Prevalence of Musculoskeletal Problems and Its Relation to Psychological Distress among General Secondary Students Subjected to Online Learning

Rasha Abdelateef Abdelaziz [(1)], Heba AbdAllah AbdElnabi [(2)], Miada Mohamed Ali [(3)], and Nesreen Mosbah Elsayed [(4)]

[(1, 2, 3, 4)] Lecturer of Pediatric Nursing, Faculty of Nursing - Zagazig University, Egypt.

Abstract

Background: The musculoskeletal problems like pain become critical problems face adolescents' especially secondary school students particularly after the learning process become totally online after corona disaster. **The aim of this study was to** identify the prevalence of musculoskeletal problems among general secondary students subjected to online learning, and to determine the relationship between musculoskeletal problems and psychological distress. **Subjects and methods; Design:** A descriptive cross-sectional design was used. **Setting:** The study was conducted at 4 general secondary schools randomly selected from Zagazig, Kafr Saqr, Ibrahemia, Abo-Hammad cities, Sharkia Governorate, Egypt. **Subject:** Sample of 421 general secondary students was selected randomly from the above mentioned settings. **Tools of data collection:** Three tools were used as follows; Tool (1): A Questionnaire Interview Sheet. Tool (2): Nordic Musculoskeletal Questionnaire. Tool (3): Depression, Anxiety & Stress Scale - 21 Items. **Results:** More than two thirds of the studied students had musculoskeletal pain at the neck and more than half at the upper back; only fifth had history of spine curvature and cartilage or ligaments injuries. Sitting for long periods of time with neck bent, without a comfortable back pillow during online learning had highly statistically significant relation with upper limb, vertebral column and lower limb pain ($p<0.01$). Moreover, there were highly statistically significant associations between depression, anxiety, stress and occurrence of musculoskeletal problems ($p<0.01$). **Conclusion:** The prevalence of musculoskeletal problems like pain was higher in different body parts among general secondary students using online learning. Musculoskeletal problems increased significantly with depression, anxiety and stress as a result of switching to online education. **Recommendations:** Intervention strategies for the students to maintain good postures during online learning and community-based psychosocial programs for managing musculoskeletal problems among students.

Key words: Musculoskeletal Problems, Psychological Distress, General Secondary Students, Online Learning.

Introduction:

Musculoskeletal problems (MSPs) are severe illnesses or discomforts that affect the muscles, joints, tendons, ligaments, nerves, and bones. These disorders can cause temporary or permanent impairments in one's ability to function and participate in activities [(1)]. Pain that is frequently chronic along with mobility impairments are the main characteristics of musculoskeletal disorders, which make it harder for individual to work and engage in society [(2)].

According to a recent review of statistics on the global burden of disease, the incidence of MSPs is 21.9% globally, impacting people of all ages and continuing to rise [(3)]. In a research done by **Atia et al.** [(4)] discovered that 69.7% of students in general schools and 83.8% of students in technical schools had MSPs in Sharkia governorate. While, in Helwan district, Cairo Governorate, researchers found that 59.7% of study sample experienced back discomfort, 45.9% had shoulder pain, and 29.6%

had spine curvature [5]. Also, **Soares et al.** [6] found that between 10 to 67% of pupils suffered from MSPs.

There are a number of causes for the relatively high prevalence rates among children and adolescents. Congenital, individual, or acquired risk factors can lead to MSPs. Physical, psychological, socioeconomic, and environmental risk factors make up the majority of acquired risk factors, including obesity and malnutrition; extremes of physical activity, leisure pursuits, or sleep deprivation; smoking; poor posture, using electronics excessively, carrying a backpack, sports injuries; mental health issues; social status; and weather conditions. All of which are mostly avoidable [7].

Students throughout the world are increasingly using computers and mobile devices as their main tools for working and studying. But the move to online learning has sparked worries about how it can affect students' physical health. Extended periods of sitting for online learning with bent backs and abnormal neck positions have been linked to pupils developing musculoskeletal conditions such wrist strain, backache, pain in the neck and shoulders [8].

Musculoskeletal problems frequently manifest as pain, restricted movement, and decreased functional abilities. Additionally, students' ability to cooperate and engage in social roles was negatively impacted [9]. Students are significantly impacted by musculoskeletal pain because, in addition to being uncomfortable, it can lead to psychological stress, and raise their medical expenses because they require more specialized care [10].

Musculoskeletal problems negatively impact everyday activities and raise the likelihood of student absences [6]. Students' health is seriously harmed by prolonged periods of time spent in the same position. This includes a rise in musculoskeletal discomfort at the classroom, and daytime fatigue. Continuous and extreme force exertion may reduce the tolerance for repeating the same effort, when students are given tasks that are beyond their capacity, they are more likely to experience MSPs [11].

Researchers have shown a connection between the onset of MSPs and psychological disturbance [12]. A statistically significant correlation was found between musculoskeletal disorders and anxiety & depression in the examined group; Almost 96% of the students who complained of MSPs also had anxiety [13], as well as medical students had higher rates of emotional discomfort as a result of the pressures of their studies, compared to their peers and the general population [14]. Studies on medical students conducted in the US and Canada reveal that they had a high rate of anxiety and depression as well as a significant increase in psychological discomfort [15]. Depression, anxiety and distress among adolescents may be important determinants of musculoskeletal pain [7].

Significance of the study:

Students in schools are more likely to have musculoskeletal pain due to their ongoing growth and development. School children's musculoskeletal problems range in severity from mild, moderate to extreme illnesses which restrict physical activity, harm health, and lower quality of life [16]. Since MSPs first manifest in adolescence, it is critical to look into the disorder during this time in life-or even before-in order to pinpoint its exact origin and help create primary preventive measures and effective treatment plans [17].

Aim of the study:

To identify the prevalence of musculoskeletal problems and its relation to psychological distress among general secondary students subjected to online learning.

Research Questions:

1. What is the prevalence of musculoskeletal problems among general secondary students using online learning?
2. What are levels of depression, stress and anxiety among studied students?
3. Is there relationship between musculoskeletal pain and psychological distress?
4. What is the relationship between conditions related online learning and musculoskeletal pain among studied students?

Subjects and Method:

Research Design:

A descriptive cross-sectional design was utilized in conducting the current study.

Study Setting:

The study was carried out at 4 general secondary schools randomly selected from Zagazig, Kafr Saqr, Ibrahemia, and Abo-Hammad cities, Sharkia Governorate, Egypt.

Study Subjects:

A sample composed of 421 of general secondary students (first, second and third grades) of both sexes with ages ranging from (16-18 years) with no congenital anomalies, injuries or mental disabilities was randomly selected for recruitment in the present study.

Sampling technique:

A stratified multi-stage cluster random sample was used as follows:

- **First stage:** The researchers randomly selected four administrations from the 18 administrations of Sharkia Governorate: West and East Zagazig, Kafr Saqr, Ibrahemia, and Abo-Hammad educational administrations.
- **Second stage:** Four secondary schools were selected randomly from the four selected educational administrations.
- **Third stage:** In this step, the classes from the selected schools were chosen as clusters based on the necessary sample size. One class from each grade in each school was randomly selected (12 classes total).

Sample calculation:

The total number of students in the secondary schools of Sharkia governorate was 102528 students obtained from the General Department of Information and Computer (GDIC) affiliated to the Education Department at Sharkia Governorate, assuming a 95% confidence level and a margin of error of 5%, the required sample size for a cross-sectional study would be approximately 383 students. Considering 10% sample attrition (38 students), the final sample size was **421** students.

