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Do the Adolescents' Physical Activity and Screen Time during the COVID-19 Quarantine correlate to their Upper Extremity Abnormalities and Anxiety?

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Abstract

Background: This study examines the prevalence of upper extremity abnormalities during COVID-19 quarantine. It emphasizes the role of physical activity and screen time in these abnormalities in male adolescents. The relationship between these components and anxiety was also examined.

Method: This descriptive-correlational study was performed on 150 13-15-year-old boys. Upper extremity abnormalities are measured using Image J software and Spinal Mouse. Physical activity, screen time, and anxiety are assessed by the use of standard questionnaires.

Results: Means of age and BMI were 22.86 and 22.48, respectively. The results showed that 70 patients (47%) had forward head posture, 51 patients (34%) had kyphosis, and 11 patients (7%) had lordosis. In addition, the results showed that physical activity and screen time were significantly correlated to forward head and kyphosis (all T>1.96). Also, physical activity, screen time, and upper extremity abnormalities were significantly associated with anxiety (all T>1.96).

Conclusion: The results indicate that upper extremity abnormalities, including forward head and kyphosis, are relatively common in male adolescents during COVID-19 quarantine. Also, physical activity and screen time may impact these abnormalities.

Key Words: Anxiety, COVID-19, Physical activity, Screen time, Upper extremity Abnormality.

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1- INTRODUCTION

Posture is defined as the body parts' alignment concerning each other at a given moment. Posture involves complex interactions between bones, joints, connective tissues, skeletal muscles, and the central and peripheral nervous systems. These interactions' complexity increases when we consider the human balance, motion control, and motion in relation to gravity. Over time, each organism undergoes changes that result from minor and severe damage to connective tissues, muscles, and neural control mechanisms, leading to notable changes in posture. Proper posture is considered one of the most critical indicators of human health (1). In the proper posture, the center of mass passes close to most of the joint axes, not the joints themselves, so in the proper posture, the gravitational moments are small, and equilibrium is achieved with minimal muscle activity or minimal energy expenditure. However, adverse changes in a person's posture can lead to skeletal abnormalities and poor posture (2). In an awkward posture, the body is in an unsuitable position, and the center of mass moves away from the axes of the joints, making it difficult to perform movements, and balance by creating significant gravitational moments. Some inappropriate postures are related to human birth and development, while some are caused by environmental factors and can overshadow the quality of life (4).

Many unsuitable postures begin in childhood and continue into adolescence and adulthood if left untreated and corrected (5). One of the most common awkward postures is related to spinal abnormalities. In the meantime, abnormalities such as forward head, kyphosis, and lumbar lordosis are more common. One of the most common body abnormalities is forward head abnormality. Forward head is an abnormal condition in the body that occurs due to weakness of the muscles and vertebrae of the neck. The sign of this anomaly is that the neck is one inch or more in front of the neck's first vertebra. Since our interactions with the world around us take place in front of the face, frequent use of electronic devices such as tablets and mobile phones, computers, watching TV, playing video games, accidents, or using a backpack can lead to forward head abnormality. Kyphosis is one of the most common spinal abnormalities (6). Kyphosis is when the back curvature is more than normal (between 20 and 25 degrees) (7). Like forward head, kyphosis can include factors such as carrying a backpack and using electronic devices such as tablets and mobile phones. Finally, lumbar lordosis is when the lumbar spine curvature is greater than normal (between -30 and -50 degrees) (8-9). The most common cause of lumbar lordosis can be obesity and a large abdomen, which weakens the lumbar and abdominal muscles and causes deformity in the lumbar spine.

