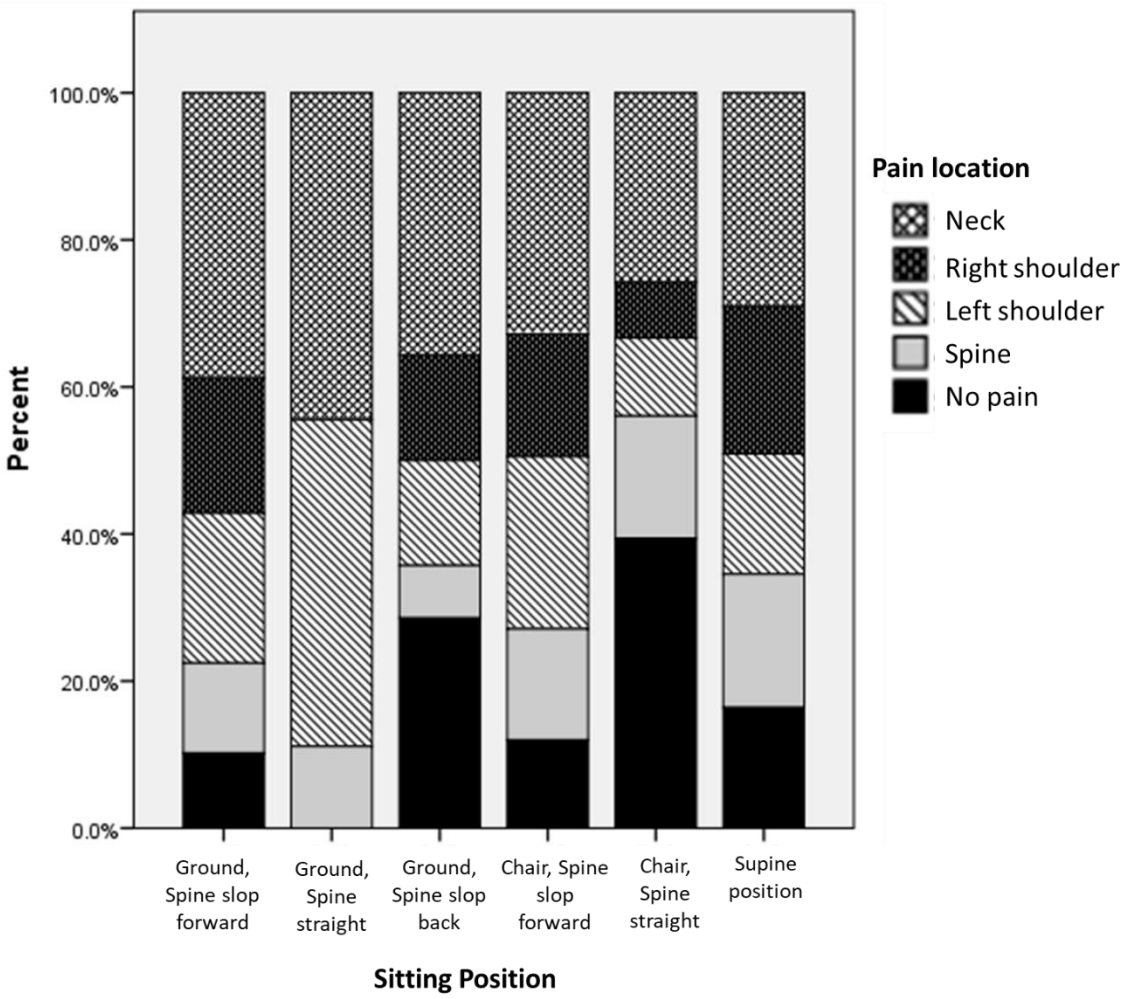

Figure 3. pain location in variable sitting positions during e-learning.

Behavioral changes:

Musculoskeletal pain can be reduced by some behavioral changes like changing the position used during e-learning. Our analysis showed that 73.2% of our participants tried to change their position to minimize the pain experienced, while 22.5% of the participants never tried to change their position during e-learning to minimize pain, Chi^2 value = (108.901) and its significant ate level of (0.05) (table 2).

	Frequency	Percentage	Chi^2	df	Sig.
Yes	104	73.2	108.901[a]	2	.000
No	32	22.5			
I don't have pain	6	4.2			
Total	142	100.0			

Table 2: Did you change your most frequent position while using your device after experiencing the pain?

When analyzing the effect of change in position on the severity of pain among participants, there was a statistical decline in the percentage of participants that experienced high degree of pain after changing the body position during e-learning (figure 4, $p<0.005$).

