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The Effect of an Online Corrective Training intervention on the Upper Cross Syndrome and Feelings of Fatigue and Pain in Adolescents

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Abstract

Background: This study aimed at investigating the effects of an online corrective exercise intervention on correcting forward head and kyphosis as well as reducing feelings of fatigue and pain in adolescents.

Methods: The present study enjoyed a causal-comparative design. The participants included 40 females aged 13-15 years. Upper cross syndrome was measured by the use of Image J software and Spinal Mouse. Feeling of fatigue and pain were assessed through questionnaires. During correctional training, the intervention group performed corrective exercises for eight weeks, three sessions per week, and each session lasting 30-45 minutes within the WhatsApp application.

Results: Body mass index (mean 22.86) in female adolescents was in the normal range (between 18.5 and 25), although it was close to its high level. The results showed that an online training course improved and corrected the condition of forward head (P=0.000) and kyphosis (P=0.000) in female adolescents. Furthermore, this training period has significantly reduced the feeling of fatigue (P=0.000) and pain (P=0.000). In addition, the results of the follow-up test revealed that the positive effects of an online correctional training period remained constant over time (P=0.000).

Conclusion: Corrective movements are effective in strengthen the muscles of the neck and back, and stretching the anterior muscles of the neck and chest in people with anterior head and kyphosis; while improving the condition of the head and kyphosis in adolescents, they can also reduce the feelings of fatigue and pain. Moreover, practicing methods for correcting abnormalities can be used online and virtually.

Key Words: Fatigue, Online intervention, Pain, Upper cross syndrome.

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1- INTRODUCTION

Posture is one of the most important factors affecting the physical and mental condition of people throughout life (1). The condition of the human body is affected by various factors including family factors, anatomical structural disorders, postal habits and occupation. In addition, a number of factors such as heredity, age, gender, environmental conditions, emotional status, physical activity and ergonomics may also affect the condition of the body (2-3). Physical position is the alignment of the body organs in relation to each other in a moment of time. Body posture involves complex interactions between bones, joints, connective tissue, skeletal muscle, and the central and peripheral nervous systems (4-5). Over time, each organism undergoes changes that result from minor and severe damages to its connective tissues, muscles, and neuro-control mechanisms, leading to unique changes in posture. The key to proper posture is the position of the spine. The spine has three natural curves - in the neck, middle / upper back and lower back (6). Proper posture should maintain these curves, but not increase or decrease them. While in an awkward position, the body's line of gravity moves away from the axes of the joints, making it difficult to perform movements and balance (7).

Many unsuitable physical postures begin in childhood and continue into adolescence and adulthood if left untreated and corrected (6). One of the most common awkward postures is related to forward head disorders and kyphosis. Forward head deformity is an abnormal condition in the body that occurs due to weakness of the muscles and vertebrae of the neck (8). The sign of this anomaly is that the neck is one inch or more in front of the first vertebra of the neck. Frequent use of electronic devices such as tablets and mobile phones, computer use, watching TV, playing video games, accidents or using a backpack can tilt your head forward. Kyphosis is a condition in which the curvature of the back of the spine is greater than normal (between 20 and 25 degrees) (2). Similar to forward head abnormalities, kyphosis abnormalities can be attributed to factors such as carrying a backpack and using electronic devices such as tablets and mobile phones.

In recent years, the prevalence of head disorders and kyphosis in children and adolescents has been increasing, which requires a greater focus on improving the status of these anomalies among these age groups (4, 8). For example, Bahrami and Farhadi (9) found that 57% of women and 68% of young girls in Lorestan province have upper body abnormalities such as kyphosis and lordosis. In addition, Moezzi et al. (8) found that about 15% of adolescent girls in Tehran suffer from upper body disorders including kyphosis and scoliosis. Karimian et al. (10) also found that most of the children aged 7 to 12 years in Fasa had upper body abnormalities. Finally, Ghorbani and colleagues (11) found that kyphosis abnormalities in 13-year-old, 14-year-old and 15-year-old adolescents in Golestan province were 70%, 65% and 75%, respectively. Lordosis abnormalities in 60-year-old, 14-year-old and 15-year-old adolescents were determined to be 60%, 40% and 50%, respectively. These findings suggest that forward head abnormalities and kyphosis are one of the most common health problems in school-age children and adolescents. However, little research has been done on the training methods to correct the current state of these disorders in adolescents.

