

The effect of pilates exercise on gait speed and strength of lower limb in elderly male

Mohsen Mohammadi¹, Murat Kaldırımçı¹, Seyed Ebrahim Kazemi², Orcan Mızrak¹ and Cemil Tuğrulhanşam¹

¹*Faculty of Physical Education & Sport Sciences, Ataturk University, Turkey*

²*Faculty of Physical Education & Sport Sciences, Gazi University, Turkey*

ABSTRACT

The study of the effect of Pilates exercise on gait speed and strength of lower limb in elderly male was the main purpose the present study. The 30 elderly male participated in this study had an average age of $63 / 7 \pm 4/3$ years, height of $158 / 2 \pm 3/6$ cm and weight $65 / 2 \pm 6/1$ kg. They were randomly divided into experimental (15 cases) and control (15 cases) groups. The experimental group participated in Pilates exercise program for ten weeks, three sessions per week and one hour per session. Evaluation of lower limb strength was performed by 30-second chair stand test and speed of gait was studied by 10-meter walk test. The Independent T-test and paired sample T-test was used to compare the differences between the pre and post-test in both groups. All statistical analyses were performed using SPSS statistical software version 19. Significant difference found between experimental and control groups in both variable ($P < 0/05$) and between pre and post-test of subjects, there was significant difference in experimental group in both variable ($P < 0/05$). According to the results of the present research, it could be concluded that for improvement of strength of lower limb and gait speed in elder male, Pilates exercise method is recommended.

Keywords: Pilates exercise, Gait speed, Strength of lower limb

INTRODUCTION

Ageing is the result of complex interactions between genetic, metabolic, hormonal, immunological and structural factors which affect cellular and tissue levels and bodily systems as well as their function, consequently leading to oldness (5). During the past century, the number and proportion of older adults among the world population has increased due to socio-economic developments and better medical services (18, 34). One of the most important changes occurring in aging is the loss of muscle mass. Longitudinal studies suggest that during older age, muscle mass decreases about 3% to 6% per decade (8, 23). The reduction of muscle mass associated with aging seems to be the primary factor responsible for reduction in muscle strength and power and the consequent loss of functional mobility in elderly people (13, 14, 56). It has been well-established in the literature that there are reductions in muscle function and level of physical activity (LPA) concomitant with aging (38, 45). Associations between measures of muscle mass and function, LPA and functional mobility have been established in older adults, demonstrating that slow walking speed and reduced handgrip strength (HG) can identify those with reduced lower-limb muscle strength and power, limitations and functional decline (11, 31, 43, 52). Balance, poor gait, lower limb muscle weakness, slowed reaction time have been identified as independent risk factors for falls in elderly (21, 33, 53).

Exercise has a major role to play in modifying key falls risk factors and preventing falls among older adults. There are, however, many different types of exercise, some of which are likely to result in greater reductions in falls risk than others (20). Studies have shown that muscles strength decreases with increased age (54) and that reduced muscle strength is one of the major risk factors for falling. Exercise interventions aimed at improving muscle

strength have been identified as a key strategy for reducing frailty and maintaining function in old age (8, 10, 34). Type of physical activity is important to increase muscle strength to gain older people living independently (20).

Pilates is an exercise approach developed that is based on body-mind spirit interaction combined with biomechanics, motor learning, and core stability (30). During a Pilates exercise session, mental effort focuses on activating specific muscles in a functional sequence at controlled speeds, emphasizing quality, precision, and control of movement with specific attention to breathing and proprioception (2, 26,27, 28, 29) and it is a term used to describe any of the exercises that were developed by Joseph Pilates, and appears to be popular across a range of age groups (25).The Pilates method is designed to stretch and strengthen muscles and improve coordination (40). The Pilates method focuses on building motions and activities that helps to strengthen minor muscles, which, in turn, helps to strengthen major muscles (32).Although recent studies (9, 22), reported that Pilates exercises are suitable for each age, all body types and for all fitness abilities due to the modifiable nature of movements (25, 27,46) experimental attempts including control conditions are still limited and do not enable researchers to draw clear conclusions regarding the effectiveness of Pilates exercises on improving physical functioning in elderly. Hence, the purpose of this study is to examine the effect of pilates exercise on gait speed and strength of lower limb in elderly male.

MATERIALS AND METHODS

Subjects

The 30 elderly male subjects participating in this study. The subjects were recruited from a social club with regular social activities. They were randomly divided into experimental (15 cases) and control (15 cases) groups. Each subject was questioned about them past medical history and present health status. They had no previous history of orthopaedic problems such as a recent injury or surgery that could affect their walking pattern. The subjects received a stipend to cover their travel expenses and time. Prior to the study, procedures and guidelines were presented orally and in written form. Subjects agreeing to participate signed an institutionally approved consent form.

