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EFFECT OF 8 WEEKS PILATES TRAINING ON KYPHOSIS LEVEL IN YOUNG WOMEN WITH FUNCTIONAL KYPHOSIS

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ABSTRACT

Kyphosis is one of the most common side effects in men and women. Research results show 43.52% prevalence of kyphosis in girls and 24.4% in boys. The aim of this study was to investigate the effect of 8 weeks of Pilate's training on kyphosis, muscular endurance and back range of motion in young women with functional kyphosis. For this purpose, 28 women with functional kyphosis in with mean of age 29.54±6.15 years old, weight 64.06 ±14.21 kg and height 161±5.78 cm were voluntarily chosen and were placed in two groups of trained (n=15) and control (n=13) groups, respectively. Training group exercised 3 times a week for 8 weeks and did a one-hour Pilate's exercises and the control group did not participate in any exercise program. Flexible ruler and bearing sourness test was used To measure the functional kyphosis, back endurance and flexibility respectively. ANOVA 2*2 and Independent T-test at the significant level of 0.05 were used to analyze data. The results showed that back flexibility in Pilate's group was significantly higher than control group (p=0.004). Back muscle endurance increased significantly in Pilates group compared with the control group (P=0.000) and the angle of kyphosis was significantly reduced in training group but not in control group (P=0.000). The results of the present study showed that in women with kyphosis, Pilate's exercise can be implemented to strengthen back muscles, increase flexibility and thereby reduce the amount of kyphosis.

Keywords: functional kyphosis, sedentary women, back flexibility, back muscular endurance

INTRODUCTION

Kyphosis is one of the most common postural abnormalities and one of the important factors affecting the pathology of upper quarter of body, this abnormality is called the excess bulge of back vertebrae, so that its intensity includes shoulder pain to spinal breakages (Sokhanguei et al., 2009). Signs include shoulders come forward and chest fallen down and breathing muscles are become short and weak (Behbudi, 1995). Back muscles that maintain body posture against gravity so lose ability, and become weak and subsequently their length increases. Another cause of Kyphosis is shortness of right and oblique abdominal muscle length, resulting in muscle imbalance of anterior and posterior parts of body (Arshadi et al. 2009). Adverse effects on the body structure are appeared in the event of muscle weakness and ignoring it can lead to fixed and incorrigible defects (Sayyari, 2007). These weaknesses lead to dysfunction of other organs such as weakness and impaired blood circulation, reduced chest expansion which disturbs ventilation and oxygen respiratary system. In addition, poor appearance and progressive short stature could pose a problem in terms of appearance and widespread mental problems (Sokhanguei et al., 2009, Behbudi, 1995, Esbati et al., 2009). Functional Kyphosis is a common abnormality in the community and is arisen due to the bad condition of the body during walking and sitting. It is usually seen in young women who are overweight or obese. If patients try out they can straight their back so there is potential to improve. A number of patients due to various illnesses, including respiratory problems, cardiovascular disease, and pain in anterior part of trunk are exposed to this type of Kyphosis. The patients' hunch will be eliminated by improving muscle strength (Alter, 1996). According to the increased prevalence of these disorders, various methods were applied to correct Kyphosis, including aquatherapy (Sokhanguei, 2009), swimming backstroke (ghadimi et al. 2009), flexibility and plyometric exercises (Seidi et al. 2013), manual therapy (Carman et al.1990), postural retraining (Carter et al, 2001) using tapes (Craig, 2008), exercise therapy (Moffroid et al.1993; Sran, et al. 2004; Sinaki, 2003; Itoi, et al. 1994; Bennell, et al. 2000; Greig, 2008) or the use of corrective exercises as a common method that physiotherapy specialists usually correct Kyphosis deformity locally based on Kendall theories (2005) in patients (Daneshmandi et al. 2004). Pilates is a method of exercise therapy that exercise rehabilitation specialists have

widely used it in recent years and it is widely used in various abnormalites (Rydeard et al. 2006). Pilates is a method for the health of mind and body that was introduced in 1920 by Joseph Pilates (Demoulin et al. 2006). These exercises improve control of pelvic, shoulder griddle, lower extremity muscles, balance development, extremities right stabilization, the stability of the spine and correct daily movements (Herrington et al. 2005). Several studies have been done on the effectiveness of the training on postural malformations. Alizamani and colleagues (2009) in their studies investigating the effects of Pilate's exercises on women with chronic low back pain reported the effectiveness of Pilates on improvement of low back pain and trunk strength. In agreement with this research Shojaeddin and colleagues (2013) also reported positive effect of Pilate's exercises on functional disability and pain in men with chronic low back pain. Rajabi and colleagues (2010) showed effectiveness of Pilates exercises for 8 weeks and three days a week in reducing pain and Lordosis in a study on 30 healthy women aged 20 to 30 with the lumbar curvature of 43.74±8.03 degree. As it can be seen from above mentioned studies major research studies have been conducted on low back pain and Lordosis but no effects has been observed on range of back motion and strength. Given the higher prevalence of Kyphosis in girls than boys (musavi gilani et al. 2001) and because of poor life style in women due to modesty and shame in Islamic culture, weight gain during pregnancy, wrong position in breast-feeding postpartum, wrong habits during growth and thus losing the ability to maintain a healthy body condition this group should be more considered. Then, the aim of this study was to study the effects of eight weeks Pilates training on Kyphosis, endurance and back range of motion in young women with functional Kyphosis.