Tools for data collection:

Three tools were designed by the researchers to gather the required data:

Tool I: A questionnaire interview sheet: It was created by the researchers following an extensive analysis of related literature and was divided into these four sections:

- **Part A: Socio-demographic data of the studied students** including their age, sex, educational grade, and residence.
- **Part B: Health status of the studied students** including weight, height, BMI, exercise, number of sleeping hours per day, and smoking.
- **Part C: Conditions related online learning** such as reasons of using the internet, type of devices used for online learning, number of hours for online studying per day, as well as place of using online learning, sitting position with neck bent or using a comfortable back pillow when using online learning.
- **Part D: Students' medical history about musculoskeletal**

problems including history of chronic illnesses, the use of medications for treating musculoskeletal pain in the last month, family history of musculoskeletal disorders, pain interfering with activities of daily living, history of spine curvature, arthritis, cartilages and ligaments injuries, as well as causes of musculoskeletal pain and history of problems other than musculoskeletal disorders.

Tool II: Nordic Musculoskeletal Questionnaire (NMQ): A self-report tool was developed by **Kuorinka et al.** [18] and used to identify symptoms related to the musculoskeletal system. It was divided into two main parts: During online learning, **the first part** assessed general health disorders related to the musculoskeletal system at various body positions. Nine different body parts are mentioned in all of the questions: the neck, shoulders, elbows, wrists, upper and lower back, hips, knees, and ankles. When taking online courses, participants were asked if they had ever encountered any episodes of pain or discomfort. **The second part** evaluated the impact of pain or discomfort on activities of daily living and medical visits over the past year related to musculoskeletal pain. It included Yes/No questions about any musculoskeletal pain or discomfort encountered throughout online courses, as well as questions about how pain affected daily activities.

Tool III: Depression, Anxiety and Stress Scale - 21 Items (DASS-21): It was developed by **Lovibond and Lovibond** [19] and employed to assess psychological distress. It is a set of three self-report measures used to assess stress, anxiety, and depression. The seven items in each of the three DASS-21 scales are divided into subscales with comparable content. Every psychological condition was evaluated using seven items. Dysphoria, hopelessness, life devaluation, self-deprecation, lack of interest or involvement, anhedonia, and inertia are all evaluated on the depression-related items. The items pertaining to anxiety evaluate situational anxiety, skeletal muscle effects, autonomic arousal, and subjective perception of anxious affect. The stress-related items evaluate nervous arousal, trouble relaxing, and susceptibility to upset/agitation, irritability/over-reactivity, and impatience.

Recommended cut-off scores for conventional severity labels (normal, moderate, severe) are as follows:

NB Scores on the DASS-21 will need to be multiplied by 2 to calculate the final score.

	Depression	Anxiety	Stress
Normal	0-9	0-7	0-14
Mild	10-13	8-9	15-18
Moderate	14-20	10-14	19-25
Severe	21-27	15-19	26-33
Extremely severe	28+	20+	34+

Source: Lovibond, S.H., and Lovibond, P.F. Manual for the Depression Anxiety & Stress Scales. (2nd Ed.). Sydney: Psychology Foundation.1995.

Content validity and reliability:

The questionnaire interview sheet, Nordic musculoskeletal questionnaire, and depression, anxiety and stress scale were reviewed by three professors (one professor of pediatric nursing, one professor of community health nursing and one professor of psychiatric nursing). Every juror

(100%) accepted that the validity of the currently available research tools was relevant to the purpose of the study. The Alpha Cronbach test was used to judge the tools' reliability. The reliability coefficient was good for Nordic Musculoskeletal Questionnaire (0.854), excellent for Depression, Anxiety and Stress Scale - 21 Items (0.906).

Field work:

This study was completed within three months between February 2024 and April 2024. Following approval to begin the study, the researchers met with the directors of the chosen schools and told them about the purpose of the study and the method of data collection. They were instructed to get consent from the pupils in the chosen classrooms in order to take part in the study. After obtaining the agreement of the students, the researchers identified themselves to the students in the classroom and explained the nature and goal of the study as well as the forms used to gather data. Under the supervision of the researchers who remained in the classroom to address any specific questions that arisen as students completed the questionnaire, they were instructed to fill out the questionnaire sheets. The student needed between twenty and thirty minutes to finish answering.

Pilot study:

42 secondary students (10%) took part in a pilot study to determine the feasibility, the items' level of comprehension, and the precise amount of time needed to complete the questionnaire. Only minor adjustments in the questionnaire were made. The students who took part in the pilot study were excluded from the research.

Administrative and Ethical considerations:

The ethical committee of faculty of nursing, Zagazig University gave the permission to conduct this study at 8/1/2024 with a code number 166, as well as permission was obtained from administrative authority of the schools under the study. All relevant ethical aspects were considered for ensuring students' privacy and confidentiality of the collected data throughout the study as the purpose of the study was explained to each student, voluntary participation and right to withdraw from the study at any time, it was emphasized to subjects and an written consent for participation in the study was obtained from each one of them.

Statistical analysis:

The collected data organized, tabulated and statistically analyzed using Statistical Package for Social Science (SPSS) version 25 for windows, running on IBM compatible computer. Descriptive statistics were applied (e.g. frequency, percentages, mean and standard deviation). Qualitative variables were compared using chi square test to test association between two variables. Multiple linear regression was utilized to determine the associations of musculoskeletal problems with psychological distress. Reliability of the study tools was done using Cronbach's Alpha. A significant level value was considered when $p < 0.05$ and a highly significant level value was considered when $p < 0.01$. No statistical significance difference was considered when $p \geq 0.05$.

Results:

Table (1) shows that 40.9% of the studied students were aged 18 years, with a mean age of 17.16±0.79. Females represented 51.8% of the studied sample and 43.2% were in the third year. It was also found that 67.5% of the studied students resided in rural areas.

As observed from **Table (2),** 46.3% of the studied students used internet for YouTube and access for educational platforms, 55.8% of them used mobile as a devices to access for online learning, also it was found that 54.2% of the studied students spent 1 to 5 hours per day for studying online and 69.8% of the studied sample used online learning at home.

Regarding body position, 80.3% of the studied students assumed sitting position when using online learning, 56.3% were sitting for long period for online learning with neck bent and 58% of them did not use comfortable back pillow when using online learning.

Table (3) reveals that 40.4% of the studied students had weight between 60 to less than 70 kg with a mean weight of 65.68±10.2 kg and 47.5% had height between 160 to less than 170 cm , as well as 72.9% had normal BMI with a mean of 23.6±3.12 kg/m^2. The same table portrayed that 55.8% were doing exercises and the most common exercises done were football, basketball or tennis among 46.8% of the studied sample. Also, 58.2% of the studied students slept 7 to 8 hours per day and 96% did not smoking.

The medical history of the studied children was represented in **Table (4)**. 89.8% of the studied students did not have history of chronic diseases and 87.9% did not take medications to treat musculoskeletal pain in the past month, as well as 65.3 did not had family history of musculoskeletal disorders, 50.8% mentioned that pain ever prevented them from practicing activities of daily living, 56.1% did not visit doctor due to pain. Only 20.9%, 14.3%, 20% of participants had history of spine curvature, arthritis, and cartilage or ligament injuries, respectively. Sitting in improper position and sitting for a long time on the tablet/phone every day were the common causes of musculoskeletal pain reported by 50.8%, 37.8% of the studied students, respectively. Moreover, it was found that headache; blurred vision and concentration difficulties were problems besides musculoskeletal pain among 51.3%. 27.1%, 24.2% of the studied sample, respectively.