On the other hand, the occurrence of pervasive viral-infectious diseases such as COVID-19 disease causes children and adolescents to experience a more sedentary life than in the pre-quarantine period, which is mainly due to the closure of

educational and sports facilities (12). The quarantine period caused by the COVID-19 virus has reduced regular physical activity in children and adolescents (13-15); and screen time (time of using computer, tablet, and mobile) has increased among them (13). However, one of the benefits of COVID-19 quarantine has been the use of online education-related technologies. One of the benefits of using online training is that people can make the most use of their time at home for training. The present study also tried to apply remote technologies in an online training experiment and evaluate its effects on correcting spinal anomalies of forward head disorders and kyphosis in adolescents.

The prevalence of upper cross syndromes among children and adolescents can have negative consequences. For example, some research has shown that forward head abnormalities and kyphosis can cause feelings of tiredness and pain (16-17). Therefore, the training methods used to correct upper cross syndromes should also have an impact on the consequences of correcting these anomalies. Thus, another purpose of the present study was to investigate the effect of the training method used in the present study to correct upper cross syndromes on reducing the feelings of fatigue and pain in adolescents. Overall, the aim of the present study was to investigate the effect of an online training course on correcting forward head disorders and kyphosis and reducing the feelings of fatigue and pain in adolescents.

2- MATERIALS AND METHODS

The present study enjoyed a causal-comparative (ex-post facto) design, with pretest-posttest intervention and control groups.

2-1. Participants

The statistical sample of the study included 40 female students aged 13 to 15 years (mean 14.49 years) who had head anomalies and kyphosis and were selected by convenience sampling. The participants were randomly divided into two groups including intervention (20 people) and control (20 people).

2-2. Measures

Imaging method and Image J software were used to check for head deformity. To do this, first the C7 and earlobe landmarks 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 to sit comfortably and look in front of him. Then, three consecutive photographs of the person were taken. The captured images were transferred to ImageJ software environment and the craniovertebral angle (the angle between the horizontal line passing through the C7 vertebra and the line extending from the C7 vertebra to the eardrum) was extracted for analysis. Spinal mouse device (MED PRO model made in Switzerland) was used to check the condition of kyphosis. Spinal Mouse is an advanced non-invasive tool that measures the position of the spine in several pages. To measure the degree of kyphosis, the person was asked to spread their legs shoulder-width apart, knees straight and forward, and to be perfectly normal. The examiner then placed the tool behind the subject and first marked and marked the C7 spine appendage (seventh cervical vertebra) as a landmark by touch. The mouse spinal device was, then, activated and by placing its rollers on the top and bottom of the C7 nut, the mouse was pulled down almost to the S3 nut (third sacral nut) along the vertebrae. 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 motion path, the shape of the vertebrae, the angle of each vertebra and the size of the dorsal curvature (from T1T2 to T12L1) were

recorded on the monitor. Then, using the relevant software, the degree of kyphosis was extracted from the level of T1 to T12 (first to twelfth dorsal vertebra). This measurement was repeated three times for each subject and the mean was calculated and recorded as a degree of kyphosis for each person. In addition, fatigue was measured using a five-point Likert scale: "no fatigue" (1), "no fatigue" (2), "slightly tired" (3), "tired" (4), and "very tired" (5). Pain sensation was also assessed using a five-point Likert scale with a range of "very painless" (1), "painless" (2), "slightly painful" (3), "painful" (4), and "very painful" (5).

