

# EFFECTS OF PILATES EXERCISES ON FLEXIBILITY AND VOLLEYBALL SERVE SKILL IN FEMALE COLLEGE STUDENTS

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## Abstract

Flexibility is an important component of physical fitness which is essential to varying degrees in different sports. It becomes even more important as it not only enhances athletic efficiency but reduces the risk of injuries as well. The objective of the present study was to investigate the effects of regular Pilates exercises on flexibility and the volleyball serve skill in female, college students. For the purposes of this study, 22 female students were randomly selected and assigned to the following two groups of equal numbers: the experimental group (age: 20.64; height: 161 cm; weight: 56.27 kg) and the control (age: 20.09; height: 161.82 cm; weight: 57.18 kg). Over the six-week period of study, the experimental (Pilates) group participated in three sessions of Pilates exercises and one session of volleyball exercises each week. The control, however, participated only in the one volleyball exercise session on a weekly basis. All the subjects were tested for their flexibility and volleyball serve skills before and after the study period. The results showed that Pilates exercises had a significant effect on the subjects' flexibility at the 0.05 probability level and improved their volleyball serve skills. Based on the results obtained from this study, Pilates exercises may be recommended for improving flexibility and sports skills.

**Keywords:** Pilates exercises; Flexibility; Volleyball skills

## INTRODUCTION

Volleyball is a sport with increasing recognition worldwide which has considerable effects on athletes' physical fitness. Coaches and physical educators employ advanced exercises in order to improve and enhance physical and technical skills in their trainees (El-Sayed, 2010). A key objective is to enable volleyball players for better offense and defense at every spot in the court and at every moment during the game. The repeated movements of jumps, stops, and volleyball techniques exert a great pressure on joints and increase the risk of injuries. Protection against the risks is often created by strengthening the musculature surrounding joints and by enhancing joint flexibility (Schirm, 2011).

Flexibility involves the range of joint movements and is reduced with aging and increasing sedentariness and inactivity. It is a major component of physical fitness which is essential for all individuals, especially for sportsmen, and is particularly required for performing sports skills and improved reactions. Flexibility declines during the adolescence, especially in men (Segal, 2004). In addition to flexibility, there are a number of other factors that influence the results of flexibility tests; these include living habits, type of exercises administered, and environmental factors such as ambient temperature and warm up before the exercises. Other factors involved such as age,

weight, and height should be considered in the flexibility tests and efforts must be made to eliminate their effects (Bertolla, 2007; El-Sayed, 2010). However, individuals may be rehabilitated to regain their flexibility from the age of 17 onwards by performing proper movements and exercises; otherwise, it may be lost to a great extent invariably in men and women (Sekendiz, 2007). Lack of flexibility is a limiting factor in doing sports which simultaneously increases the risk of muscular injuries (Segal, 2004).

Volleyball is a universally known sport that attracts many young sportsmen every year. Coaches generally find dynamic and static stretching as well as Proprioceptive Neuromuscular Facilitation (PNF) as the most effective exercises for enhancing flexibility in their trainees (Bertolla, 2007). Pilates exercises have also offered new effective methods for increasing strength and enhancing flexibility. The techniques are recommended as modern exercise methods, both for general exercises and for volleyball training in particular, to strengthen weak muscles (El-Sayed, 2010).

Over the past decade, specific Pilates exercises, originally introduced by Joseph Hubertus Pilates (1883-1967), have also been exploited for increasing the muscular mass in the body (Duncan J.Critchley, 2011). Pilates designed an exercise protocol which was meant to enhance muscular strength, flexibility, and endurance while it also

improved bodily concentration and balance (Emerya, 2010). The exercises aimed at increasing strength and endurance in the innermost muscles by gradually repeating complete sets of movements which simultaneously created natural coordination among muscles and body organs, unlike Yoga which was meant to achieve the same objectives with the body kept motionless and at rest (Menacho, 2010). Nowadays, Pilates exercises that focus on proper body structure and strengthening weak muscles are among modern exercises recommended for training volleyball players at both elementary and advanced levels (Aekland, 1998).