The increase in the percentage of spinal abnormalities among children and adolescents is a worrying sign that necessitates more focus on analyzing the current status of these abnormalities in these age groups and studying the factors (3, 6). Upper extremity abnormalities in school-age children and adolescents are among the most common health problems in these individuals. However, little research has been done on the current status of these abnormalities in adolescents in Iran. For example, Bahrami and Farhadi (10) found that 57% of boys and 68% of girls in Lorestan province have upper extremity abnormalities such as kyphosis and lordosis. In addition, Moezzi et al. (6) found that about 15% of adolescent girls in Tehran suffer from upper extremity abnormalities, including kyphosis and scoliosis. Karimian et al. (11) also found that children aged 7 to 12 years in Fasa are strongly susceptible to upper extremity abnormalities. Finally, Ghorbani et al. (12)

found that kyphosis abnormalities among the 13-year-old, 14-year-old and 15-year-old adolescents in Golestan province were 70%, 65%, and 75%, respectively. Lordosis among 13-year-old, 14-year-old, and 15-year-old adolescents was determined to be 60%, 40%, and 50%, respectively. However, due to the lack of research on the current status of upper extremity abnormalities in adolescents, the first goal of the present study was to investigate the prevalence of upper extremity abnormalities, including forward head, kyphosis, and lumbar lordosis in adolescents.

Several factors can affect a person's posture. Meanwhile, research has shown that age, gender, obesity, race, bone and joint structure, mental status, lifestyle, and physical activity are among the factors seriously affecting posture (1, 5). The main determinant of posture is physical activity (6, 11, 13-15). Industrial and modern life has led to inactivity, which leads to various physical abnormalities. In addition, viral-infectious diseases such as COVID-19 cause children and adolescents to experience a more sedentary life than before the quarantine, mainly due to the closure of educational and sport centers (16-18). Therefore, regular physical activity is necessary to reduce the incidence of physical abnormalities, including skeletal abnormalities. In this regard, research has shown that regular physical activity can reduce the incidence of skeletal abnormalities (6, 11, 13-15). Therefore, constant monitoring of the current state of physical activity in adolescents, especially during the pandemics quarantine, seems necessary. Thus, the second aim of the present study is to investigate the rate of adolescent physical activity during COVID-19 quarantine and its relationship with the prevalence of skeletal abnormalities, including forward head, kyphosis, and lumbar lordosis in these individuals.

Also, some research has shown that the screen time (time spent using computer, tablet, and mobile phone) among children and adolescents has increased during the COVID-19 quarantine. Moreover, unnecessary and excessive use of these tools can intensify a sedentary lifestyle and increase inactivity in humans, leading to muscle weakness and skeletal abnormalities (19-21). However, this issue has rarely been explored in previous research. Therefore, the third objective of the present study is to examine the screen time in adolescents during COVID-19 quarantine and its relationship with the prevalence of upper extremity abnormalities, including head forward posture, kyphosis, and lumbar lordosis in these individuals.

In addition, one of the psychological components that can be affected by physical activity, screen time, and upper extremity abnormalities is anxiety (22). Anxiety refers to the unpleasant and vague feeling of fear and distress with an unknown origin that affects a person and includes uncertainty, helplessness, and arousal (18). Some research has shown that COVID-19 quarantine has increased mental and emotional abnormalities such as depression and anxiety in children and adolescents (18). Also, some research has shown that people who have a higher screen time have a higher level of anxiety (16). Therefore, the fourth aim of the present study was to investigate how physical activity, screen time, and upper extremity abnormalities are associated with anxiety in adolescents during COVID-19 quarantine.

Altogether, the purpose of the present study was to investigate the prevalence of upper extremity abnormalities, 2) the relationship between physical activity and the prevalence of upper extremity abnormalities, 3) the relationship between screen time and the prevalence of upper extremity abnormalities, and 4) the

association of anxiety relationship physical activity, screen time, and upper extremity abnormalities in adolescents during COVID-19 quarantine.

2- METHOD

The research method was descriptive-correlational.

2-1. Participants

The statistical population included all male adolescents in the high schools of Golestan province. Among them, a statistical sample of 150 male students aged 13 to 15 years (mean 14.41 years) were selected by convenience sampling.