Figure (1) shows that, the most common sites of musculoskeletal problems as pain among general secondary students were the neck (69.8%), followed by the upper back (54.9%), whereas the least common sites were the elbow (21.6%) and the thigh (24.9%).

Levels of depression, anxiety and depression were illustrated in **Figure (2)** shows that, 29.9% of the studied general secondary students had mild level of depression, while 50.8% and 51.3% of them had moderate level of anxiety and stress, respectively.

Table (5) shows the presence of a highly significant model 1, as indicated by the F-test result of 82.281 with a p-value of 0.000. This model explains 37.2% of the variation in total depression score, with an R-squared value of 0.372. Also, it reveals that the lower limb pain had a strong predictor of total depression score followed by vertebral column pain and upper limb pain. Moreover, this table reveals that, the presence of a highly significant model 2, as indicated by the F-test result of 94.05 with a p-value of 0.000. This model explains 40.4% of the variation in total anxiety score, with an R-squared value of 0.404. Also, it reveals that the lower limb pain had a strong predictor of total anxiety score followed by upper limb pain and vertebral column pain. Also, presence of a highly significant model 3, as indicated by the F-test result of 85.88 with p-value of 0.000. This model explains 38.2% of the variation in total stress score, with an R-squared value of 0.382. Also, it reveals that the vertebral column pain had a strong predictor of total stress score followed by upper limb pain and lower limb pain.

Table (6) shows that, only gender was highly statistically significant with vertebral column pain (OR: 1.870; p = 0.003). Female had a 1.870 -fold higher odds ratio than male. In the lower limb pain, Gender was statistically significant (OR: 1.504; p value = 0.046)". Females had a 1.504-fold higher odds ratio than males. Also, there was statistically significant relation between upper limb pain, lower limb pain and students'

age & academic year at p value < 0.05.

Table (7) shows that, sitting for long periods of time for online learning with neck bent, using a comfortable back pillow while using online learning and doing exercise had highly statistically significant relation with upper limb pain (OR: 0.235, 4.271, 2.494, respectively at p < 0.01), with vertebral column pain (OR: 0.155, 6.144, 3.453, respectively at p < 0.01) and lower limb pain (OR: 0.331, 2.858, 3.052, respectively at p < 0.01). Also, family history from musculoskeletal disorder, history of curvature of the spine and history of arthritis had highly statistically significant relation with upper limb pain (OR: 0.380, 0.288, 0.316, respectively at p < 0.01), with vertebral column pain (OR: 0.503, 0.316, 389, respectively at p < 0.01) and lower limb pain (OR: 0.474, 0.210, 0.280, respectively at p < 0.01). Moreover, number of hours per day for studying online had highly statistically significant relation with upper limb pain, vertebral column pain and lower limb pain (p < 0.01). While, body mass index, number of hours of sleep per day and smoking don't had statistically significant relation with upper limb pain, vertebral column pain and lower limb pain (p > 0.05).

Discussion:

The results of the present study showed that more than half of the secondary students were females; more than two thirds were lived in the rural areas, as well as there was highly statistically significant relation between gender and neck & lower back pain where females had neck and lower back pain than males. This may be related to females spend more time than males for studying online. These results are consistent with **Martins et al.** [20] who discovered that more than half of adolescents were females; majority of them resided in the rural areas. Similarly with, **Shan et al.** [21] clarified that significantly higher proportion of girls reported neck and lower back pain compared to boys. On the contrast with, **Zheng et al.** [22] found that there was no significant correlation between sex of the participants and the prevalence of neck pain. Also, **Obembe et al.** [23] discovered that prevalence of musculoskeletal pain didn't significantly differ between male and female.

A statistically significant relation was found between upper, lower limb pain and student's age & academic year (p< 0.05). This may be revealed that as age and academic level increase; upper and lower back pain increase. This is in agreement with **Shan et al.** [21] who clarified that the frequency of neck, shoulder and lower back pain increased with the grade level over the high school years. This contrast with **Salameh et al.** [24] who found academic year was not significantly associated with musculoskeletal pain. Also, **Zheng et al.** [22] revealed that the frequency of neck pain did not sign ificantly correlate with the participants' age or grade (p > 0.05).

The most common sites of musculoskeletal pain among general secondary students were the neck, followed by the upper back, shoulder and lower back, knee and hand whereas the least common site were the elbow, thigh and foot. This may be related to rigid posture can increase bone and muscle tension around the waist & neck and is closely linked to neck; shoulder and lower back pain [25]. This is the same result with **Karingada and Sony** [26]**; Salameh et al.** [24]**; Masondo and Khoza** [27]**; Srirug et al.** [28] who reported that the musculoskeletal disorders commonly occur in the shoulders, neck, and upper back & lower back.

Regarding body mass index (BMI), the results clarified that nearly three quarters of the secondary students had normal body mass index with a mean of 23.6±3.12 kg/m^2, as well as BMI had no statistically significant relation with upper limb, vertebral column and lower limb pain (p > 0.05).

This may be attributed to BMI were not associated with musculoskeletal pain. These findings consistent with **Salameh et al.** [24] who mentioned that the majority of students were healthy weight and BMI were not significantly associated with musculoskeletal pain. Similarly with, **Shan et al.** [21] who reported that most of the study sample had an average BMI of 21.76±4.42 kg/m^2 and BMI was not related to musculoskeletal pain prevalence. On the contrary, this disagrees with **Martins et al.** [20]**; Maumita et al.** [29]**; Kanjilal et al.** [30] who observed that more than two thirds of participants were underweight; BMI was 17.58±3.71, with statistically significant differences. Also, **Srirug et al.** [28] discovered that musculoskeletal disorders were statistically associated with body mass index ($p < 0.05$).

The results clarified that over half of the studied pupils reached the online learning through mobile, while more than one third accessed through the tablet. This may be due to tablet & mobile were easy, common and accessible devices for the students. This result matches with **Salameh et al.** [24] who mentioned that higher proportion of the sample used electronic devices such as mobile, and tablet during distance learning. Similarly, **Mohan et al.** [31] who found that two fifths of children used notebook computers for online learning, and three fifths used smartphones for online learning.

As observed from the following study, more than half of the participants used online learning for 1-5 hours, more than two fifths used for 6-10 hours, also more than half of the students were sitting with neck bent and did not use comfortable back pillow. These results in agreement with **Rakhadani et al.** [32]**; Yaseen and Salah** [33]**; Elhossiney et al.** [13] who found that over one-third of medical students studied online for four to five hours a day. Approximately three quarters of the students exhibited static head position, over three quarters assumed awkward posture, and two thirds did not employ a comfortable back support when studying online. This agreement could be explained by after pandemic of COVID-19 finding new ways for education and transformation for online learning worldwide.

The effect of online learning on students' physical and mental health may be numerous as it requires students to spent considerable time on digital devices. These devices cause harm by emitting short high-energy waves that can penetrate the eyes and making the person susceptible to various eye disorders [22, 34]. These facts about the side effects of the online learning could explain the findings of this study which clarified the higher proportion of the students consumed sitting position with neck bent without comfortable back support when using online learning, Moreover, more than half of participants complained of headache, more than one quarter of students suffered from blurred vision besides musculoskeletal pain. Also, these matches with **Rakhadani et al.** [32]**; Yaseen and Salah** [33]**; and Salameh et al.** [24] who found that more than half of students sitting on chair with supine bent forward, as well as low chair, a lot of time spent on computer, uncomfortable chairs were causes of musculoskeletal pains associated with computer usage. Moreover, Eye problems, muscle cramp, headache, blurred vision were the results of computer related musculoskeletal problems.