2-3. Procedure

In the research protocol, the pre-test was completed first and the post-test was performed immediately after the intervention. A follow-up test was also performed one month later. All tests and evaluations were performed at home under the guidance of an examiner. During the correctional training period, the intervention group performed the desired exercises for eight weeks, three sessions per week, and each session lasting 30 to 45 minutes, under the supervision of the researcher, using the WhatsApp application. To run the experiment, we created a WhatsApp group, and all participants in the intervention group were added to the online training course. In the training protocol section, the purpose of the designed program was to stretch the shortened muscles in the front of the neck and chest and strengthen the muscles in the back of the neck and back. In this study, 12 different exercises were prescribed for the subjects, which were a combination of strength training, stretching and self-movement activities. In order to prevent possible injuries and to create mobility in the neck and back muscles, at the beginning of each session, the subjects performed flexibility exercises for five minutes. After the warm-up phase, first, the stretching exercises (static and dynamic) and then the strengthening exercises (isometric and isotonic) were performed. The static stretching exercise program increased from 10 seconds at the beginning of the workout to 30 seconds at the end of the workout. Static stretching exercises were performed by both the subject and the researcher and were repeated three times in each session. The beginning of the dynamic stretching exercise was performed in such a way that the neck was gently moved backwards, which stretched the muscles in front of the neck. The arms were also bent horizontally at a 90-degree angle to the front, with the help of contraction of the dorsal muscles. This movement stretches the muscles in front of the chest. These movements increased from 10 repetitions at the beginning of the exercise to 25 repetitions at the end of the exercise. Also, to prevent the possibility of injury to the muscle tissue, hitting movements are avoided in this stage; and the movements are performed in a soft and controlled manner. Isometric strengthening exercises increased from 10 seconds of contraction at the beginning of the exercise to 20 seconds at the end of the exercise. Isotonic training also increased from 6 repetitions at the beginning to 15 repetitions at the end of the training period.

2-4. Data analysis

Descriptive statistics including mean, standard deviation and frequency percentage along with the inferential statistics including independent t-test were used to analyze the data in SPSS software. Significance level was determined at the level of $P \geq 0.05$. Written consent was obtained from the subjects to participate in this study.

3- RESULTS

3-1. Descriptive characteristics

The general characteristics of the research subjects including height, weight

and body mass index as well as the mean of the research variables are presented in **Table 1**. Based on the data in **Table 1**, it can be said that body mass index (mean 22.86) in female adolescents is in the normal range (between 18.5 and 25), although it is close to its high level. According to the research data, the age of the subjects in the intervention and control groups are relatively similar. Also, the body mass index in both groups is relatively similar, which indicates that the subjects in both groups are at a relatively similar height and weight.

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

Groups	Age	Weight(kg)	Height(m)	BMI
Intervention	14.54±1.82	1.60±0.18	52.86±14.28	20.06±2.55
Control	14.43±1.16	1.61±0.22	53.09±13.66	20.50±2.21

3-2. Comparing the pre-, post-, and follow-up test results

The mean and standard deviation of the research variables in pre-test, post-test, and post hoc test are shown in **Table 2** and **Fig. 1** to **4**. Pre-test results show that all subjects in the intervention and control groups had forward head abnormalities and kyphosis. The results of the independent t-test showed that no significant difference was observed in forward head anomalies and kyphosis between the two groups. However, the post-test results showed that there was a significant difference between the two groups in both head-forward disorders and kyphosis, the intervention group being in a better position than the control group. These results indicate that the course of corrective exercises used in the present study improved the condition of the head anomalies and kyphosis in the subjects of the intervention group. The results of the post hoc test also showed that the condition of head forward and kyphosis abnormalities in the intervention group is significantly better than the control group. These results also indicate that the corrective exercises which improved the upper cross syndrome in the subjects in the intervention group have long-term effects.

Furthermore, according to the pre-test results, all subjects in the intervention and control groups had relatively high feelings of fatigue and pain. The results of an independent t-test showed that there was no significant difference in fatigue and pain between the two groups, in the pretest. However, the post-test results showed that there was a significant difference between the two groups in both feelings of fatigue and pain, where the intervention group had a lower feeling of fatigue and pain than the control group. These results indicate that a period of corrective exercise used in the present study reduced the feeling of fatigue and pain in the intervention group. The results of the post hoc test also showed that the feelings of fatigue and pain in the intervention group were significantly lower than those in the control group. The results of the follow-up tests, further, indicate that the effects of the corrective exercises maintain over time.