RESEARCH METHODOLOGY

Research method of this study was semi-experimental. The population of this study was women with functional Kyphosis with age ranging from 20 to 40 years old via formation and advertising in public and health centers. The initial assessment of candidates eligible for this study was conducted by a chessboard of 30 subjects with a degree of Kyphosis of more than 40 degrees on a voluntary basis. In this research, subject should stand behind chessboard without covering her body and examiner stand aside and observe her based on New York view test and recorded the results. Then the subjects were asked to consciously keep their back straight while a decrease was observed in the curve of their

Kyphosis was functional due to muscle weakness. Then a flexible ruler was used to measure the abnormalities to quantify the diagnosis. To measure Kyphosis with flexible ruler spinous process of 4^{th} and 12^{th} spines were marked. The spinous process of 7^{th} spine is exactly perpendicular to the inferior angle of the scapula is the spinal vertebrae, therefore, by drawing an imaginary line between the two lower angles of shoulder bones of process of 7^{th} spine can be found and thorn appendage of 4^{th} spine was marked by touching and counting processes of spinous process of three upper vertebrae. To mark the 12^{th} thoracic vertebra by drawing an imaginary line between the two preeminence of left and right pelvic bone the 5^{th} hip was found. so the 12^{th} thoracic vertebra was marked by touching this vertebra and counting the 5^{th} vertebra upwards after marking 4^{th} and 12^{th} thoracic vertebra which the person standing in a normal way the flexible ruler is put on these two vertebrae then with making no change in ruler , it is put on the paper and the resulted curve is drawn by connecting two curves a line is made as L. by measuring this line, a line called H perpendicular to the middle of the line drawn so that passes through the middle of the curve . So Q angle that reflects the angle between the 4^{th} and 12^{th} thoracic vertebrae is calculated by the equation (Q=4 Arc tan (2H/L)). To further validate the measurement is done for three times and the average of resulted angles is recorded. If Q is more than 40 degrees it is diagnosed as Kyphosis. According to precious studies, functional Kyphosis has been reported less than 48 degrees with no inter-vertebrate adhesion and lack of spinal illnesses (culham et al. 1994; Ghadimi et al. 2009). After diagnosis, the subjects were randomly assigned in two groups of control and Pilates training group and Kyphosis angle, bearing sourness and flexibility in both stages before starting training protocols Pilates training was taken from both groups after 8 weeks of Pilates training.

The subjects were asked to bow forwards and completely relax themselves and bend their back in order to measure the flexibility of spines. At this stage the distance from T1 toT2 was measured by a tape then the subjects were asked to straight their trunk and open it backwards then the distance was measured again. The difference between the two measurements is the spinal flexibility of back. Subjects in bearing soreness test, which is used to measure the endurance of back muscles were asked to lie over abdomen in the bed while their trunk is out of bed and legs are fixed by a partner's help. The subjects are asked to hold their trunks parallel to the

ground. Subjects should keep their hands near their ears in this test because in this situation shoulders and back extensor muscles are fully engaged. The reliability of this test has been reported as very high (numerical value) (Rajabi, 2010).

The Training Protocol:

Training group carried out Pilates exercises for 8 weeks three sessions of 60 minutes a week. First, the principles of Pilate's movement such as standing and centrality of body, breathing, control, concentration, and mental exercises were taught in a justification session. Each session consists of 10 minutes of warm up exercises 40 minutes of core exercises and 10 minutes of cool down exercises (Table 1). First week of exercises with 7 repetitions, second week with 10 repetitions and since third week combined exercises added to basic training with 7 to 10 repetitions.

Statistical Methods

Kolmogorov-Smirnov test was used in this research to examining normality of distributing data and ANOVA 2*2 and Independent T-test at the significant level of 0.05 were used to analyze data. All statistical procedures were performed with 16^{th} version of SPSS and Excel.