Sekendiz et al. (2006) investigated the effects of Pilates exercises on trunk strength, endurance, and flexibility in sedentary adult females. They found a positive correlation between Pilates exercises, on the one hand, and abdominal muscle strength, back pain, abdominal muscle endurance, and flexibility in posterior trunk muscles, on the other, while their subjects did not exhibit any significant changes in their body fat or weight as a result of the exercises (Sekendiz, 2007). Segal et al. (2004) reported that Pilates exercises led to enhanced flexibility but they admitted that further research was needed to confirm effects on body composition, health, and posture (Brody, 2012). Emery et al. (2010) found that their experimental group achieved improved abdominal muscle strength and reduced kyphosis after 24 sessions of Pilates exercises (Segal, 2004). El-Sayed et al. (2010) studied the effects of Pilates exercises on muscular strength, jumping, and aerobic capacity as well as the offense and defense skills in volleyball players. They found that the exercises led to enhanced muscular motions of the lower body, improved jumping, and increased aerobic capacity in their subjects while significant improvements were also observed in their offense and defense capabilities (El-Sayed, 2010). English et al. (2007) studied the effect of Pilates exercises on pitch speed in baseballers and found that the exercises had a significant effect on their subjects' pitch speed (English, 2007).

Few studies, if any, have so far been conducted to establish the positive correlation among Pilates exercises, individual performance, and players' body posture in performing balanced movements (English, 2007). Moreover, while modern Pilates exercises are expected to have positive effects on performing volleyball techniques, little research has been conducted in this area. The present study

was designed to investigate the effects of a Pilates program on certain factors such as trunk flexibility and volleyball serve skills in non-athlete subjects.

## METHODS

The present quasi-empirical study was conducted on a statistical population consisting of female students at the college level who attended a volleyball training course. From among the participants in the course, 22 volunteer subjects were randomly selected and assigned to the two equally numbered groups. The variables investigated included flexibility and volleyball serve in the subjects. Initially, personal data including height, weight, and age of the subjects were recorded and the subjects were examined to ensure their health. They were also asked to sign a disclaimer.

The experimental instruments used consisted of flexibility tests including the sit-and-reach test to check the flexibility of hamstrings and posterior trunk muscles (Bertolla, 2007; Phil, 2012; Segal, 2004; Sekendiz, 2007), the zipper test to check the thoracic muscles and shoulder rotators (Kendall, 1979; Lawrenson, 2012; Quinn, 2010), and the serve skill (Bagherpour, 2009). The subjects were randomly selected and assigned to the two experimental (age: 20.64; height: 161 cm; weight: 56.27 kg) and control (age: 20.09; height: 161.82 cm; weight: 57.18 kg) groups of equal numbers. The experimental group participated in an especially designed Pilates exercise protocol that consisted of three sessions of exercises per week plus one weekly session of common volleyball exercises. The study period was six weeks at the end of which the same tests were repeated as post-test. All the tests and procedures were approved by the Bureau of Human Ethical Research of Isfahan University of Technology.

The special protocol consisted of two parts: Pilates exercises and volleyball exercises.

The Pilates protocol is summarized in Table 1. The exercises were given in 40-minute sessions running from simple to difficult from the first to the sixth week of the study period. The protocol had been approved by the Physical Education Research Bureau of Isfahan University of Technology. A description of the volleyball exercises which took place in 60-minute sessions is presented in Table 2.

**Table 1** Pilates exercises for one session

Warm up	Pilates exercises	Cool down
Spinal rotation; Hip rotation; Shoulder stretch; Shoulder abduction and adduction; Palm rotation and twist; Shoulder elevation; Thoracic muscles stretch; Leg muscles stretch; Cat stretch	- Simple to difficult exercises - Single Leg Sit-Stretch - Pilates bridge - Pilates swimming - Locust stretch exercise	- Simple stretch and return to normal position

**Table 2** Volleyball exercises for one session

Warm up	Volleyball exercises	Cool down
Simple stretch exercises and special volleyball exercises	- Training and practice of volleyball techniques including claw, forearm, and the serve	- Simple stretch exercises

Flexibility of the posterior trunk muscles was measured using the sit-and-reach box test in which the subjects warmed up for 5 minutes before they sat on the ground and pulled their fingers on the flexible box while they maintained flat knees. According to the YMCA standard, the distance the subject pulls fingers on the box is recorded as the score for trunk flexibility.