2-2. Measures

In this study, the height and weight of the subject were accurately measured, and then the body mass index was calculated using the formula of weight (kg) / height^2 (m). The standard physical activity questionnaire (23) was used to assess the amount of physical activity. This questionnaire consists of eight items that assess the amount of physical activity during the last seven days. Each item is evaluated using a 5-point Likert scale between 1 and 5. The total score of the questionnaire is obtained by averaging eight items, which is a score between 1 and 5. A score of 1 indicates low physical activity, and a score of 5 indicates high physical activity. The validity and reliability of this questionnaire have been reviewed and confirmed by Kowalski, Crocker, and Kowalski (23) (r=0.73). The reliability of this questionnaire was also examined in the present study, and Cronbach's alpha coefficient was 0.92. Moreover, we measured the CVI and CVR of this questionnaire, as 1.00 and 0.92, respectively. The screen time was also measured, using a self-report questionnaire, which questioned the subjects' use of mobile phones and tablets as well as their TV watching during the day. The total score of the screen time variable for each subject was obtained by summing the amount of time spent using mobile devices, tablets, and televisions. The imaging method and Image J software were used to investigate the forward head posture. For this purpose, first, the C7 landmarks and earlobe were marked, and the person was placed in a standing position. Then a camera was placed at a distance of 2.5 meters above the subject's shoulder. Then, the subject was asked to bend and straighten three times and then sit comfortably and look forward. Then, three consecutive photographs of the person were taken. The captured photographs were transferred to the Image J software environment, and the craniovertebral angle (the angle between the horizontal line passing through the vertebra C7 and the line extending from the vertebra C7 to the Auricle) was extracted for analysis. A spinal mouse device (MED PRO, Switzerland) was used to evaluate the kyphosis and lumbar lordosis. Spinal Mouse is an advanced non-invasive tool that measures the spinal shape in several planes. The participant was asked to spread his legs shoulder-width apart, knees straight and forward, and completely normal to measure the degree of kyphosis and lumbar lordosis. The examiner placed himself behind the subject and first marked the C7 Spinous process (7th cervical vertebra) as a landmark. Then the spinal mouse device was activated, and by placing its wheel on the top and bottom of the C7 vertebra, the mouse was pulled down almost to the S3 vertebra (3rd sacral vertebra) along the Spine. Then, this measurement was performed in the case of bending and opening the trunk. Simultaneously with the movement of the mouse along the vertebrae, the movement path, the shape of the vertebrae, the angle of each vertebra, and the size of the lumbar spine curve (from T1T2 to T12L1) and the lumbar (from L1L2 to L5S1) were recorded on the monitor. Then, using the relevant software,

the degree of kyphosis from T1 to T12 (first to twelfth dorsal vertebra) and the degree of lumbar lordosis from L1 to L5 (first to fifth lumbar vertebra) were extracted. This measurement was repeated and recorded three times for each subject, and their mean was further calculated and analyzed as the degree of kyphosis and lumbar lordosis. We used Beck Anxiety Inventory (BAI-II) (24) to measure the level of anxiety of the subjects. The Beck Anxiety Inventory is a four-option questionnaire in which each question is scored from 0 to 3. Each item deals with one of the most common mental (e.g., anxiety, distress, fear, nervousness), physical (e.g., restlessness, shortness of breath, palpitations, muscle tension, etc.) symptoms, or anxiety and fear symptoms (e.g., sadness, worry, panic). The overall score is from 0 to 63. The internal reliability of this scale was reported as 0.71 to 0.93 with a mean of 0.87 and an alpha coefficient of 0.86 for the control group (18). In the present study, the reliability of this questionnaire was assessed with a CVI of 0.92 and CVR of 0.90. Moreover, here, Cronbach's alpha coefficient of this questionnaire was 0.88.

2-3. Data analysis

The descriptive statistics, including mean, standard deviation and frequency percentage, along with the inferential statistics including Kolmogorov-Smirnov tests, correlation, and structural equations were used to analyze the data through SPSS and SmartPLS softwares. The significance level was determined at the level of $P<0.05$. Written consent was obtained from the subjects to participate in this study.