Data Collection

Measuring of variables was performed before (pre-test) and after (post-test) the protocol. The experimental group participated in Pilates exercise program for ten weeks, three sessions per week and one hour per session, while the control group did not participate in any pilates exercises and not to participate a regular exercise program or a sport, during the study. Each exercise session consisted of 20 minutes of warm up (10 minutes) and cool down (10 minutes) and 40 minutes of pilates exercises. The Pilates method exercises were taught and performed on exercise mats and tables in the research area. In Pilates exercise, there are different equipments to use for different aims. We used thera band or elastic bands, and Pilates or exercise ball. Modified Pilates based exercises were divided three parts, in first part (4 week), mat exercises (41,46), in the second part (3 week), thera-band exercises and in the third part (3 week), Pilates ball exercises (30) were performed (20).Pilates exercise were performed by the subjects on an informal schedule and were not under the supervision of a coach or athletic trainer. Evaluation of lower limb strength was performed by 30-second chair stand test and speed of gait was studied by 10-meter walk test. Prior to the testing, a standardized 5 min warm-up was completed.

30 SECOND CHAIR STAND TEST

The purpose of this test is to examine lower body strength (24). Therefore, in this study Evaluation of lower limb strength was performed by 30-second chair stand test. Equipment was required for this test: timer and straight back with a 44cm seat height, preferably without arms. From the sitting position, the participant stands up completely up so hips and knees are fully extended, then completely back down, so that the bottom fully touches the seat. This is repeated for 30 seconds. Count the number of times the subjects comes to a full standing position in 30 seconds (24).

10 METER WALK TEST

The aim of this test is a measure of gait speed (6, 7, 55). Therefore, in this study Evaluation of speed of gait was performed by 10 meter walk test. Equipment was required for this test: timer, measuring tape and quiet hallway or open space at least 14 m long. Individual walks without assistance 10 meters (32.8 feet) and the time is measured for the intermediate 6 meters (19.7 feet) to allow for acceleration and deceleration. Start timing is when the toes of the leading foot crosses the 2-meter mark and stop timing is when the toes of the leading foot crosses the 8-meter mark(6, 7, 55). Test be performed at preferred walking speed with three trials, then collect three trials and calculate the average of the three trials.

Statistical Analysis

All data were analyzed using SPSS version 19. The data were tested for normal distribution with the Shapiro-Wilk test. The Independent T-test and paired sample T-test was used to compare the differences between the pre and post-test in both groups. Significance was set at the $P < 0.05$ level.

RESULTS

The age, height and weight for experimental and control groups are presented in table 1.

Table 1. Characteristics of subjects (mean and standard deviation)

Group	N	Age(yr)	Height(cm)	Weight(kg)
Experimental	15	64.1±1.3	158.7±2.8	64.1±4.4
Control	15	63.3±2.1	157.9±2.5	66.4±4.9

Table 2 shows for normal distribution with the Shapiro-Wilk test before performed exercise in both groups. The result of analysis indicated that there was no significant difference in both variables in experimental and control groups.

Table 2. The result of analysis for normal distribution with Shapiro-Wilk test

Test	Group	p
30 second chair stand test	Experimental	0.61
	Control	0.57
10 meter walk test	Experimental	0.57
	Control	0.54

* Significance level set to: $P \leq 0.05$.

Table 3 compares for 30 second chair stand test data in of subjects in the pre and post-test in two groups. The result of analysis indicated that there was no significant difference in pre and post-test in control group. Significant difference found between pre and post-test in experimental groups in 30 second chair stand test variable ($P < 0.05$).

Table 3. T-test for comparing 30 second chair stand test data of subjects in the pre-test and post-test in two groups

Variable	Group	Pre test	Post test	D.F	T	P
30 second chair stand test	Experimental	8.25±0.8	10.01±0.22	14	5.73	0.065*
	Control	8.61±1.53	8.57±2.16	14	1.23	0.2

* P value set to 0.05.

Table 4 presents compares of pre and post-test for 10 meter walk test variable in both groups. Significant difference found between pre and post-test in experimental group in 10 meter walk test variable ($P < 0.05$) and between pre and post-test of subjects in control group there was no significant difference in this variable ($P < 0.05$).

Table 4. T-test for comparing 10 meter walk test data of subjects in the pre-test and post-test in two groups

Variable	Group	Pre test	Post test	D.F	T	P
10 meter walk test	Experimental	7.97±1.61	6.10±0.01	14	8.26	0.08*
	Control	7.92±0.77	7.52±1.17	14	0.59	0.3

* P value set to 0.05.