In the zipper test, the hands reach behind the subject's back, one from the top and one from

below. The distance remaining between the two hands is recorded as a negative point but as a positive point if they reach (Kendall, 1979; Quinn, 2010). This test is meant to measure the flexibility of the anterior trunk muscles and shoulder muscles.

In the serve skill test, the court was divided according to the AAHPERD test and each serve was scored according to Fig. 1 below (Hmayattalab, 2009; Sozande Pour Seyed Rasoul, 2009).

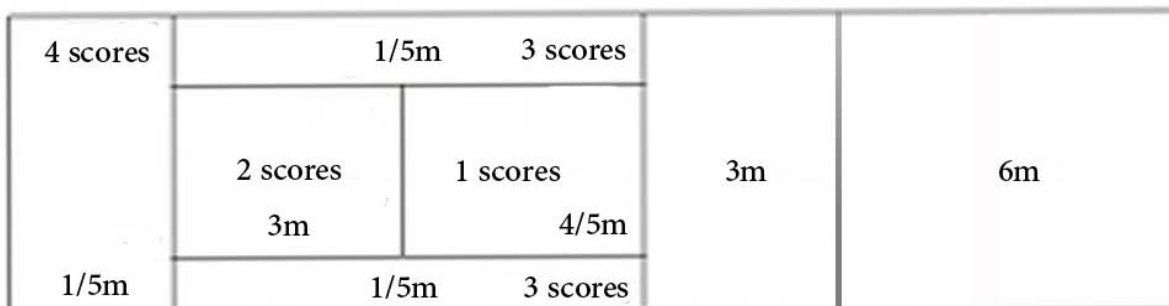


Fig. 1 Scoring based on the AAHPERD Test

The data were collected in the Excel software and subjected to SPSS analysis. The effects of the exercises on the study variables were investigated and compared using the ANCOVA test.

**RESULTS**

The subjects in this study consisted of 22 non-athlete female students who were divided into

two experimental (Pilates) and control groups of equal numbers. Both groups participated in their specific training and exercises over a period of six weeks. Pre-test and post-test measurements were performed in both groups and the ANCOVA results for each test were reported in Table 3.

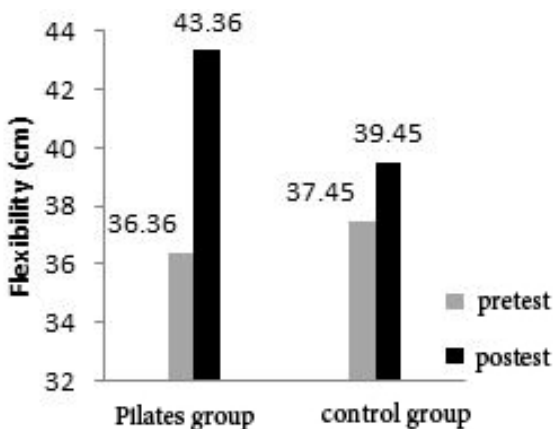
**Table 3.** Test results

		Variable effect				Exercise effect	
		Age	Height	Weight	Pre-test	Sig	F
Test	Sit-and-reach	0.977*	0.866*	0.977*	0.000	16.825	0.001
	Right hand	0.574*	0.921*	0.293*	0.183*	28.435	0.000
	Left hand	0.873*	0.157*	0.648*	0.001	16.773	0.001
	Serve	0.356*	0.183*	0.825*	0.469*	4.548	0.049

\* These variables had no significant effects; hence, they were removed from the model and the covariance analysis was repeated.

The above results indicate that the Pilates exercises had significant effects as revealed by all the flexibility tests, right-hand stretch, left-hand stretch, and the serve skill test. Moreover, it is clear that the auxiliary variables of height, age, and weight had no effects on the results obtained.