Sitting for long periods of time with neck bent, using a comfortable back pillow while using e-learning had highly statistically significant relation with upper limb, vertebral column and lower limb pain ($p < 0.01$) as revealed from the current study. This may be attributed to musculoskeletal pain in the students during online learning can arise from various factors, including poor posture, prolonged sitting or standing and improper ergonomics [35].

This finding consistent with **Salameh et al.** [24] who illustrated that there was a very significant positive correlation between musculoskeletal pain and postural habits ($p < 0.0001$). Similarly with **Anton et al.** [36]**; Schmidt et al.** [7]**; Masondo and Khoza** [27]**; and Zheng et al.** [22] who stated that incorrect postures, heavy use of electronic devices were significantly associated with neck, shoulder, hand/wrist or back pain ($p < 0.05$).

According to **Macias et al.** [37]**; Moras and Gamarra** [38], the long-term a symmetrical loading on the shoulders may alter the spine curvature. This finding matches with the current study that showed that only fifth of the students sample had history of spine curvature. This may be related to most online tasks require the students to look down sharply or hold their arms out in front of them to read the screen. This forward head posture can result in an excessive anterior curve in the lower cervical vertebrae and an excessive posterior curve in the upper thoracic vertebrae, placing stress on the cervical spine and neck muscles [39 - 40].

According to the results of the current study, over half of the students were sleeping from seven to eight hours per day and there was no statistically significant relation between sleep hours and upper limb, vertebral column and lower limb pain ($p > 0.05$). Such finding may be indicated that lack of sleep cannot associate with musculoskeletal pain. This result contrasts with **Anton et al.** [36] who found that Lack of sleep was positively correlated with back pain in children and adolescents and sleep quality seems to be correlated with neck, lower back, and shoulder pain.

Concerning physical activity, more than two fifths of the studied students did not do exercises and there was a highly statistically significant relation between poor exercises and musculoskeletal pain ($p < 0.01$). Such study suggested that students who exercise regularly had lower prevalence of musculoskeletal pain. This in agreement with **Rakhadani et al.** [32]**; Ghanbari et al.** [41]**;** and **Ogunlana et al.** [42] who found that the students who do not regularly participate in the exercises while using online teaching had a higher percentage of musculoskeletal pain. Moreover, in the same line **Fritz and Clifford** [43]**; Yao et al.** [44] ; **Shan et al.** [21]**;** and **Zheng et al.** [22] who suggested a significant correlation was also found between neck, shoulder, lower back pain and exercising habits ($p < 0.05$).

The present study revealed that half of the pupils mentioned that pain did not prevent them from performing daily tasks; two fifths of them were seen doctor due to pain. This may be related pain can be severe in certain students that it interferes with their capacity to carry out some activities of daily living [33]. This is consistent with the findings of **Elhossiney et al.** [13] who discovered that quarter of the students stated that their pain kept them from engaging in their regular activities and just 17% of them had seen a doctor.

As revealed from the current study, more than one third of the studied secondary school students had mild level of depression, while half of them had moderate level of anxiety and stress, respectively. Such result may be indicated that students felt stress, anxiety and depression due to academic pressure during online studying. This contrasts with **Maumita et al.** [29] who found that the majority of participants in domains of stress, anxiety were normal. Also, **Shan et al.** [21] showed that the majority of students had severe depression.

The present study portrayed that the lower limb pain had a strong predictor of total depression score followed by vertebral column and upper limb pain with highly statistically significant difference with (p value of 0.000). This matches with **Elhossiney et al.** [13] who reported that there was a statistically significant association

between depression and occurrence of musculoskeletal disorders ($p < 0.05$). Similarly with **Masondo and Khoza** [27] who reported that statistically significant risk factors for musculoskeletal disorders among students were depression ($p = 0.032$). This result may be attributed to those who felt depressed due to academic pressure showed a higher prevalence of neck, shoulder and lower back pain [21].

In addition, the present study demonstrated that the lower limb pain had a strong predictor of total anxiety score, followed by upper limb pain and vertebral column pain with highly statistically significant ($p = 0.000$). This is in agreement with **Kayabinar et al.** [45] who discovered that musculoskeletal problems and anxiety increased significantly as a result of switching to online education. The same result by **Anton et al.** [36] who showed the prevalence of anxiety and distress may be important determinants musculoskeletal pain in adolescents.

The current study revealed that the presence of a highly significant in total stress score, the vertebral column pain had a strong predictor of total stress score, followed by upper limb pain and vertebral column pain ($p = 0.000$). Such result goes in line with **Masondo and Khoza** [27] who reported that statistically significant risk factors for musculoskeletal disorders among students were stress ($p = 0.028$). Moreover, **Srirug et al.** [28] found that musculoskeletal disorders were associated with psychosocial factors ($p < 0.05$).

Conclusion:

It can be concluded that increased prevalence of musculoskeletal problems among general secondary students and the most common sites of musculoskeletal pain were the neck, followed by the upper back, shoulder and lower back, as well as students felt stress, anxiety and depression due to academic pressure during online studying. Furthermore, musculoskeletal problems increased significantly with depression, stress and anxiety as a result of switching to online education. Moreover, incorrect postures, prolonged use of online learning and lack of exercises were significantly associated with musculoskeletal pain.

Recommendations:

1. Intervention strategies for the students about maintaining good postures during online learning to prevent the recurrence of MSPs.
2. Psychosocial programs to maintain school student emotions and relieve academic pressures during online courses.
3. Providing educational posters, booklets, pamphlets about preventive measures for students to increase their awareness and to overcome the leading risk factors of MSPs.
4. Develop guidelines for students on recognizing early signs of discomfort and appropriate self-care strategies (e.g., applying heat/ice, modifying postures … etc.).

Table (1): Frequency distribution of the studied students according to their demographic data (n=421)

Demographic data of the studied students	No.	%
Age (Years)		
16-	105	24.9
17-	144	34.2
18	172	40.9
Mean ± SD	**17.16±0.79**	
Gender		
Male	203	48.2
Female	218	51.8
Academic year		
First year	99	23.5
Second year	140	33.3
Third year	182	43.2
Residence		
Urban	137	32.5
Rural	284	67.5

SD= Standard deviation.

Table (2): Frequency distribution of the studied students according to some conditions related online learning (n=421)

Items	No.	%
***Reasons for using the Internet:**		
Follow Facebook, WhatsApp and Telegram	170	40.4
To communicate, watch and listen to some things	93	22.1
Do homework and scheduled daily activities	98	23.3
Use YouTube and access for educational platforms	195	46.3
For games	37	8.8
To take pictures and make videos	15	3.6
***Devices used during online learning:**		
Mobile / phone	235	55.8
Laptop or computer	52	12.4
Tablet	160	38.0
TV screen	9	2.1
Number of hours of online learning per day:		
1-5	228	54.2
6-10	184	43.7
11-15	9	2.1
Place of using online learning:		
Home	294	69.8
School	14	3.3
Both home and school	113	26.8
***Body position when using online learning:**		
Sitting	338	80.3
Supine	82	19.5
Standing	8	1.9
Sitting for long periods of time for online learning with neck bent:		
Yes	237	56.3
No	184	43.7
Using a comfortable back pillow when using online learning:		
Yes	177	42.0
No	244	58.0

(*) Responses not mutually exclusive

Table (3): Frequency distribution of the studied students according to their health status (n=421)

Health status of the studied students	No.	%
Weight (Kg)		
40-	21	5.0
50-	67	15.9
60-	170	40.4
≥70	163	38.7
Range	**(40-97)**	
Mean ± SD	**65.68±10.2**	
Height (Cm)		
140-	11	2.6
150-	51	12.1
160-	200	47.5
≥170	159	37.8
Range	**(140-190)**	
Mean ± SD	**166.2±9.33**	
Body mass index (BMI)		
Under weight	12	2.9
Normal weight	307	72.9
Over weight	95	22.6
Obese	7	1.7
Range	**(17.4-35.7)**	
Mean ± SD	**23.6±3.12**	
Doing exercise:		
Yes	235	55.8
No	186	44.2
***If doing exercise, what types of exercises? (n=235)**		
Gym	90	38.3
Home exercises	79	33.6
Yoga exercises	15	6.4
Running	54	23.0
Football, basketball or tennis	110	46.8
Exercises using videos	10	4.3
Number of hours of sleep per day:		
≤ 6	117	27.8
7-8	245	58.2
≥9	59	14.0
Smoking:		
Yes	17	4.0
No	404	96.0

Kg= Kilogram**, Cm= Centimeter, SD=** Standard deviation, (*) Responses not mutually exclusive.