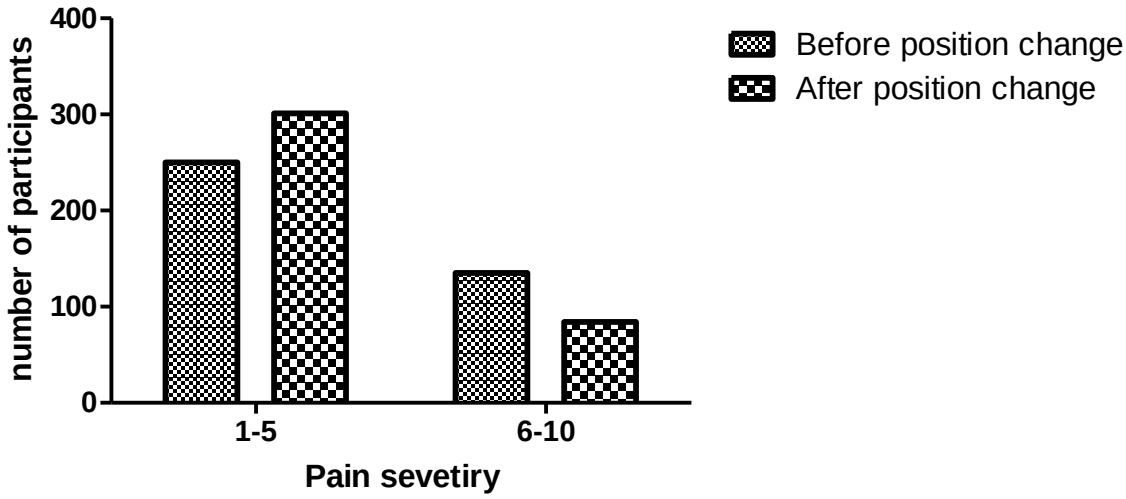

Figure 4: pain severity before and after changing body position.

In addition to changing body positions, taking breaks regularly can also minimize the degree of pain experienced by the participants. Our analysis showed that 72.2% of the participants usually takes breaks during e-learning, while 27.8% doesn't take breaks, Chi^2 value = (75.951) with significant level of (0.05) (table 3).

	Frequency	Percentage	Chi^2	df	Sig.
Yes	278	72.2	75.951[a]	1	*0.000
No	107	27.8			
Total	385	100.0			

Table 3: Do you take breaks when using the device?

Moreover, our results showed that 80.9% of the participants confirmed that taking breaks helped ease their pain and 19.1% of them were not helped by taking breaks, Chi^2 value = (106.417) and its significant at level of (0.05) (table 4).

	Frequency	Percentage	Chi^2	df	Sig.
Yes	225	80.9	106.417[a]	1	*0.000
No	53	19.1			

Total	278	100.0			

Table 4: Do talking breaks helped ease your pain?

Use of exercise:

Several studies showed conflicting results regarding the association between physical activity and musculoskeletal pain. In an attempt to understand if engaging with sport activity can minimize body aches associated with e-learning, we asked the participants about the different sport they used during their education.

Our results showed that 62.3% of the participants engage in sport activities (table 5) where 70.4% of the participants do sports activities (1-6 hours per week) while 17.9 % of them do sport activities (7-12 hours per week) and the rest do sport activities more than 12 hours per week. Chi^2 value was (149.925) with significant level at (0.05) (table 6).

	Frequency	**Percentage**	**Chi^2**	**df**	**Sig.**
Yes	240	62.3	23.442[a]	1	*0.00
No	145	37.7			
Total	385	100.0			

Table 5: Do you engage in sport activities?

	Frequency	**Percentage**	**Chi^2**	**df**	**Sig.**
1-6 hours per week	169	70.4	149.925[a]	2	*0.00
7-12 hours per week	43	17.9			
More than 12 hours per week	28	11.7			
Total	240	100.0			

Table 6: Frequency of engagement in sport activities.

When analyzing the data about the different type of sport played by the participants, our results showed that 23.8% of the participants used jogging, 37.9% used walking, 6.3% did aerobic exercises, 4.6% did therapeutic exercises, 11.7% did resistivity exercises and 5% did relaxation exercises. Chi2 value was (207.667) with significant level at (0.05) (Table 7).

	Frequency	**Percentage**	**Chi^2**	**df**	**Sig.**
Jogging	57	23.8	207.667[a]	7	*0.000
Walking	91	37.9			
Aerobic exercises	15	6.3			
Therapeutic exercises	11	4.6			

Resistivity exercises	28	11.7			
Relaxation exercises	12	5.0			
None	1	.4			
Others	25	10.4			
Total	240	100.0			

Table 7: Type of used exercises or sport activities.

