The effect of periodical corrective motions on cardia - respiratory indexes of young girls with scoliosis

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Abstract: The purpose of this study was to evaluate the impact of corrective exercises on Max oxygen intake and heart rate indexes in girls (12-15 years old) with scoliosis. 40 girls (12-15 years old) with scoliosis were selected randomly from a guidance school and divided to two groups, 20 in experimental and 20 in control ones. All participants filled out the form to ensure that they had no heart and cardiovascular disease, in order to perform the required tests. After measuring the height and weight of participants, they were familiar with the tests. The pre-test consisted of the scoliosis evaluation, static strength and flexibility of back muscles and range of bending motion. Both groups practiced training programs for four weeks, each week four sessions for an hour and a half. Data were analyzed by paired t and independent t test and chi-square test (chi square). The research results demonstrated that the spinal flexibility and back muscles strength increased in the experimental group after a period of corrective movements, but there was not a significant difference between experimental and control groups. Corrective exercises had a positive impact on the level of the posterior superior iliac spine and there was significant difference between experimental and control groups. Corrective exercises had a positive impact on the shoulders surface, but there was not a significant difference between experimental and control groups. Lateral bending in the subjects of our research was asymmetrical and the results of corrective exercises did not show any significant difference in both groups.

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Keywords: corrective exercises, scoliosis, flexibility, strength

1. Introduction

The term scoliosis is originated from Greek word meaning crooked; it is one of the most common changes of the spinal cords that its recovery very difficult. The human spine is located in the vertical situation due to supporting muscles and balanced position and degrees of kyphosis or lordosis is normal and there is no any lateral curvature in these natural spines (Anderson, 1992). Scoliosis is consisted of the lateral deviation and rotational series of verterbrae from the midline axis, (Frymoyer, 2004; Pehrson et al, 1991; Jackson et al, 1989). Adolescent Idiopathic Scoliosis (AIS) is the most common of scoliosis and it includes more than 70% (Anthony , 2002). This change of the spine with lateral curvature and vertebral rotation (Frymoyer, 2004). The prevalence of Scoliosis depends on the size of curvature so that the much more curvature makes its prevalence lower. There is a definite relationship between the prevalence of Idiopathic scoliosis and type. In the lowest degrees, the prevalence rate is equal in two types but how the degree of curvature becomes high, this prevalence gets high in girls (Anthony, 2002; Karol et al., 1993). The cases higher than 40, causes the related incidence in girls 10 times higher than boys (Frymoyer, 2004; Terry, 2003; Anthony, 2002). The progression rate of deformation is higher in females (Anthony, 2002). Idiopathic scoliosis is seen in 2-3 % of children under sixteen years old (Terry, 2003). Increasing the size of curvature leads to the low prevalence so that the above 40 degree angler is seen in one-tenth percent of under sixteen years old (Weinstein, 1989). One of the most considerable complications of scoliosis can be Cardiac- respiratory dysfunction. This malfunction is due to the mechanism of chest following functional inability, Cardiac – respiratory disorders and finally early death would take place (Person et al., 1991; Jackson et al., 1989). Scoliosis causes to decrease the vital capacity in the thoracic lobe and impaired exercise capacity. Given the known cases, the effect of scoliosis is easily found on individual performance. Obviously, to increase physical performance of Cardiac– respiratory, the correction of scoliosis is exercise and scoliosis corrective movements have been shown as followings: Romano (2008) showed that among several proposed programs such as massage,

manual exercise and so on, people who actively participated in the exercise group showed a reduction in the size of kab angle indicating the rate of scoliosis recovery after active exercises. Negrini (2008) in a review study stated that exercising can be effective in the prevention and progression of Scoliosis. Corrective exercises with the aim of relieving pain is recommended for the prevention of deformation, creation of beautiful appearance, improved respiratory, increased chest expansion improved mobility and increase range of spine lateral motion and reduction of mechanical stress on the spine. Barrios et al (2006) have carried out the comparison between normal subjects and Idiopathic Scoliosis in terms of respiratory functional limitations and maximal oxygen uptake; he concluded that , the limitations of respiratory function and maximal oxygen uptake test in idiopathic Scoliosis patients is higher in compare to healthy individuals. Although the emphasis of emergency correction is based on radiographically cliche or using non – aggressive methods such as chess sheet, the effects of deformation on the respiratory and Cardiovascular physiology and also the effects of flexibility deformation on the respiratory physiology has been emphasized ; The researcher will attempt to demonstrate that how these corrective exercises will be effective on improving the circulatory and respiratory systems. Accordingly and due to the high statistical anomaly Scoliosis in girls, this study aims to answer this question whether the corrective exercises can effect on the Cardiac – respiratory function or no ?