4- DISCUSSION

Lack of proper physical activity and excessive use of tablets and mobile phones have caused upper cross syndromes to be very common in children and adolescents. On the other hand, the spread of epidemics such as COVID-19 has caused children and adolescents to spend more time at

home, so online education has become a common method of education (13-15). Therefore, in the present study, we tried to investigate the effects of an online training course of corrective exercises on upper cross syndromes, including forward and kyphosis in female adolescents. The effect of this method on reducing the feeling of fatigue and pain was also investigated.

The results revealed that the course improved the condition of head anomalies and kyphosis in the intervention group. Additionally, the results of the follow-up test confirmed the long-term effects of the corrective exercises in the intervention group. However, no significant difference was observed between the pre-test and post-test results in the control group. These results are in accordance with those of the previous studies (16-20). Moreover, these results are especially efficient in two aspects. First, corrective exercise alone is effective in correcting upper cross syndromes.

Table-2: Comparison of the pre-, post-, and follow-up test results

	Group	Forward head	Kyphosis	Fatigue	Pain
Pretest	Intervention	46.58±5.20	39.29±9.58	3.38±1.20	3.67±1.20
	Control	45.69±5.80	39.92±9.01	3.22±1.62	3.59±1.16
	Comparison	t=0.265 P=0.697	t=0.694 P=0.584	t=0.964 P=0.432	t=0.593 P=0.519
Posttest	Intervention	55.05±8.39	28.46±8.19	2.25±1.96	2.67±1.72
	Control	45.86±5.39	39.27±9.28	3.29±1.53	3.53±1.50
	Comparison	t=6.531 P=0.000*	t=5.943 P=0.000*	t=4.697 P=0.000*	t=5.085 P=0.000*
Follow-up	Intervention	55.19±8.67	29.08±8.09	2.39±1.79	2.68±1.96
	Control	46.69±5.08	39.27±9.28	3.54±1.60	3.81±1.43
	Comparison	t=6.924 P=0.000*	t=5.391 P=0.000*	t=4.937 P=0.000*	t=5.158 P=0.000*

*Significant at P<0.001

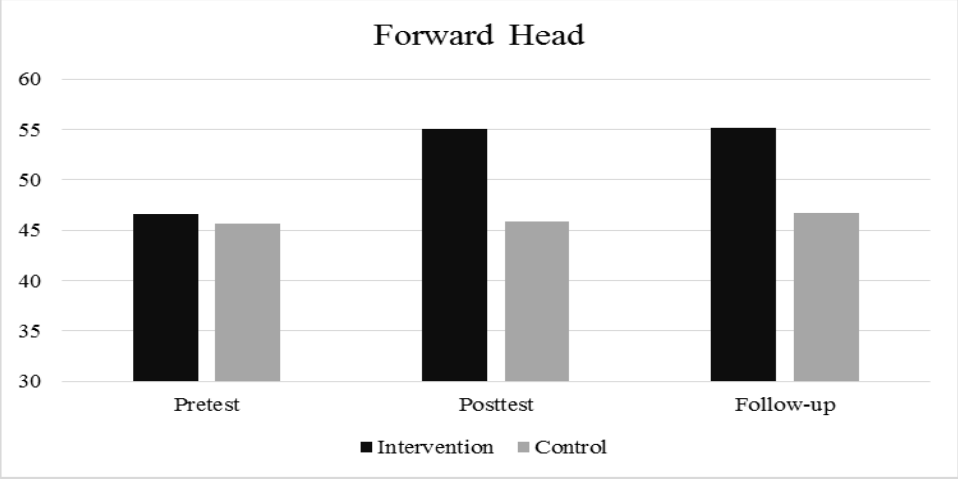

Fig. 1: Forward head mean scores of the two groups in the pretest, posttest, and follow-up