Our results showed that most of student who are engaged in sport activities have less degree of pain. The exact frequencies are shown in table 8.

				Total
		1-5	6-10	
Type of sport	Jogging	34	22	57
	Walking	60	31	91
	Aerobic exercises	7	8	15
	Therapeutic exercises	8	3	11
	Resistivity exercises	20	8	28
	Relaxation exercises	9	3	12
	None	1	0	1
	Others	16	9	25
Total		155	84	240

Table 8: Pain severity with exercises or sport activities.

Further analysis for the severity of the pain experienced by the participants and the type of exercise engagement of them showed that 71% of the students that did resistance exercises had a severity of pain less than 5 compared to 66 % of the students who are engaged in walking and 60 % who did jog (figure 5).

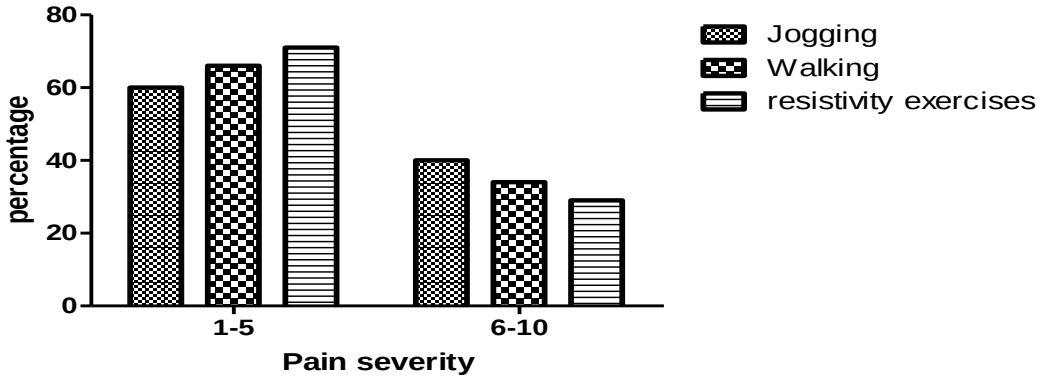

Figure 5. pain severity with different types of exercises

Discussion

Our study investigated the location of pain associated with the use of e-learning during COVID-19 pandemic, and the type of behavioral modifications and exercises experienced by the students to minimize that pain.

The results of the current study showed a significant correlation between the sitting position during e-learning and the degree and location of pain experienced by the students. These results showed that the students suffered more from neck and back pain during e-learning. The neck and shoulder pain were highly associated with sitting on the ground with supine strait position and the back pain was associated with supine position while using electronic devices during e-learning.

In accordance with our results, there is a high prevalence of musculoskeletal-related pain among young people. One of the studies found neck pain to be most common among all musculoskeletal pain syndromes, affecting around 17.2% of adolescents [10]. In addition, computer use has been associated with adolescent neck pain, with daily use of computers exceeding 2-3 hours as a threshold for neck pain [11, 12]. Another study on university students reported a relationship between mobile phone usage and musculoskeletal system problems; after-usage complaints are focused on the neck and shoulder regions [13]. Moreover and in accordance with our study, the position of the body when using computer or tablets is important and has a significant impact on increasing neck and back pain, especially in the forward hunched position [14-16]. The Isha Sikka 2020 study also developed training programs in order to relieve neck pain for the front head position during the long use of tablets [17]. This indicates the importance of the sitting position during the use of tablets and the pain it causes.

Around 20% of adults worldwide suffer from musculoskeletal system pain [18]. In comparison to asymptomatic controls, adult individuals having neck pain are found to have increased forward head posture (FHP) and impaired performance of neck flexor and extensor muscles [14-16]

In order to try to minimize pain experienced during the use of electronic devices during e-learning, the students tried to make some behavioral changes. Our study showed a significant correlation between minimizing pain experienced by the student and changing the sitting position during e-learning. This is consistent with the study of Çalık BB et all that staying in a stable position for a long time during the use of electronic devices and using the body in incorrect positions and inappropriate conditions in the work environment leads to disorders of the musculoskeletal system [19].

In accordance with our results, several studies showed increase in musculoskeletal pain in association with electronic devices usage as tablet, smartphones and computer [20, 21]. In addition, the position used during the electronic devices use affect the degree and type of pain associated with their use. For instance, a study published in 2018 showed that muscle activity of upper trapezius, erector spinae and the neck extensor muscles are increased as well as head flexion angle, head tilt angle and forward head shifting which increased during the smartphone use. Also, smartphone use in a sitting position seems to cause more shift in head–neck angle than in a standing position [21].