2. Methods

The study population is Consisted of all female students ranging 12 – 15 year old of – middle school who had referred to the institute of corrective movements in Tehran education department, District 4; The total number of these students was 643 one ; After the diagnosis of these student by the help of the institution of – Corrective motions, it is specified 257 ones with scoliosis trauma which 84 ones were structural and 173 had situational Scoliosis ; finally , Among these people with Scoliosis , 40 ones were voluntary taken up in two groups: 20 0nes as an experimental and the rest as control group were considered.

2.1. The measurement tool (Gauges)

The page raster and plummet line, meter, stair with a height of 40 cm, metronome, stopwatch were applied to measure the maximal oxygen uptake through McArdel stair test. In performing this test, the subject goes up and down on a stair 40 cm height with a four – step beat (up – up- down - down) consisting of 22 rounds (88 minute walk); this test is performed for 3 minutes . For evaluation, the number of – heart – beat returned to the initial State for 15 seconds immediately after the end of the index finger on the radial artery can be counted. The number of heart beat (beat per minute) into the equation which allows the prediction of maximum oxygen uptake , predictive equation for estimation of maximum oxygen uptake is:

$$\text{Women Vo2max} = 65.81 - \left(\frac{0.1847x \quad \text{recycled}}{\text{heartbeat per} \quad \text{minute}} \right)$$

2.2. Measuring heart beat

The Subject is Sitting on a chair before warming – up the body and performing tests ; then with the index finger , the relaxed heartbeat is being measured from radial artery for 15 seconds multiplying in 4 to get the relaxed heart beat per minute.

2.3. The method of performing test

In order to Collect data, all the Subject were invited to the test location at 8:00 morning after filling the health questionnaire from and being confident of any cardiovascular disease ; the Subjects get familiar with the method of performing tests after measuring the relaxed heartbeat, age height and weight and finally they were asked to fulfill pre-test step; then, these subjects were randomly divided into two experimental and control groups participating four weeks, four sessions a week for 1.5 hr in the corrective exercise program ; After finishing the program, they were again invited and participated in the test at 8:00 morning. The t-test was used for the Comparison of data before and after corrective movements. In order to Compare two experimental and Control groups , the independent t- test was also applied; To analyze `the descriptive data, k-z (square) test was used. The significant level of the test with 95%, $x<0.05$ and $p<0.05$ was considered.

3. Results

The results of descriptive Statistics showed that the participants in these three characteristics in terms of- age weight in and height are homogeneous and no differences were found ($P> 0.05$). (Table 1)

Table 1. The mean and standard deviation of the general profile of participants

Variable	Experimental		Control group		Sig
	mean	Criteria deviation	Mean	Std. dev	
Age	13.2	1.0	13.3	0.9	0.7
Weight	45.7	10.0	46.1	8.6	0.8
Height	157.6	6.2	157.4	6.1	0.9

As it is show in Table 2, the mean maximal oxygen uptake, the number of heartbeat and chest expansion have amount of energy that a person can consume during exhausting work and the work intensity slowly and regularly increased.

Table 2. Results of paired t-test in experimental research

Variable	Pre-test	Post-test	Df	T	Sig
Maximal oxygen uptake	Std. dev.	Std. dev.	19	-3.074	0.006
	28.9 ± 3.8	30.1±2.4			
Heart beat	200±20.5	192±13.4	19	3.074	0.006
Chest expansion	2.2±0.9	2.6±1.1	19	-3.657	0.002

The result of Table 3 have been representing the significant differences between experimental and control groups in terms of the mean maximal oxygen uptake variables of the heart beat and chest expansion ($P<0.05$).

Table 3. Result of t independent variables of the research in experimental and control group

Variable	Control group	Experimental group	F	Sig	T	Df
	Std. dev.	Std. dev.				
Maximal oxygen uptake	27.8±3.0	30.1±2.4	0.201	0.6	2.534	37
Number of heartbeat	204±16.2	192±13.4	0.075	0.7	-2.588	38
Chest expansion	1.7±0.4	2.6±1.1	4.936	0.03	3.475	38