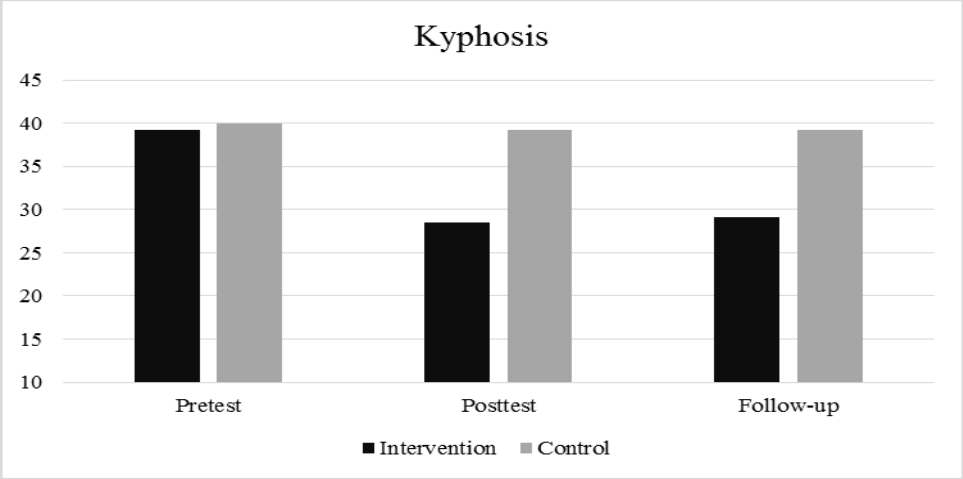

Fig. 2: Kyphosis mean scores of the two groups in the pretest, posttest, and follow-up

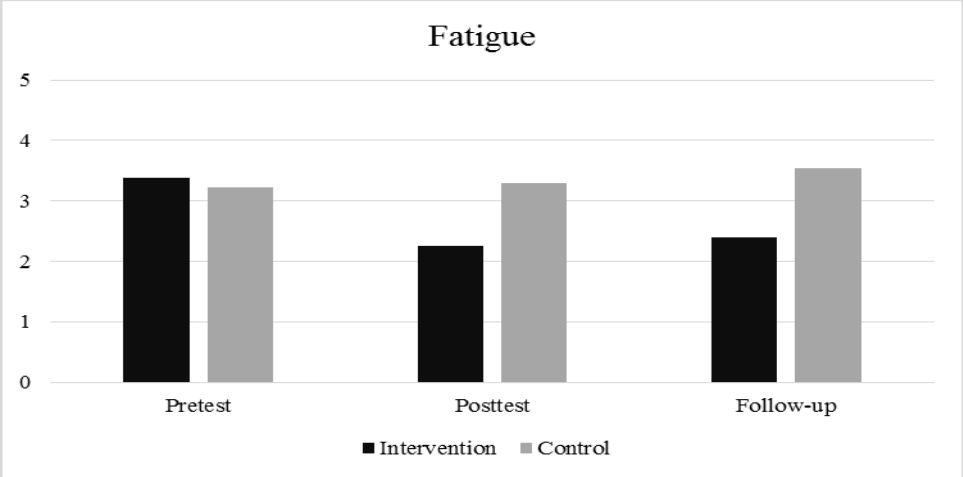

Fig. 3: Fatigue mean scores of the two groups in the pretest, posttest, and follow-up

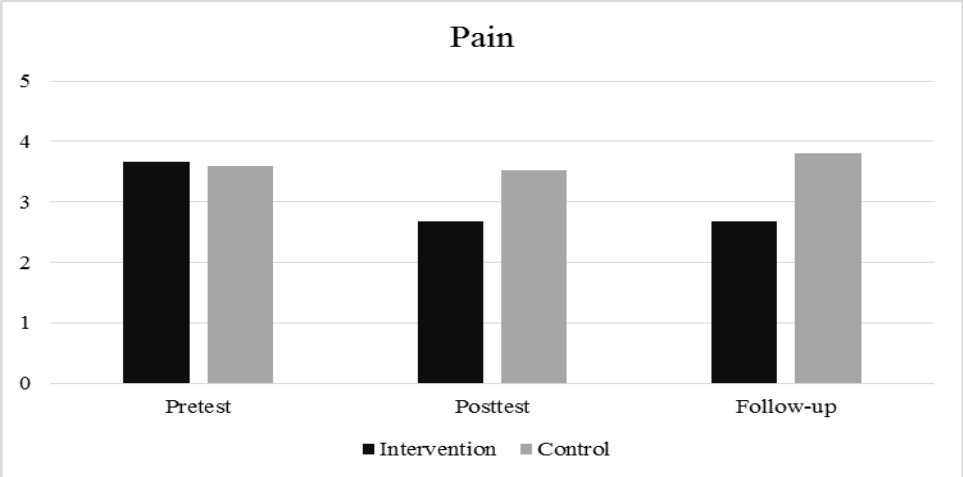

Fig. 4: Pain mean scores of the two groups in the pretest, posttest, and follow-up

