## Original Research

# The Effect of Pilates Exercise on the Static Balance of Teenage Female Students

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**Abstract:**

**Background:**

Lack of balance is one of the side effects of inactivity during adolescence, which plays an important role in the physical health of people in adolescence and adulthood. Pilates as a new but low-cost exercise by strengthening the body, mind and muscle plays an important role in improving static balance. Therefore, this study was conducted with the aim of investigating the effect of Pilates exercise on the static balance of teenage female students.

**Methods:** This experimental study was conducted on 50 female students in Gorgan city. The students, who had been selected by simple random sampling method, were at the age range of 11-15 years and after selection were divided into two groups of intervention (Pilates) and control. Stork test was used to measure static balance before and after the intervention. In the Pilates group, 8 training sessions (30-45 minutes) were performed once a week for 8 weeks. The data was analyzed by descriptive statistics (table, mean, standard deviation) and inferential statistics (paired t-test, independent t-test and ANCOVA) at the significant level of 0.05.

**Results:** There was no significant difference in the static balance of the right and left legs between the two Pilates and control groups before the intervention. But after the intervention, a significant difference was observed in the static balance of the right and left legs between the two groups. ANCOVA test showed a significant difference by removing the effect of pre-test ($P < 0.01$, Eta=0.42).

**Conclusion**: Pilates exercise increased the static balance of female students. Therefore, community health nurses and instructors can use this modern and new exercise method, which can be implemented in limited facilities and space, to increase physical activity and static balance of female students.

**Keywords:** Pilates, Static Balance, Students, Girl, Teenager

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## Introduction

Adolescence is a transitional-developmental period between childhood and adulthood, and is considered as one of the most important periods of human's growth and development (1, 2).

Statistics show that the largest number of teenagers in the world belongs to the present era. Nearly half of the world's population is under the age of 25, and one fifth of the world's population is 10-19 years old (3). In Iran, there are 16 million 11-19 years old adolescents, which account for 27% of the entire population (1). Due to the changes in lifestyle and advances made in technology, lack of movement and physical activities is a major health concern all around the world, especially among teenagers (4, 5). According to the studies conducted in this area, more than 80% of the world's teenagers are not physically active (6). According to the report of the World Health Organization, the level of physical activity among teenagers is lower than the average standard (7, 8). Meanwhile, physical activities in adolescence improve physical and mental health in adulthood (9, 10). Since adolescence is a critical period for learning and undertaking regular physical activity, the effect of this learning can continue to adulthood (11). On the other hand, muscle weakness is one of the side effects of inactivity that causes movement disorders, skeletal muscle abnormalities and imbalance, especially in teenage girls (12, 13). This decrease in balance and impaired movement function causes back pain in adolescents and adults (14). For this reason, imbalance and movement disorders in the future are one of the common problems of teenage girls (15, 16). Thus, maintaining and strengthening static balance plays an important role in preventing movement disorders in adolescence (17). Maintaining static balance is also the main aim of movement and balance activities (18). Meanwhile, sports activities such as Pilates exercises reduce body fat, increase flexibility and endurance, and help to maintain balance in the body (19). Pilates exercise is one of the most effective traditional and functional exercises that are recommended to improve balance. The Pilates exercises activate and coordinate several muscle groups at the same time, and have a positive effect on the general flexibility and health by strengthening trunk muscles, improving body position and making coordination between breathing and body movements (20, 21). The Pilates exercises also harmonize the mind and body, and maintain balance in the body (13, 22). Since this training method emphasizes on the use of brain in muscle control, its purpose is to strengthen the muscles that help to maintain balance in the body (23). Also, the implementation of this exercise does not require special skills and equipment. This method can also be used for people with normal physical fitness (24, 25). Pilates exercise is a new training method in Iran that does not require a large space and advanced equipment (26). For this reason, the researchers in this study decided to investigate the effect of Pilates exercise on the static balance of teenage girls.

## Method

This experimental study was conducted in 2022 on 50 teenage girls aged 11-15 years in the city of Gorgan, Iran. The criteria for entering the study were; being a teenage female student, and having no chronic physical or mental illness based on the school health record. Exclusion criteria included not willing to participate or continue with the study by students or parents. The sample size of this study was calculated to be 50 people based on the study of Akhli et al. (2019) with an effect size of 0.70, test power of 80%, and confidence interval of 95% at the significant level of 0.05 (13). The researcher selected 50 samples from students who met the inclusion criteria by simple random method. Then, by random method (coin tossing), 25 students were allocated to the intervention

(Pilates) group and 25 students to the control group. Stork test was used to measure static balance of the participants. The stork test is a fixed position in which, the subjects stand on a flat surface putting their hands on their hips. Then they place their non-support legs (superior leg) next to the knee of the supporting legs (non-superior leg). The time that the subject can maintain this position is considered as a score. When an error occurs, the timer stops. The errors of this test include; removing the hand from the hip, swinging the non-supporting leg in any direction, separating the non-supporting leg from the knee, and touching the ground with the heel of non-supporting leg (27, 28). In the intervention of group, 8 sessions (30-45 minutes) of Pilates exercise were performed once a week for 8 weeks under the supervision of a sport coach with expertise in Pilates exercises (Table 1). In the control group, routine school exercises were performed. At the end of the study, The Pilates exercise was performed for students in the control group who wished to receive the exercise. The information was collected and entered into SPSS-21 statistical software to be analyzed by descriptive statistics (table, average, standard deviation) and inferential statistics (paired t-test, independent t-test and ANOVA test) at a significance level of 0.05.