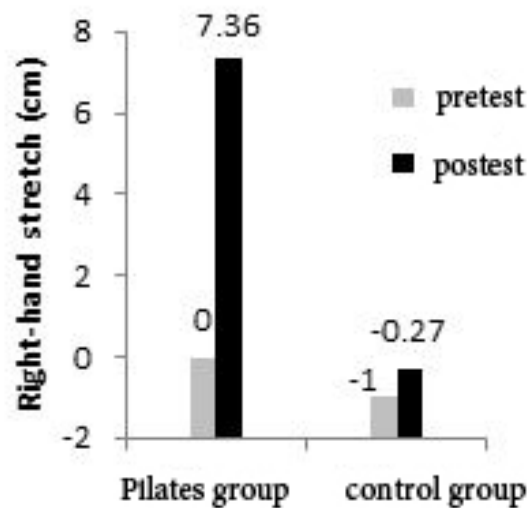
In the sit-and-reach box test, a significant difference was observed between the Pilates and control groups with respect to their pre-test and post-test results ( $F=16.825$ ,  $p<0.05$ ). As seen in Fig. 2, the Pilates group exhibited an improvement by +5 cm in this test as revealed by the difference between the pre-test average of 36.36 and the post-test average of 43.36 cm. This is while the control only showed an increase of +2 cm (pre-test average = 37.45 and post-test average = 39.45). These results confirm the greater and significant effect of Pilates exercises on flexibility compared to the mere volleyball exercises.



**Fig. 2** Assessment of posterior trunk muscles in the sit-and-reach box test

A significant difference was also observed between the Pilates and control groups in the right-hand stretch test as revealed by their pre-test

and post-test results ( $F= 28.435$ ,  $p<0.05$ ). It is seen in Fig. 3 that the Pilates group improved in this test by gaining an average score of +7.36 cm as the difference between the pre-test average score of 0.00 cm and the post-test average score of 7.36. In contrast, the control scored a pre-test average of -1 cm and a post-test average of -0.27 cm which shows an average reduction of -0.73. It may, therefore, be concluded that the Pilates program led to an improvement in the right-hand stretch test results and that its effect was significant.



**Fig. 3** Assessment of the anterior trunk and shoulder muscles in the right-hand stretch test

As regards the left-hand stretch test, a significant difference was observed between the Pilates and control groups based on their pre-test and post-test results ( $F= 16.773$ ,  $p<0.05$ ). Fig. 4 shows that the Pilates group achieved an improvement in the results of this test by gaining an average score of + 4.7 cm as the difference between the pre-test average score of - 2.18 cm and the post-test average score of +2.55. The control group, in

contrast, scored a pre-test average of  $-3.82$  cm and a post-test average of  $-3.55$  cm, which shows an average reduction of  $-7.37$ . The Pilates program clearly led to improved performance of the subjects in the left-hand stretch post-test results and its effect was clearly significant.

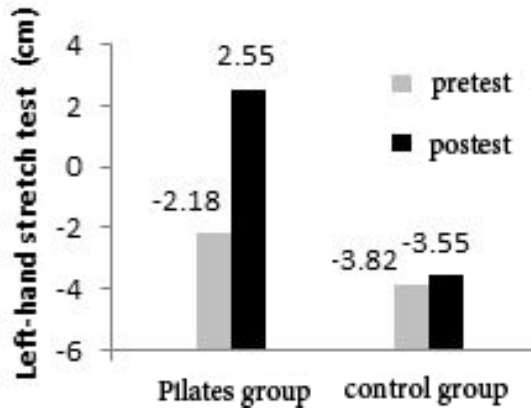


Fig. 4 Assessment of the anterior trunk and shoulder muscles in the left-hand stretch test

Turning to the volleyball serve skill, the Pilates and control groups showed a significant difference on the basis of their pre-test and post-test results ( $F=4.546, p<0.05$ ). It is clear from Fig. 5 that the Pilates group obtained an improved score of  $+5.54$  in the results of this test as shown by the difference between the pre-test average score of  $+3.55$  and the post-test average score of  $+9.09$ . The control group, however, achieved an improved score of  $+3.18$  points as indicated by the difference between their pre-test average point of  $+2.09$  and post-test average point of  $+5.27$ . The Pilates group had a better performance and the effect of the Pilates exercises was clearly significant.