These exercises were generally based on stretching the shortened muscles in the front of the neck and chest and strengthening the muscles of the back of the neck and back; and had a combination of strength exercises (isometric and isotonic) and stretching (static and dynamic). Second, online and virtual intervention exercises are also able to correct upper cross syndromes in adolescents, and this can emphasize the use of modern technologies to implement training programs (18).

Forward head deformity is associated with weakness in the muscles of the short neck flexors and middle scapulae of the chest and shortness of the neck and pectoralis extensor muscles (8, 18). Forward head abnormalities can be corrected by restoring normal muscle balance between agonist and antagonist muscles. In the present study, an intervention protocol was performed using strengthening exercises for deep neck flexors and shoulder retractors as well as stretching exercises for pectorals and triceps-clavicle muscles. These results are consistent with the findings of previous research (8, 18). For example, Harman et al. (19) showed that an intervention-correction program consisting of strengthening exercises for deep neck flexors and shoulder retractors and stretching exercises for neck and pectoralis muscle extensions can improve position-related forward head deformity.

Strength training seems to affect the length of the muscle tendon, displace different parts of the skeleton, and stabilize the ligaments. On the other hand, stretching exercises act as a coordinator of the muscles. Therefore, these exercises increase the length of the muscles on the concave side, increase the strength of the muscles on the convex side, and ultimately reduce the amount of abnormality. In the present study, strength training, especially isometric training, for increasing the strength of the spinal rectus muscles in cases with kyphosis, improved this disorder; and therefore, it can be stated that increasing the strength of the spinal rectus muscles plays an important role in maintaining the body structure and stature. These results are consistent with the findings of Mousavi et al. (20) and Carter et al. (21).

In the present study, the exercise program reduced fatigue and pain levels in the participants, and this result is similar to the findings of a previous study (16-17, 22), which shows that an exercise program including yoga and stretching reduces the feeling of fatigue and back pain in high school students. In addition, in another study, the participants' neck and shoulder pain levels were significantly reduced after 4 weeks of stretching compared to before the exercise program. In a study by Jung and Chah (22), which was limited to the neck area, pain levels decreased significantly by 38.8% after 8 weeks of traction compared to those before the traction. Another study examined the effect of isometric exercises on low back pain and reported a significant reduction in low back pain after the exercises, improved walking ability, ability to sit in a hard chair, reduced disability, improved standing posture, reduced pain levels, and led to a desire to improve quality of life. The results of the studies mentioned above show that appropriate correction programs improve the condition of upper cross syndromes in adolescents and also reduce the feeling of fatigue and pain in the body. Therefore, developing and presenting appropriate exercise programs contributes to the physical and mental health of the community.

4-1. Limitations of the study

The present study had some limitations. First, the results of this study should be interpreted with caution, because not all upper cross syndromes were evaluated, and indirect methods were used to assess the structure-stature status of the upper

body. Second, the subjects of this study were only females. Future research should also look at the differences between males and females in a gender-wise perspective. 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

According to the findings of the present study, it can be generally concluded that in cases with anterior head and kyphosis, the corrective movements for strengthening the muscles of the neck and back, and stretching the anterior neck and chest muscles, can improve the condition of the forward head and kyphosis in adolescents; and also reduce the feelings of fatigue and pain. Moreover, online and virtual practicing methods for correcting abnormalities can be effectively applied for these cases. According to the findings of this study, it can be suggested that future research should focus on examining the effects of various interventions on correcting postural abnormalities. Moreover, other age groups including adults and elderlies should be included in future studies.

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