3- RESULTS

3-1. Descriptive characteristics of the subjects

The mean±SD of the research variables and the general characteristics of the research subjects, including height, weight, and body mass index are given in **Table 1**. Based on the data in **Table 1**, it can be said that the body mass index (with an average of 22.86) in male adolescents is normal (between 18.5 and 25), although it is close to its high level.

Table-1: General characteristics of subjects along with the mean and standard deviation of research variables

Variable	Weight(kg)	Height(m)	BMI	Physical Activity	Screen Time	Forward Head	Kyphosis	Lordosis	Anxiety
Mean	1.59	57.68	22.86	1.39	4.81	46.85	39.12	23.90	27.42
SD	0.12	12.60	4.51	0.79	1.13	5.14	9.38	7.90	11.10

According to the data on the amount of physical activity, it can be said that the research subjects are in the physical activity range of 1 to 2, indicating their low level of physical activity. Screen time data show that the subjects have a high screen time. Moreover, 70 adolescents (47%) had forward head posture, 51 (34%) had kyphosis, and 11 (7%) had lordosis. Finally, 61 patients (41%) were found to have moderate anxiety, and 20 patients (13%) severe anxiety.

3-2. Normality of data distribution

The results of the Kolmogorov-Smirnov test showed that the research data did not have a normal distribution (all $P<0.05$). Therefore, the Spearman correlation test and Smart PLS software were used for the analyses.

3-3. Investigating the relationship between research variables

The results of Spearman correlation test (**Table 2**) showed that there is a significant relationship between BMI and all upper extremity abnormalities. Both physical activity and screen time are significantly correlated to forward head Posture, kyphosis, and anxiety, but there is no significant relationship between physical activity and lordosis. Finally, anxiety is significantly correlated with all upper extremity abnormalities.

Table-2: Results of the relationship between research variables

	BMI	Physical Activity	Screen Time	Forward Head	Kyphosis	Lordosis	Anxiety
BMI	-						
Physical Activity	r = -0.175 p = 0.001*	-					
Screen Time	r = 0.394 p = 0.000**	-	-				
Forward Head	r = -0.134 p = 0.009*	r = 0.318 p = 0.000**	r = -0.497 p = 0.000**	-	-	-	
Kyphosis	r = 0.290 p = 0.000**	r = -0.281 p = 0.000**	r = 0.301 p = 0.000**	-	-	-	
Lordosis	r = 0.271 p = 0.000**	r = -0.264 p = 0.000**	r = -0.039 p = 0.394	-	-	-	
Anxiety	r = -0.239 p = 0.000**	r = -0.681 p = 0.000**	r = 0.319 p = 0.000**	r = -0.425 p = 0.000**	r = 0.296 p = 0.000**	r = 0.419 p = 0.000**	-

3-4. Structural equation modeling

The results of structural equation modeling (**Table 3** and **Fig**. **1**) showed that physical activity is significantly correlated to forward head Posture, kyphosis, and anxiety (all T > 1.96). However, there is no significant relationship between physical activity and lordosis. In addition, the results showed that screen time is significantly correlated to forward head Posture, kyphosis, and anxiety (T > 1.96), but there was no significant relationship between screen time and lordosis. Finally, there was a significant relationship between all upper extremity abnormalities and anxiety (T > 1.96).

Table-3: Results of the path analysis

NO.	Path	β	T
1	Physical activity => forward head	0.625	12.125
2	Physical activity => kyphosis	0.265	-4.621
3	Physical activity => lordosis	0.012	0.095
4	Physical activity => anxiety	0.458	-8.968
5	Screen time => forward head	0.593	-10.160
6	Screen time => kyphosis	0.204	3.901
7	Screen time => lordosis	0.064	1.021
8	Screen time => anxiety	0.695	10.089
9	Forward head => anxiety	0.341	-7.694
10	Kyphosis => anxiety	0.307	6.039
11	Lordosis => anxiety	0.273	4.937