Table (4): Frequency distribution of the studied students according to their medical history of musculoskeletal problems (n=421)

Medical history of musculoskeletal problems	No.	%
History from chronic diseases:		
Yes	43	10.2
No	378	89.8
Take medications to treat musculoskeletal pain in the past month :		
Yes		
No	51	12.1
	370	87.9
Family history from musculoskeletal disorder:		
Yes	146	34.7
No	275	65.3
Has pain ever prevented you from practicing activities of daily living:	207	49.2
Yes	214	50.8
No		
See a doctor due to pain:		
Yes	185	43.9
No	236	56.1
History from curvature of the spine:		
Yes	88	20.9
No	333	79.1
History from arthritis :		
Yes	60	14.3
No	361	85.7
History from cartilage or ligament injuries:		
Yes	84	20.0
No	337	80.0
***Causes of musculoskeletal pain:**		
Sitting for a long time on the tablet/phone every day	159	37.8
Not exercising regularly	83	19.7
Sitting in improper position	214	50.8
Being overweight or obese	12	2.9
***History from other problems besides musculoskeletal pain:**		
Burning eyes	65	15.4
Blurred vision	114	27.1
Headache	216	51.3
Excessive tears	32	7.6
Difficulty in concentration and academic achievement	102	24.2

(*) Responses not mutually exclusive

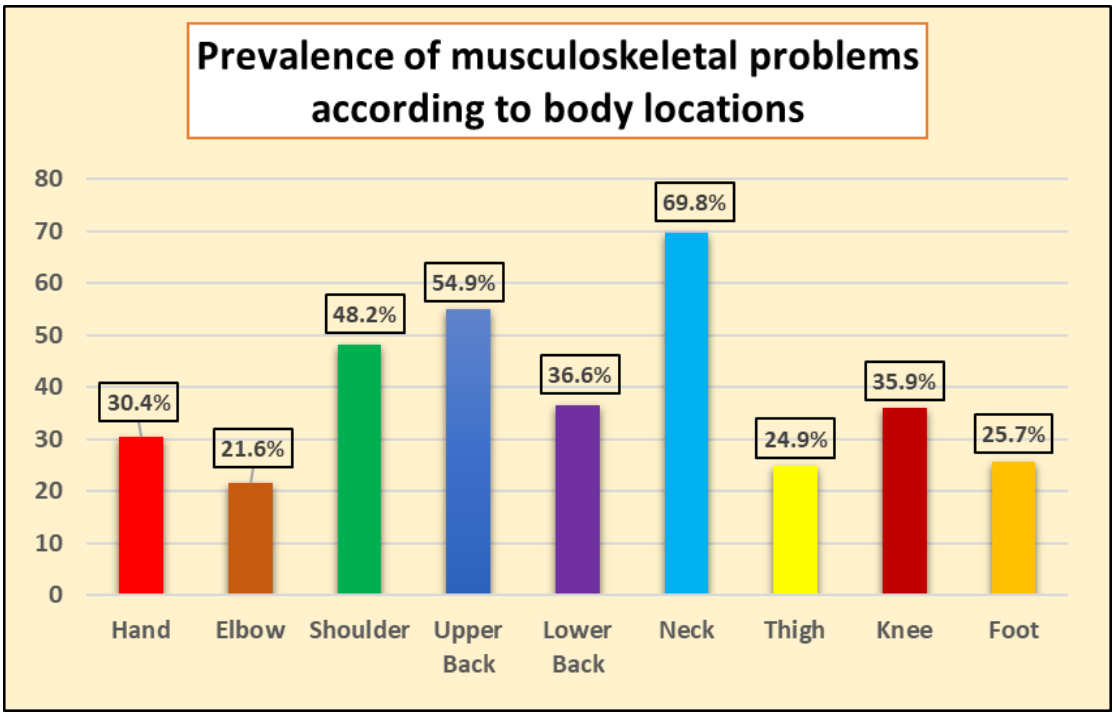

Figure (1): Prevalence of musculoskeletal problems according to body locations among general secondary school students (n=421)

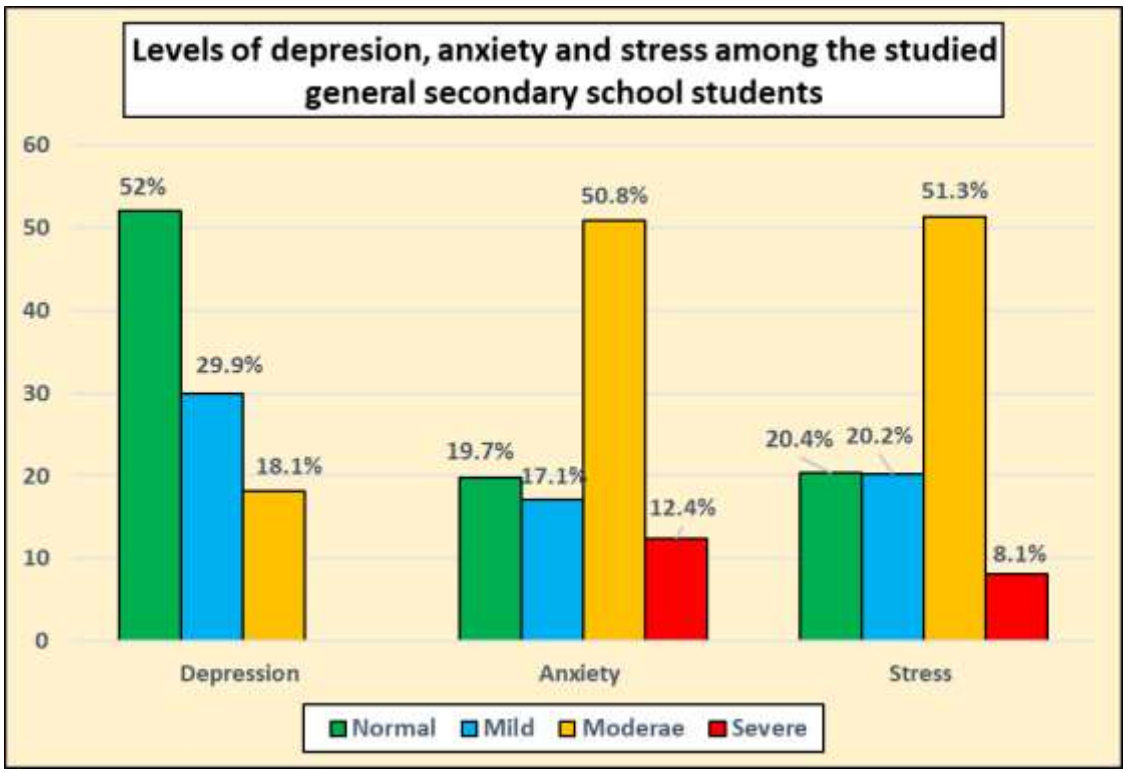

Figure (2): Percentage distribution of the studied general secondary school students according to level of depression, anxiety and stress (n=421)