DISCUSSION

Pilates based exercise challenges these systems (sensory, musculoskeletal, and nervous systems) while focusing on the principles of breathing, control, centering, precision, concentration, and flow(2). The purpose of this study is to examine the effect of pilates exercise on gait speed and strength of lower limb in elderly male. In this respect, the results revealed a significant difference between experimental and control groups in 30 second chair stand test and 10 meter walk test. Also, there was a significant difference between pre and post-test of 30 second chair stand test and 10 meter walk test in the experimental group. Conducting a pilates exercise period increased the strength of lower limb and gait speed of subjects in experimental group. The total, there was an improvement in gait speed and lower limb strength in experimental group. The results of the present research are consistent with previous findings indicating an improvement of motor functions in elderly adults after conducting a pilates exercises period(17, 25, 42).

In the scientific literature for Pilates exercise, there is no valid data regarding the length of Pilates exercise program (29, 32, 44, 46). We carried out 10 weeks program and found a significant difference in gait speed and strength of lower limb for elderly male. Therefore we may suggest that this length of the training program could be sufficient to gain improvements for gait speed and strength of lower limb.

Petrofsky et al (2005), conducted a study to compare the Pilates exercises with and without a resistance band. They found that Pilates exercises performed with a resistance band are more effective in increasing muscular strength than the Pilates exercises without resistance bands (39). In line with this study, we used resistance bands and found a positive effect on muscle strength within the exercise group. In contrast to their study, we also added exercise ball or the Pilates ball exercises to the Pilates exercise program.

Previous research indicates that regular participation in physical activity has a positive impact on muscle strength (12,35). Activities of daily living are composed of static and dynamic conditions such as sitting or walking (37, 50, 51). Our study reports a significant increase in strength of lower limb after the pilates exercise in elderly male. These findings supported previous findings in relevant literature. Levine et al. suggested that the Pilates exercises can be used after arthroplastic surgeries because strength and flexibility is increased by this method (32). Improvement of strength in lower limb as well as the increase of coordination in these muscles has improved gait ability and balance of subjects. Regarding the improvement of lower limb strength after conducting a period of pilates exercises, we can consider the increase in subjects' balance, especially in lower limbs, plays an important role in maintaining and controlling stature and posture (45). In another study in which the effects of Pilates-based exercise on dynamic balance in healthy adults were investigated, dynamic balance increased (15). In another study, investigating Pilates Exercise has Positive Long Term Effects on the Aged-Related Decline in Balance and Strength in Older, Community Dwelling Men and Women, a significant increase was found in strength and balance in older ambulatory adults (4). Nazakatolhosaini et al. suggested that Pilates training sessions could improve motor functions in elderly people especially balance and cognitive functions. Therefore, it seems that this type of training May reduce the risk of falling in elderly females (36). In another study investigating of the effects of Pilates exercise into an exercise program for 65+ year-old women to reduce falls, in the study were observed there was an improvement in dynamic balance and muscle strength in experimental group (20). In another study, investigating Pilates Exercises Influence on the Serotonin Hormone, Some Physical Variables and the Depression Degree in Battered Women, it was extracted that Pilates exercise have a positive impact on improvement in muscle strength (1). The consistent results of our study with previous studies (17, 25) which indicated that various exercise programs and pilates exercises can improve the muscle strength and balance in age groups.

One goal of the present study was the effect of the Pilates exercises on gait speed in older male, the results of this study revealed that a significant increase in gait speed after the pilates exercise in elderly male, which supported previous findings (36, 48) in the relevant literature. The consistent results of this study with previous studies (3, 49, 50) which indicated that various exercise programs can improve walking speed in patients with multiple sclerosis. The results of the present research are consistent with previous findings (8, 19) indicating an improvement of some physical fitness factors in elderly adults after conducting a training period. Nazakatolhosaini et al. suggested that Pilates training sessions could improve gait speed in elderly female (36), which these findings are similar to the findings of the present research. In another study investigating of The Effect of Pilates Exercises and Aquatic Training on Walking Speed in Women with Multiple Sclerosis, in the study were observed there was an improvement in gait speed in Pilates Exercises and Aquatic Training groups (48). In another study in which Effect of exercise on walking speed, fatigue and quality of life of patients with multiple sclerosis were investigated, gait speed increased in patients with multiple sclerosis (3). The results of the present study is in contrast to other research (16) that no significant difference was found between pilates exercise and gait speed in patients with low back pain. Therefore, the results of the present study did not support these results. This disagreement in results is may be due to the difference in Type of subjects.

The main aim of the study was to investigate whether individuals improved because of the pilates exercises, which the results of the present research Indicated was an improvement in gait speed and lower limb strength in experimental group.

CONCLUSION

Considering the results of present study and the fact that independence of elderly adults is affected by the ability to maintain balance and to walk, we can say that conducting a period of pilates exercises improves life independence of geriatric population and will ultimately result in their more contribution in the society. Our findings suggest that Pilates exercise may be a useful tool for dynamic balance and gait in elderly. Therefore, we can recommend pilates exercises to be included in designing training programs for this group of society.

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