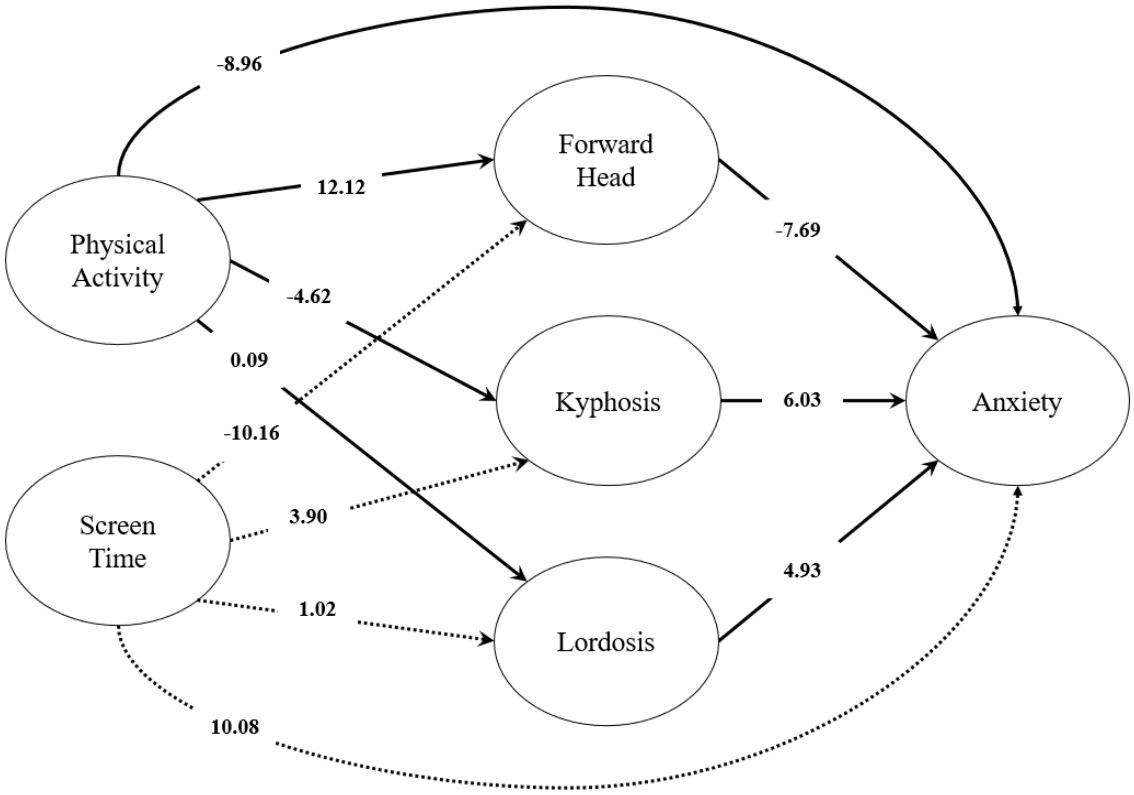

Fig. 1: Results of structural equation modeling in the form of T-values

4- DISCUSSION

COVID-19 quarantine forced children and adolescents to stay at home. They are less likely to engage in physical activities. Instead, their screen time, using tablets and mobile phones and watching TV, has increased during this period. Thus, the complications resulting from low physical activity and high screen time need to be investigated. One of the possible consequences is the development of upper extremity abnormalities and anxiety in children and adolescents. This study aimed to investigate the status of upper extremity anomalies in male adolescents in Golestan province during COVID-19 quarantine with emphasis on the role of physical activity and screen time in these anomalies. The relationship between these variables and anxiety was also examined. The results showed that the subjects were in the physical activity range of 1 to 2, indicating their low levels of physical activity. The data related to screen time showed that the participants had a high screen time. The results revealed that, 70 (47%) of the adolescents had forward head posture, 51 (34%) had kyphosis, and 11 (7%) had lordosis. Finally, 61 patients (41%) had moderate anxiety, and 20 (13%) suffered from severe anxiety. Finally, the results demonstrated that the male adolescents were in the normal range of body mass index, which is a symbol of height and weight, although this index was close to the high range. The comparative test results showed that the boys aged 15 years had a significantly higher body mass index than those aged 14 and 13 years. According to the health criteria of the World Health Organization, the body mass index in adolescence for boys should be in the range of 18.5 to 25. And the male adolescents are in this range, which

indicates their normal condition in terms of height and weight.