Table (5): Multiple linear regression examining associations of musculoskeletal problems with psychological distress among general secondary students (n=421)

Items	B	Beta	95% Confidence interval		t	P. value	R^2	ANOVA	
			Lower	Upper				F	P. value
Depression									
Model 1							0.372	82.281	0.000**
Constant	8.013		7.475	8.552	29.25	0.000**			
Upper limb pain	1.779	0.230	.983	2.576	4.390	0.000**			
Vertebral column pain	1.935	0.229	1.125	2.744	4.699	0.000**			
Lower limb pain	2.208	0.274	1.444	2.972	5.680	0.000**			
Anxiety									
Model 2							0.404	94.05	0.000**
Constant	8.484		8.037	8.932	37.29	0.000**			
Upper limb pain	1.763	0.267	1.101	2.424	5.237	0.000**			
Vertebral column pain	1.645	0.229	.973	2.317	4.810	0.000**			
Lower limb pain	1.832	0.266	1.197	2.467	5.673	0.000**			
Stress									
Model 3							0.382	85.88	0.000**
Constant	11.965		11.187	12.744	30.22	0.000**			
Upper limb pain	2.223	0.197	1.072	3.374	3.796	0.000**			
Vertebral column pain	4.793	0.390	3.624	5.963	8.056	0.000**			
Lower limb pain	1.636	0.139	0.531	2.740	2.911	0.000**			

Dependent Variable in model 1: Depression score.
Dependent Variable in model 2: Anxiety score.
Dependent Variable in model 3: Stress score.
B=Unstandardized Coefficients. **Beta**=Standardized Coefficients. **t:** Independent t-test. R^2 = Coefficient of multiple determination ** p<0.01.

Table (6): Relation between demographic data of the studied students and musculoskeletal pain (n=421)

Items		Upper limb pain					Sig.	Vertebral column pain					Sig.	Lower limb pain					Sig.
		Yes (n=203)		No (n=218)		OR		Yes (n=294)		No (n=127)		OR		Yes (n=151)		No (n=270)		OR	
		No.	%	No.	%			No.	%	No.	%			No.	%	No.	%		
Age (years)	16 -	52	25.6	53	24.3	_	**0.048***	70	23.8	35	27.6	_	**0.234**	28	18.5	77	28.5	_	**0.013***
	17 -	58	28.6	86	39.5			96	32.7	48	37.8			48	31.8	96	35.6		
	18	93	45.8	79	36.2			128	43.5	44	34.6			75	49.7	97	35.9		
Gender	Male	89	43.8	114	52.3	1.404	**0.083**	128	43.5	75	59.1	1.870	**0.003****	63	41.7	140	51.9	1.504	**0.046***
	Female	114	56.2	104	47.7			166	56.5	52	40.9			88	58.3	130	48.1		
Academic year	First	50	24.6	49	22.5	_	**0.047***	65	22.1	34	26.8	_	**0.400**	27	17.9	72	26.7	_	**0.034***
	Second	56	27.6	84	38.5			96	32.7	44	34.6			47	31.1	93	34.4		
	Third	97	47.8	85	39.0			133	45.2	49	38.6			77	51.0	105	38.9		
Residence	Urban	64	31.5	73	33.5	1.093	**0.668**	99	33.7	38	29.9	0.841	**0.451**	52	34.4	85	31.5	0.875	**0.535**
	Rural	139	68.5	145	66.5			195	66.3	89	70.1			99	65.6	185	68.5		

Note: OR, Odds ratio. No significant at p ≥0.05. * p < 0.05. ** p <0 .01. Upper limb pain includes (Shoulder, Elbow and Hand), Vertebral column pain includes (Neck, Upper Back and Lower Back), and Lower limb pain includes (Thigh, Knee, and Foot).

Table (7): Relation between conditions related online learning and musculoskeletal pain among studied students subjected to online learning (n=421)

Items		Upper limb pain					Sig.	Vertebral column pain					Sig.	Lower limb pain					Sig.
		Yes (n=203)		No (n=218)		OR		Yes (n=294)		No (n=127)		OR		Yes (n=151)		No (n=270)		OR	
		No.	%	No.	%			No.	%	No.	%			No.	%	No.	%		
Number of hours of online learning per day	1-5	91	44.8	137	62.8	_	**0.000****	139	47.3	89	70.1	_	**0.000****	60	39.7	168	62.2	_	**0.000****
	6-10	105	51.7	79	36.2			148	50.3	36	28.3			87	57.6	97	35.9		
	11-15	7	3.4	2	0.9			7	2.4	2	1.6			4	2.7	5	1.9		
Sitting for long periods of time for online learning with neck bent	Yes	150	73.9	87	39.9	0.235	**0.000****	204	69.4	33	26.0	0.155	**0.000****	110	72.8	127	47.0	0.331	**0.000****
	No	53	26.1	131	60.1			90	30.6	94	74.0			41	27.2	143	53.0		
Using a comfortable back pillow while using online learning	Yes	50	24.6	127	58.3	4.271	**0.000****	86	29.3	91	71.7	6.114	**0.000****	40	26.5	137	50.7	2.858	**0.000****
	No	153	75.4	91	41.7			208	70.7	36	28.3			111	73.5	133	49.3		
Body mass index	Under weight	3	1.5	9	4.1	_	**0.167**	7	2.4	5	3.9	_	**0.198**	1	0.7	11	4.1	_	**0.043***
	Normal weight	144	70.9	163	74.8			209	71.1	98	77.2			105	69.5	202	74.8		
	Over weight	53	26.1	42	19.3			74	25.2	21	16.5			43	28.5	52	19.2		
	Obese	3	1.5	4	1.8			4	1.3	3	2.4			2	1.3	5	1.9		
Do exercise	Yes	90	44.3	145	66.5	2.494	**0.000****	139	47.3	96	75.6	3.453	**0.000****	58	38.4	177	65.6	3.052	**0.000****
	No	113	55.7	73	33.5			155	52.7	31	24.4			93	61.6	93	34.4		
Number of hours of sleep per day	≤6	53	26.1	64	29.4	_	**0.103**	83	28.2	34	26.8	_	**0.421**	50	33.1	67	24.8	_	**0.112**
	7-8	114	56.2	131	60.1			166	56.5	79	62.2			78	51.7	167	61.9		
	≥9	36	17.7	23	10.6			45	15.3	14	11.0			23	15.2	36	13.3		
Smoking	Yes	11	5.4	6	2.8	0.494	**0.165**	16	5.4	1	0.8	0.138	**0.026**	9	6.0	8	3.0	0.482	**0.134**
	No	192	94.6	212	97.2			278	94.6	126	99.2			142	94.0	262	97.0		
History from chronic diseases	Yes	39	19.2	4	1.8	0.079	**0.224**	42	14.3	1	0.8	0.048	**0.000****	38	25.2	5	1.9	0.056	**0.000****
	No	164	80.8	214	98.2			252	85.7	126	99.2			113	74.8	265	98.1		
Family history from musculoskeletal disorder	Yes	93	45.8	53	24.3	0.380	**0.000****	115	39.1	31	24.4	0.503	**0.004****	69	45.7	77	28.5	0.474	**0.000****
	No	110	54.2	165	75.7			179	60.9	96	75.6			82	54.3	193	71.5		
Pain prevented from practicing daily life	Yes	127	62.6	80	36.7	0.347	**0.000****	163	55.4	44	34.6	0.426	**0.000****	110	72.8	97	35.9	0.209	**0.000****
	No	76	37.4	138	63.3			131	44.6	83	65.4			41	27.2	173	64.1		