In addition, the students confirmed that taking breaks during electronic devices use for e-learning eased their pain. However, no statistical significance was observed in the student's pain frequency or severity that used several types of exercises. Although many studies have highlighted the clinical changes produced in musculoskeletal pain perception following exercises, such as isometric exercise for tendinopathies, aerobic exercise or strength programs, the dosage of exercises and optimal frequency are not clear [22, 23].

Talking breaks during e-learning can also reduce the pain associated with electronic devices use. This is supported by the finding of a recent study that showed that active breaks and postural shift interventions shortened recovery time and reduced recurrence of neck and low back pain among high-risk office workers [24].

It is known that the result of exercise induces the production of endogenous analgesia. However, for this to happen, certain intensities, exercise times or frequencies need to be achieved to stimulate the organism to produce it [25]. It should also be taken into account that subjects exhibiting chronic pain are

often associated with established patterns of kinesiophobia. Therefore, the first days or weeks of exercise could be the key to achieving exercise adherence [26]. Moreover, within the basic training principles, we find the neural adaptations that are generated at the start of physical exercise, which would help to create a suitable motor pattern that could improve the perception of safety and confidence concerning the performance of physical exercise [27].

The practice of physical activities is very important for a person's health, whether in terms of physical health or psychological. The amount of daily time for the practice of physical activities also plays an important role in relieving the amount of pain. Our study indicated that 70.4% of the percentage of students practicing physical activities practice from 1- 6 hours a week, and this demonstrates the high level of pain in students and the lack of time to exercise. In accordance with this, a study conducted in 2019 on university students reported that 64% of students have insufficient levels of physical activity. It was also observed that there was a negative relationship between students' physical activity levels and their perceived stress [28].

A number of other studies have confirmed how exercise can reduce pain and nociceptive sensitivity in subjects that do not exhibit chronic pain [29, 30]. Likewise, systematic reviews have shown that strength exercise, aquatic therapy and aerobic exercise are better strategies than inactivity in controlling chronic musculoskeletal pain [31, 32]

There are many clinical studies in which, based on the pathology studied and the type of exercise performed, positive effects have been reported in the reduction or control of chronic pain. However, it has yet not been possible to establish the best dose of exercise to achieve this objective, given that all are beneficial [33].

Our study also showed that a large number of students practices walking and running exercises, and that about half of them suffer from pain at a degree (1-5) and half of them suffer from a degree of pain (6-10). This indicates that walking and running have no effect on relieving pain. Furthermore, the results of our study showed that resistance exercises and therapeutic exercises had a greater effect in relieving the intensity of pain, and this is consistent with the study [34], where the results of her study showed that those who practice strength and resistance exercises have a greater perception of pain reduction, by 51.1 %, followed by those who do aerobic exercise with 35.6%. In addition, only 8.9% of the mixed exercisers (strength and aerobics) considered that exercises reduce pain. On the other hand, for other exercises, such as Pilates and locomotion, 2.2% of the participants found that these

exercises reduced pain. Regarding the two participants who did the walking activity, neither of the participants found that this activity reduced pain.

In addition, during the pandemic the stress levels were intense. It has become increasingly important to raise the levels of physical activity and exercise as a component of physical activity among the population and especially students receiving distance education. In this direction, one of the most critical steps that may help the individual transform exercising into behavior is the stage of decision-making. More awareness should also be made concerning the type of the exercise the student should perform to minimize the pain experienced by the students during electronic devices use for e-learning.

Conclusion:

The university students are prone to have an increase in body aches during the electronic devices use for e-learning process. The pain is highly associated with the sitting position the student use during the e-learning experience. Awareness programs should be lunched to all university students to help them minimize this pain based on behavioral changes during the e-learning like encouraging them to use proper sitting positions, talking breaks and the use of correct type and duration of exercise.

Competing interest:

The author(s) have no conflicts of interest relevant to this article

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Author contribution:

Q.Y. and H.S. contributed equally in the design, analysis and writing of this article.

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Table legend:

Table 1. Distribution of the study sample according to gender, handedness and age.

Table 2: Did you change your most frequent position while using your device after experiencing the pain?

Table 3: Do you take breaks when using the device?

Table 4: Do talking breaks helped ease your pain?

Table 5: Do you engage in sport activities?

Table 6: Frequency of engagement in sport activities.

Table 7: Type of used exercises or sport activities.

Table 8: Pain severity with exercises or sport activities.

Figure legend:

Figure 1. Percentage of student participation from several faculties.

Figure 2: The presence of pain during different sitting positions while using electronic devices.

Figure 3. pain location in variable sitting positions during e-learning.

Figure 4: pain severity before and after changing body position

Figure 5. pain severity with different types of exercises