Also, the results related to physical activity showed that male adolescents in Golestan province perform few physical activities in COVID-19 quarantine, which is consistent with the results of previous research (13-15). These findings further highlight the fact that the COVID-19 pandemic has had much worse effects on physical activity behavior of adolescents than previously demonstrated. There is another fact that shows physical inactivity in children and adolescents was a global problem even before the onset of COVID-19 pandemic. Our findings, together with the findings of previous studies (18), worryingly reveal the fact that the COVID-19 pandemic has seriously and negatively affected the patterns of physical activity behavior in children and adolescents.

Also, the results, consistent with previous studies (10-14), showed that physical activity is significantly correlated to head forward posture and kyphosis. Moreover, physical activity was significantly correlated to anxiety. These results indicate that the variable of physical activity is considered an essential factor affecting the prevention of skeletal abnormalities and mental injuries. This result may indicate that the more physical activity, the better the health. However, the objective physical activity measurement tools (accelerometer) can provide a more accurate assessment of a person's actual physical activity during a week, while subjective measurements (e.g., a questionnaire) in the form of self-reported assessments do not report the exact amount of physical activity.

Also, the results related to screen time showed that male adolescents in Golestan province used electronic devices such as tablets or mobile phones or watched TV in the COVID-19 quarantine for 4.81 hours a day. The correlation test results showed that the screen time is significantly correlated to forward head posture and kyphosis. This result is also consistent with those of previous studies (19-21). In fact, mobile phones and electronic devices have become very common in recent years, and these devices are increasing throughout the day (19). To use these tools, especially mobile phones, neck flexion, and hyperflexion are essential. Neck flexion and head weight disturb the Spine balance. Depending on the flexion degree, the pressure on the spine's vertebrae in the neck and the back increases. This can develop upper limb abnormalities, including forward head and kyphosis. The data from the present study also show that the more time adolescents spend on electronic devices, the greater the rate of kyphosis they suffer from. This in itself can be considered an alarm for these people because research has shown that skeletal abnormalities can be associated with neck and back pain (20). Furthermore, screen time was significantly associated with anxiety. Playing exciting and sometimes violent games that can be easily played on mobile phones and tablets can lead to negative emotions and anxiety in adolescents. Therefore, excessive use of mobile phones and tablets during the COVID-19 quarantine can endanger the mental health of children and adolescents and increase their stress-related abnormalities and anxiety.

Finally, there was a significant relationship between upper extremity abnormalities and the incidence of anxiety in adolescents. These, in line with the previous literature (22), indicate that body deformity in adolescents can cause mental disorders.

4-1. Limitations of the study

The present study has some limitations. First, the results should be interpreted with caution because not all upper extremity abnormalities were evaluated, and indirect methods were used to assess the upper extremity structure. Second, the subjects of this study were only boys. Future research

should look at the differences between girls and boys with a gender-centered approach. Third, the present study was conducted only on adolescents. Examining the condition of children and adults may also be a priority for future research.

5- CONCLUSION

Overall, the results show that upper extremity abnormalities, including forward head and kyphosis, are relatively common in male adolescents in Golestan province during the COVID-19 quarantine. It is further revealed that physical activity and screen time can affect these abnormalities and anxiety. Practical considerations may accompany these results. First, the results of this study can clarify the current status of upper extremity abnormalities in male adolescents in Golestan province during the COVID-19quarantine for the medical professionals and occupational therapists, as well as the teachers. These people can use this data to prevent, improve, and treat these abnormalities in future planning.

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