Table 1: The Training Protocol

Warm up exercises	basic training	compound exercises
Tribute and standing Pilates Pilates breathing Balance a front foot with flat and bend foot and flex and point Scott and kinds of Scott along with a variety of hand gestures Cat standing Go down vertebrate to vertebrate Respect and sitting with legs crossed Screw trunk Shoulders rotation	A four-limb cat Rooking Prostrate Kobra Darts First round star Superman Step on board or pillow swimming The active range of motion One leg stretch with the upper screw Roll up and roll down Saw	Dart with the rotation of the waist to the sides Full star Roll up and roll down with the open and closed legs
Cool down exercises		
Cradle Mermaid Go down vertebrate to vertebrate Prostrate		

RESEARCH FINDINGS

Research results are in both descriptive and inferential statistics of Tables 1 and 2. The results showed that there is a significant difference between control group and Pilate's training group in the amount of Kyphosis angle (P=0.000) and Pilate's group reported a 15%decrease in back curve against 0.0009 increase in control group and the effect size of independent variable was 0.47. Also the results indicated that there was a significant difference between control group and training group in back flexibility and

Pilate's training group reported a 42% increase in flexibility in compared with control group with a 0.005% increase. The effect size of independence variable was 0.36. Also there is a significant difference between control and experimental group in endurance of back muscles (P=0.001) and Pilate's exercises and control group showed 73% and 1% increase in back endurance, respectively. The effect size of independence variable was 0.52.

Table 2: changes of flexibility, muscular endurance and Kyphosis in response to Pilates exercises

Variable	Pilates group		control group	
	Pre-test	post-test	Pre-test	Post-test
Age (years)	29.93±5.96		29.15±6.34	
Weight (kg)	64.06±14.21		14.63±64.07	
Height (cm)	161±5.78		159.84±6.18	
Flexibility(mm)	27.66±13.44	39.40±10.67 *	27.3±16.02	27.46±14.19
Back muscular endurance(s)	11.93±98.31	205.93±65.38 *	100.69±32.86	111.69±34.64
Kyphosis angle (degree)	43.52±5.56	37.02±6.96 *	42.62±3.85	42.66±3.72

***Significant difference between the two groups**

DISCUSSION AND CONCLUSION

The results of this study showed that Pilate's exercises lead to an increase in flexibility and muscle strength. The results of this study are in consistent with that of Segal et al (improving flexibility and range of motion in joints, 2004), Kish et al (influence of Pilate's training on the performance of dancers, 1998) Gibson and Roogres (endurance of trunk flexor muscles 2006), Rajabi et al., (Pilate's influence on Lordosis, 2010), Rahnama (corrective influence on Kyphosis, 2010). The effectiveness of these exercises on strength and flexibility of trunk muscles is that these exercises are designed in such a way that different body muscles are simultaneously applied. These kinds of exercises mainly focus on trunk extensors and abdominal muscles. Pilate's exercise is a combination of static and dynamic stretching exercises that can be helpful in increasing flexibility. Characteristics of neurophysiological contractile tissues respond to stretching exercises. Once performing stretching Pilate's exercises, soft tissues such as skin, tendon and joint capsule and muscles lead to activation of Golgi tendon organ. These receptors inhibit activity of alpha motor neuron and thereby reduces muscle tension and allows the sarcomere be long. It seems that it is possible to increase the flexibility of trunks of patients with Kyphosis by Pilate's training as a treatment.

Also in justifying the flexibility increase from Pilate's exercises it is said that these exercises are mainly dynamic exercises which are not kept for a long time, but

since the dynamic stretches are repeated in exercises so they can result in flexibility increase. Back strength increase results in adjustment with improvement of neuromuscular control and therefore increases trunk stability and better function and efficiency. Pilate's develops sensory-motor control of trunk muscles and core muscles of body (Herrington and Davies, 2005).

Another result of present study is a decrease in Kyphosis angle after Pilate's exercises which is significant in compared with control group. The reason of Kyphosis angle reduction which is result of back flexibility and strength may be due to back strength increase, core muscles of body, power and stretch in abdominal muscles, multifidus power and pelvic muscle strength. Back flexibility in Pilate's training group increased by 42% in this study and muscular endurance increased by 73% thus these changes led to a 15% reduction in Kyphosis angle in women with functional Kyphosis. Although there are several studies on Pilate's influence on other side effects such as Lordosis, there has been no study on the influence of these exercises on Kyphosis so far, in these exercises which are resistance trainings, the resistance is applied through body weight of subjects (OmidAli, 2012). After Pilate's exercises some changes are observed in skeletal muscles such as increasing contractile total protein especially in myosin fibers, ligament, increasing capillary density in the muscle fiber, increasing the number of muscle fibers due to longitudinal division of muscle filaments which leads to muscular strength and endurance (Shavandi, 2011; Fox and mathews, 1976). It seems that tendon length exercises affect muscles, more different skeletal parts and makes ligaments stable. In the other side, stretching exercises act as coordinator of agonist and antagonist muscles (Meyer, 2001). Therefore, these exercises increase muscle length in the concavity and increase force and power of muscle in convexity part and then decrease abnormalities. Strengthening erector spine muscles plays a crucial role in maintaining the structure and these kinds of exercises can help in improvement of Kyphosis deformities in patients (Rahnama, 2010) and 8 weeks strengthening exercises of erector spine muscles, flexibility exercises and deepness of spines improve Kyphosis angle, muscular endurance and flexibility of subjects. Thus it can be concluded that performing Pilate's exercises can be used as a helpful tool and a useful way to improve kyphosis.

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