**Results**

Independent t-test showed no significant difference between the intervention and control group in terms of the students' age (P=0.49), weight (P=0.32), and height (P=0.49).

Independent t-test before the intervention showed no significant difference between the two groups in terms of the static balance of right leg (P=0.13) and left leg (P=0.26), (Table 1).However after the intervention, this test showed a significant difference between the two groups in terms of the static balance of right leg ($P < 0.01$) and left leg ($P < 0.01$), so that the static balance was higher in the Pilates group compared to the control group (Table 1). Also, the paired t-test showed no significant difference in the static balance of right leg (P=0.56) and left leg (P=0.61) of the control group before and after the intervention. But, it showed a significant difference in the static balance of right leg ($P < 0.01$) and left leg ($P < 0.01$) of the Pilates group before and after the intervention, so that the static balance in the Pilates group improved after the intervention.

ANOVA test by removing the effect of pre-test ($P < 0.01$, Eta=0.42) showed that 42% of static balance changes in the Pilates group could be explained by the Pilates exercise.

**Discussion**

The results of present study showed that Pilates exercise increased the static balance in the right and left legs of students.

Castro (2022) stated that Pilates exercise strengthens back muscles and helps to maintain body posture (24).

Kibar et al. (2018) conducted a study on the effect of Pilates exercise on the static and dynamic balance as well as the flexibility of hamstring and abdominal muscles. They showed that Pilates exercise has a positive effect on improving balance and strengthening abdominal and hamstring muscles (29).

Rahmani (2015) showed that Pilates exercise strengthens physical strength and increases balance (30).

Adıguzel (2022) argued that Pilates exercise strengthens walking and balance (23). Dunyapour (2013) revealed that Pilates exercise improves dynamic balance, and strengthens performance and walking (31).

Alizadeh et al. (2016) showed that after eight weeks of Pilates training, static balance of the participants improved significantly (32).

Tolnai (2016) conducted a study to examine the effect of Pilates exercise on skeletal muscle mass as well as flexibility, balance, and strength of trunk and abdominal muscles

among healthy young women. This study showed that even one session of Pilates exercise per week can have positive effects on the muscle mass, balance and strength of abdominal and trunk muscles (33).

Khodashenas et al. (2015) showed that performing regular exercise increases dynamic and static balance in children (34). Kazemi (2019) stated that combined resistance exercises cause weight loss, decrease muscle mass and increase balance in the body (35).

Essar (2022) revealed that muscle resistance exercise strengthens the body's central muscles and improves the function of lower limbs by reducing muscle stiffness, which strengthen the balance and stability of the body (36, 37).

As a simple, low-cost and effective exercise method, Pilates exercise improves dynamic balance and flexibility, and also increases bone density and quality of life (26). Pilates, as a regular exercise method, regulates neurotransmitter neurons, stimulates and releases calcium and accelerates the production of dopamine and acetylcholine. It also plays an important role in increasing balance and promoting mental health (26).

Based on studies conducted in this area, it can be said that exercise plays an important role in improving health and quality of life (5). Exercise is a safe, low-cost and complication-free method to improve mental health (38, 39). One of the limitations of this research was its concurrency with the Covid-19 pandemic that caused many problems in implementing group exercises. We overcame this problem by holding the training sessions in groups of 3 to 4 people and complying with the recommended health protocols.

## Conclusion

The results of present study showed that Pilates exercise increased static balance in teenage female students. Pilates exercise strengthens body muscles and helps to maintain balance by coordinating body and mind. The use of this exercise method is recommended as it requires a limited space and equipment. We also recommend this low-cost and effective method to be implemented as a physical activity at schools.

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## Conflict of interest

There was no conflict of interest in this study.

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**Table**

**Table 1: Comparison of the static balance of the samples in the Pilates and control groups before and after the intervention**

| Time / Variable | Before the intervention | | After the intervention | |
|---|---|---|---|---|
| | Right leg | Left leg | Right leg | Left leg |
| Control | 13.04 ± 3.18 | 12.72 ± 2.15 | 12.36 ± 2.46 | 13.01 ± 1.93 |
| Pilates | 14.56 ± 3.37 | 13.41 ± 2.1 | 16.12 ± 2.89 | 16.66 ± 2.41 |
| P-value | P=0.13 | P=0.26 | P<0.01 | P<0.01 |