History of spine curvature	Yes	65	32.0	26	11.9	0.288	**0.000****	78	26.5	13	10.2	0.316	**0.000****	59	39.1	32	11.9	0.210	**0.000****
	No	138	68.0	192	88.1			216	73.5	114	89.8			92	60.9	238	88.1		
History of arthritis	Yes	45	22.2	18	8.3	0.316	**0.000****	53	18.0	10	7.9	0.389	**0.007****	39	25.8	24	8.9	0.280	**0.000****
	No	158	77.8	200	91.7			241	82.0	117	92.1			112	74.2	246	91.1		
History of cartilage or ligament injuries	Yes	61	30.0	26	11.9	0.315	**0.000****	70	23.8	17	13.4	0.495	**0.015***	46	30.5	41	15.2	0.409	**0.000****
	No	142	70.0	192	88.1			224	76.2	110	86.6			105	69.5	229	84.8		

Note: OR, Odds ratio. No significant at p ≥0.05. * p < 0.05. ** p <0 .01. Upper limb pain includes (Shoulder, Elbow, and Hand), Vertebral column pain includes (Neck, Upper Back and Lower Back), and Lower limb pain includes (Thigh, Knee, and Foot).

References:

1. Bayan, S., Saeed, G., Kourosh, Z., Mahin, G., and Maryam, Z. Investigating prevalence of musculoskeletal disorders among Iranian nurses: A systematic review and meta-analysis. *Clin. Epidemiol. Glob. Health*. 2019; 7(3):513-518. DOI: 10.1016/j.cegh.2018.06.007
2. WHO. Musculoskeletal health. 2022. Available at: https://www.who.int/news-room/fact-sheets/detail/musculoskeletal-conditions. Accessed on [April 5, 2024].
3. Briggs, A. M., Woolf, A. D., Dreinhöfer, K., Homb, N., Hoy, D. G., Kopansky-Giles, D., Åkesson, K., and March, L. Reducing the global burden of musculoskeletal conditions. *Bulletin of the World Health Organization*. 2018; 96(5): 366-368. https://doi.org/10.2471/BLT.17.204891
4. Atia, D.T., Elsayed, N.I., Abdelmonem, A.F., Mahmoud, S.M.S., Mahmoud, M.M.M., Mohamed, K.E.S., Turky, K.T.Y., Rashad, U.M., and Abdel Karim, A.E. Prevalence of Musculoskeletal Disorders among General and Technical Secondary School Students in Egypt. *International Journal of Environmental Research and Public Health*. 2023; 20(2):1465. https://doi.org/10.3390/ijerph20021465
5. Helmy, A.A., Mohammed, A.A., and Yossif, H.A. Knowledge and Practices of School Children and Teachers Regarding Musculoskeletal Problems: An Educational Intervention. *Egyptian Journal of Health Care*. 2019; 10(3): 421-432.
6. Soares, C.O., Pereira, B.F., Pereira Gomes, M.V., Marcondes, L.P., de Campos Gomes, F., and de Melo-Neto, J.S. Preventive factors against work-related musculoskeletal disorders: Narrative review. *Rev. Bras. Med. Trab*. 2020; 17(13): 415-430. https://doi.org/10.5327/Z1679443520190360
7. Schmidt, K., Friedrichs, P., Cornelsen, H.C., and Tischer, T. Musculoskeletal disorders among children and young people: prevalence, risk factors, preventive measures: A Scoping Review. *European Agency for Safety and Health at Work*. 2021; 11, 253774.
8. Direksunthorn, T., Polpanadham, P., Summart, U., Mahem, K., Kempanya, P., A'la, M.Z., and Wittayapun, Y. Association of electronic learning devices and online learning properties with work-related musculoskeletal disorders (WMSDs): A cross-sectional study among Thai undergraduate students. *PLoS ONE*. 2023; 18(10): e0291597. https://doi.org/10.1371/journal.pone.0291597
9. Amro, A., Albakry, S., Jaradat, M., Khaleel, M., Kharroubi, T., et al. Musculoskeletal disorders and association with social media use among university students at the quarantine time of COVID-19 outbreak. *J Physic Med Rehabilita Stud*. 2020; 1(1): 104. DOI: 10.15744/2767-4584.1.104
10. Murray, C.B., Groenewald, C.B., de la Vega, R., and Palermo, T.M. Long-term impact of adolescent chronic pain on young adult educational, vocational, and social outcomes. *Pain*. 2020; 161(2):439-445. https://doi.org/10.1097/j.pain.0000000000001732
11. Daneshmandi, H., Choobineh, A., Ghaem, H., Alhamd, M., and Fakherpour, A. The effect of musculoskeletal problems on fatigue and productivity of office personnel: a cross-sectional study. *J Prev Med Hyg*. 2017; 58(3): E252-E258.

12. Nahit, E.S., Hunt, I.M., Lunt, M., Dunn, G., Silman, A.J., et al. Effects of psychosocial and individual psychological factors on the onset of musculoskeletal pain: common and site-specific effects. *Ann Rheum Dis*. 2013; 62(8):755-60.

13. Elhossiney, D.M., Gamal, D.A., and Ghanem, E.A. Musculoskeletal disorders and its relation to psychological distress among medical students subjected to online learning during covid-19 pandemic. *Egyptian Journal of Occupational Medicine*. 2023; 47(1): 111-126. DOI: 10.21608/ejom.2022.144124.1282

14. Melaku, L., Mossie, A., and Negash, A. Stress among Medical Students and Its Association with Substance Use and Academic Performance. *J Biomed Educ*. 2015; 1-9. https://doi.org/10.1155/2015/149509

15. Liselotte, N., Dyrbye, Y., Matthew, R., and Tait, D. Systematic review of depression, anxiety, and other indicators of psychological distress among U.S. and Canadian medical students. *Acad Med*. 2016; 81(4):354-7.

16. Pranjic, N., and Azabagic, S. Evidence-based Management Options for Nonspecific Musculoskeletal Pain in Schoolchildren. *Mater. Socio-Med*. 2019; 31(3):215-218. DOI: 10.5455/msm.2019.31.215-218

17. Kamper, S.J., Henschke, N., Hestbaek, L., Dunn, K.M., and Williams, C.M. Musculoskeletal pain in children and adolescents. *Brazilian journal of physical therapy*. 20(3): 275-284. https://doi.org/10.1590/bjpt-rbf.2014.0149

18. Kuorinka, I., Jonsson, B., Kilbom, A., Vinterberg, H., Biering-Sørensen, F., Andersson, G., and Jørgensen, K.I. Standardised Nordic questionnaires for the analysis of musculoskeletal symptoms. *Appl Ergon*. 1987; 18(3):233-237. https://doi.org/10.1016/0003-6870(87)90010-x

19. Lovibond, S.H., and Lovibond, P.F. Manual for the Depression Anxiety & Stress Scales. (2nd Ed.). Sydney: Psychology Foundation. 1995.