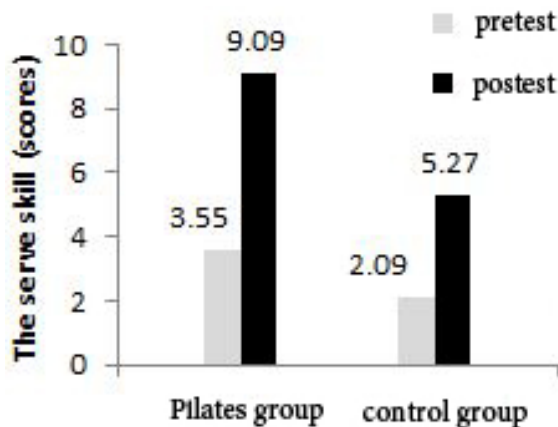


Fig. 5 Assessment of the volleyball serve skill

## DISCUSSION

The game of volleyball is one of speed and power in motion that are provided by the body joints including the shoulders, elbows, wrists, hips, knees, ankles, and a huge mass of muscles. A knowledge of the human anatomy and biomechanics can help coaches and trainers design useful exercises for the volleyball players' enhanced robustness and performance of skills while they create the ability to avoid possible injuries as well. The shoulder joints become engaged in performing hits, passes, and serves; shoulder extensors involving the Latissimus dorsi, pectoralis major, Teres major, and shoulder internal rotator muscles become engaged in performing serves and spikes; and the shoulder flexor muscles are active in receiving ball while the spinal column also plays the major role in all the volleyball movements (Schirm, 2011). Given the importance of these joints and muscles and the role of the muscular flexibility in performing volleyball skills, the present study was designed as an effort to achieve improved skills in players. The objective was to investigate the effects of Pilates exercises on general body flexibility and that of the shoulder while the effects of these exercises were also determined on the volleyball serve skill.

The sit-and-reach box test was used by Segal et al (2004) who showed that flexibility was improved in their subjects after 5 weeks of administering Pilates exercises (Segal, 2004). Skendiza et al. (2007) also found that Pilates exercises had a significant effect on the flexibility of the posterior trunk muscles (Sekendiza, 2007). The differences between the average values obtained from the pre-test and post-test measurements in the present study revealed that the Pilates exercises had a significant effect on enhancing the flexibility of the posterior trunk muscles at a probability level of less than 5%. As observed in the results, flexibility was improved in both the experimental and control groups but the Pilates group showed higher values in this respect, indicating the greater effect of the Pilates exercises than the mere volleyball exercises.

To the best of the authors' knowledge, no data has been reported in the literature on zipper test measurements of the anterior trunk muscles and shoulders for any athlete or non-athlete age groups. The present report can, therefore, be used as novel information for use in future studies. According to these results, the Pilates exercises had a significant effect at the 5% probability level on improving the flexibility of the anterior trunk

muscles and shoulders. Moreover, despite the fact that the control group participated in weekly volleyball exercises, they exhibited a reduction in their flexibility while the Pilates group exhibited improved flexibility in their anterior trunk muscles and shoulders.

El-Sayed et al. (2010) investigated the effects of Pilates exercises on leg strength and jumps in addition to offense and defense activities in volleyball players. They found that their Pilates exercises had a significantly positive effect on these parameters as evidenced by an enhanced offense skill of 10.06% and an enhanced defense skill of 20.94% (El-Sayed, 2010). English (2007) reported an increased pitch speed of 5.61% in baseball players following Pilates exercises (English, 2007). Comparison of the control and Pilates groups in the present study revealed the better results achieved by the Pilates group as evidenced by their increased ratio of pre-test and post-test flexibility scores equal to 1.56,

or more specifically an enhancement of 156.17%. These results are in agreement with those reported above by El-Sayed (2010) on the offense and defense skills of volleyball players and English (2007) on pitch speed in baseball pitchers. It may, therefore, be concluded that Pilates exercises have had positive effects.

Based on the results obtained, the Pilates exercises enhanced both trunk and shoulder flexibility in the subjects, which might be attributed to the increased flexibility gained in the muscles surrounding these regions. The especially designed Pilates protocol also helped the subjects gain improved volleyball serve skill at the end of the six-week study period, indicating improvements gained in the performance of the muscles engaged in performing the volleyball serve skill. Relevant and carefully designed Pilates exercises may, therefore, be recommended for both beginner players and improving volleyball techniques in professional players.

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