4. Discussion

Negrini (2008) concluded that exercise can prevent the progression of idiopathic scoliosis. Our results represent the same subject consistent with the above results. Since the oxygen uptake is the key to endurance exercises, the body needs oxygen to produce enough but because it is not able to save energy it is continually provide energy delivering in the tissues and muscles. The amount of oxygen that the body is able to produce and deliver every minute into the tissues or muscles or in other words, the maximum oxygen uptake per minute in person is the best indicator of a persons' readiness for doing long-term exercises. There, the most reliable and accurate measure of aerobic capacity is the maximal oxygen uptake (Vo_{2max}) (Jackson, 1990). Vo_{2max} is the maximum To reach the exhaustion stay is measured. If the intensity reaches to higher point than Vo_{2max} , the oxygen uptake goes to a balanced or mood or slightly reduces (Keston et al., 1995). In an another definition, Vo_{2max} is the maximum rate at sea level (V) stands for the volume of oxygen consumed per minute, (O_2) is the oxygen and the high point (V) per time unit and (MAX) is the maximum indicator (Barious et al., 2006). Based on our research on scoliosis patients, the maximum oxygen uptake after a period of reform movements in the experimental group showed significant differences between experimental and control groups. The reasons can be an increase of flexibility in the soft tissues followed by reform motions; this flexibility on the chest expansion has been considered as a key role in the process of respiration and inhalation as well as lung thickness positively (Zaner et al, 1989). Also, it is viewed that there is not any corrective motion in the control group; the maximum oxygen uptake in the experiment group is become significant after reform movements comparing control group. Keston et al. (1995) showed the maximal oxygen uptake decreases in kyphosis and scoliosis people. The results of this research is consistent with ours and before the onset of corrective movements, the maximal oxygen uptake was less than normal situation after doing corrective movements. Barious et al. (2006) concluded that the maximal oxygen uptake in Scoliosis people is lower than healthy people. Our researches results are consistent with this mentioned research. Zaner et al. (1982) indicated that aerobic exercise increases the maximum oxygen uptake. Our research on the scioliotic patients showed that the corrective movements has led to increase the maximal oxygen uptake; so is matched to our research. The heart beat is a physiological characteristic that it is used for estimating oxygen consumption and of course there are other factor influencing on the heart beat; These factors include age, sex, temperature, posture, muscle groups involved, continous exercise and whether these muscles work statistical or dynamically.

Researches show that the intense exercise increase the heart beat 60-1000 heartbeat increases due to the rapid activity and it backs to its normal state after 3=5 min exercise (Terry, 2003). The completion of corrective movements on scoliotic patients lead to decrease the number of heartbeat in the experimental group in compare to early Corrective movements. It seems that this change is due to the effect of cardiac function recovery because these individual have not already been practicing and these exercises have changed the cardiac function as well. Also, the recovery of respiratory and chest expansion functions

can influence positively on the cardiac function. The recovery of trunk movements also effect on the cardiovascular function. Probably, the heart pump has been also improved by these corrective movements (McArdel et al, 1997). Also, the lack of corrective movements in control group, there is a significant difference between the heartbeat of experimental and control group followed by corrective movements due to the positive changes. Dermala and Sasneska (2006) studied the ECG of 77 girls and 13 boys with idiopathic scoliosis and concluded that these people had cardiac disorders. In this research we did not use Electrocardiongraphic method but the heartbeat of scolictic people were recovered following corrective movements. Marganato et al (2005) showed that using "artz" leads to disorder in cardiac pulmonary function but doing exercise improves the function of cardiac – pulmonary in Scoliotic with this research and the maximum oxygen uptake increased due to corrective decreased representing the recovery of cardiac-respiratory function. The corrective movements on scoliotic patients showed significant results in relation to the chest expansion as well as control group: thus, there was again significant difference in the comparison of result after corrective movements in experimental and control groups representing an increase in the chest experimental group. Many reasons can be effective in this regard such as the recovery of flexibility in the spine and the effect of corrective movements on the inter-rib muscles (Strazenberg, 1994). Atmen et al (2005) studied the effect of corrective movements on idiopathic scoliosis and concluded that the vital capacity in these patients improved following corrective movements. Our results are consistent with this research. In our study, the maximal oxygen uptake increased and the chest expansion improved which suggest a positive impact on the respiratory function. Wis (1991) carried out the effect of corrective movement on the vital capacity and the rib mobility and then concluded that these corrective movements lead to 20% increase of chest expansion. Our results are consistent with our research and in consistent to increase of the back muscles and flexibility power, the chest expansion is also improved, too. Ferrari et al (1997) reviewed the effect of corrective in scoliotic patients and concluded that these actions improve the surrounding muscles especially on the respiratory pumpage function. Our results are consistent with this research because the rate of chest expansion in scoliotic patients under our research increased and the increase of chest expansion was also effective in the recovery of respiratory function. Hawz (2001) had carried out a research on the recovery of-chest expansion in scoliotic patients after non- surgical treatments. Treatments include mobilization and stretching hand. After 8years, 6 cm increase in chest and 7.5 cm in chest expansion were taken during breathing. The voluntary participants did not report any respiratory diseases. Our result also indicated an increase of the chest expansion after corrective movements in the experimental group. Finally, our results are consistent with Howez.

5. Conclusion

Based on the results in this research, the intensity of scoliosis has been reduced in the subjects after giving Corrective movements for 4weeks, each week four sessions for 1.5 hour ; In addition the rate of maximal oxygen uptake, heartbeat and the chest expansion were recovered .

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