20. Martins, R.L., Carvalho, N., Albuquerque, C., Andrade, A., Martins, C., Campos, S., Batista, S., and Dinis, A. Musculoskeletal disorders in adolescents: a study on prevalence and determining factors. *Acta Paul Enferm*. 2020; 33(37): e-APE20190173. DOI: 10.37689/acta-ape/2020AO0173

21. Shan, Z., Deng, G., Li, J., Li, Y., Zhang, Y., and Zhao, Q. Correlational Analysis of neck/shoulder Pain and Low Back Pain with the Use of Digital Products, Physical Activity and Psychological Status among Adolescents in Shanghai. *PLoS ONE*. 2013; 8(10): e78109. https://doi.org/10.1371/journal.pone.0078109.

22. Zheng, D.D., Li, D., Cheng, J.X., and Jin, R.H. The prevalence of neck pain among online learning students: An observational study. *Medicine Baltimore*. 2024; 103 (32): e39264. DOI: 10.1097/MD.0000000000039264

23. Obembe, A.O., Johnson, O.E., Tanimowo, T.O., Onigbinde, A.T., and Emechete, A.A. Musculoskeletal pain among undergraduate laptop users in a Nigerian University. *J Back Musculoskelet Rehabil*. 2013; 26(4): 389-395. DOI: 10.3233/BMR-130397

24. Salameh, M.A., Boyajian, S.D., Odeh, H.N., Amaireh, E.A., Funjan, K.I., and Al-Shatanawi,

T.N. Increased incidence of musculoskeletal pain in medical students during distance learning necessitated by the COVID-19 pandemic. *Clin Anat*. 2022; 35(4): 529-536. DOI: 10.1002/ca.23851

25. Yue, P.P., Liu, F.F., and Li, L.L. Neck/shoulder pain and low back pain among school teachers in China, prevalence and risk factors. *BMC Public Health*. 2012; 12: 789. https://doi.org/10.1186/1471-2458-12-789.

26. Karingada, T., and Sony, M. Demonstration of the relationship between MSD and online learning during the COVID-19 pandemic. *Journal of Applied Research in Higher Education*. 2021; 2050-7003. DOI: 10.1108/JARHE-08-2020-0269

27. Masondo, P.S., and Khoza, T.E. Musculoskeletal disorders among undergraduate radiography students during work integrated learning in Kwazulu-Natal, South Africa. *Journal of Medical Imaging and Radiation Sciences*. 2023; 54 (1): 153-161.

28. Srirug, P., Kongbankhong, N., Jongjit, K., Muansri, O., and Sengsoon, P. Prevalence and factor associated work-related musculoskeletal disorders of students in virtual classroom. *Heliyon*. 2023; 9(8): e18461. https://doi.org/10.1016/j.heliyon.2023.e18461.

29. Maumita, K., Uma, K., Kumar, G. G., Deepika, A., Kant, A. R., and Singh, D.J. Musculoskeletal Pain and its Risk Factors among School-Going Adolescents in Delhi, India. *OJHAS*. 2020; 19(2): 9.

30. Kanjilal, M., Kumar, U., Gupta, G.K., Agrawal, D., Arya, R.K., and Dhakar, J.S. Musculoskeletal pain and its risk factors among school going adolescents in Delhi, India. *Online Journal of Health and Allied Sciences*. 2022; 19(2): 7.

31. Mohan A., Sen, P., Shan, C., Jain, E., and Jain, S. Prevalence and risk factor assessment of digital eye strain among children using online e-learning during the COVID-19 pandemic: digital eye strain among kids (DESK study-1). *Indian J. Ophthalmol*. 2021; 69(1):140-144.

32. Rakhadani, P.B., Goon, D. T., and Mandeya, A. Musculoskeletal Problems Associated with University Students Computer Users: A Cross Sectional Study. *Online Journal of Health and Allied Sciences*. 2017; 16(2): 1-7. Available at: http://www.ojhas.org/issue62/2017-2-7.html.

33. Yaseen, Q.B., and Salah, H. The impact of e-learning during COVID-19 pandemic on students' body aches in Palestine. *Sci Rep*. 2021; 11(1): 22379. https://doi:10.1038/s41598-021-01967-z.

34. Bhattacharya, S., Saleem, S.M., and Singh, A. Digital eye strain in the era of COVID-19 pandemic: an emerging public health threat. *Indian Journal of Ophthalmology. Medknow Publications*. 2020; 68(8): 1709-1710. https://doi.org/10.4103/ijo.IJO_1782_20

35. Gotum, T., Keeratisiroj, O., and Jariya, W. Prevalence of musculoskeletal symptoms from online learning during the COVID-19 epidemic: a systematic review and meta-analysis [version 1; peer review: 1 approved]. *F1000Research* 2024; 13:790. https://doi.org/10.12688/f1000research.152382.1

36. Anton, D., Bray, M., Hess, J. A., Weeks, D.L., Kincl, L.D., and Vaughan, A. Prevalence of work-related musculoskeletal pain in masonry apprentices. *Ergonomics*. 2020; 63(9):1194-1202. DOI: 10.1080/00140139.2020.1772380

37. Macias, B.R., Murthy, G., Chambers, H., and Hargens, A.R. High contact pressure beneath backpack straps of children contributes to pain. *Archives of pediatrics & adolescent medicine*. 2005; 159(12): 1186-1187. DOI: 10.1001/archpedi.159.12.1186

38. Moras, R., and Gamarra, T.A. Survey of ergonomic issues associated with a university laptop program. *Journal of Education and Human Development*. 2007; 1: 1-15.

39. Berolo, S., Wells, R.P., and Amick, B.C. Musculoskeletal symptoms among mobile hand-held device users and their relationship to device use: a preliminary study in a Canadian university population. *Appl Ergon*. 2011; 42(2):371-378. DOI: 10.1016/j.apergo.2010.08.010

40. Mansour, O.A.R., and Kandil, O.A.D. The use of knowledge based expert system approach in examining causes of low back pain in computer users. *Eur J Sci Res*. 2011; 50(3): 357-367.

41. Ghanbari, L., khazaei, S., Mortazavi, S.S., Saremi, H., and Naderifar, H. The Effect of Online Teaching on the Prevalence of Musculoskeletal Pain in Female Students during the Covid-19 Pandemic. *JRSR*. 2021; 9(1): 36-41. https://doi.org/10.30476/jrsr.2021.92956.1220.

42. Ogunlana, M.O., Govender, P., and Oyewole, O.O. Prevalence and patterns of musculoskeletal pain among undergraduate students of occupational therapy and physiotherapy in a South African university. *Hong Kong physiotherapy journal: official publication of the Hong Kong Physiotherapy Association Limited = Wu li chih liao*. 2021; 41(1): 35-43. DOI: 10.1142/S1013702521500037

43. Fritz, J.M., and Clifford, S.N. Low back pain in adolescents: a comparison of clinical outcomes in sports participants and nonparticipants. *J Athl Train*. 2010; 45(1): 61-66. https://doi.org/10.4085/1062-6050-45.1.61

44. Yao, W., Luo, C., Ai, F., and Chen, Q. Risk factors for nonspecific low-back pain in Chinese adolescents a case-control study. *Pain medicine (Malden, Mass.)*. 2012; 13(5): 658-664. https://doi.org/10.1111/j.1526-4637.2012.01369.x

45. Kayabınar, E., Kayabınar, B., Önal, B., Zengin, H. Y., and Köse, N. The musculoskeletal problems and psychosocial status of teachers giving online education during the COVID-19 pandemic and preventive telerehabilitation for musculoskeletal problems. *Work (Reading, Mass.)*. 2021; 68(1): 33-43. https://doi.org/10.3233/WOR-203357