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ORIGINAL ARTICLE

The Impact of Pilates Exercises on Motor Control of Inactive Middle-Aged Women

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ABSTRACT
Inactive lifestyle and its degrading consequences such as increased body fat mass, muscle atrophy and physical functioning problems are among factors affecting the motorcontrol in adulthood. Therefore, the aim of study was to investigate the effect of Pilates exercise on motor control indexes of inactive middle-aged women.
Method: This was a semi experimental study with pretest and post test design performed on 43 inactive females with mean age of 44.4±5.1 yearswith low activity, body percent fat above 35%, WHR> 0.95. They were assigned into two experimental (n=22) and control (n=21) groups. The pilates group did their exercise for 4 months, three weeks a week while the control group did their daily routines. Allbody composition variables were measured by body composition analyzer and functional tests were measured by speed and balance tests. Independent and dependent t-test was used to analyze the data.
Results: The results suggested that dynamic balance and walking speed were improved significantly and those effective factors on motor control such as obesity variables,including body mass index (BMI), waist hip ratio (WHR), percent body fat (PBF), visceral fat (VF) (respectively, p=0.003; p=0.001; p=0.004) were also improved. Walking speed and balance were the other parameters affecting the motor control of aged women (respectively, p=0.001; p=003).
Conclusion: It seems that pillates exercise may improve walking speed, balance and also lead to a better bodycomposition. Therefore, having such an exercise program can be effective in motor controland its major consequences for gait and postural control of elderly people.
Keywords: pillates, body composition, motor control

INTRODUCTION

Nowadays, due to the necessities existing in the country, the proportion of elderly to young people has tremendously increased, and some physical problems such as muscleatrophy and obesity are also increased gradually with the age (Buchner et al., 1997; Khadije Irandoust & Taheri, 2016; Taheri & Irandoust, 2017). On the other hand, changes in the body composition can cause loss of physical function and exercise control. On the other hand, changes in the body composition can cause physical loss and motor control. In this regard, functional weakness and body composition malchangesare of the most common problems occurs most often from the middle age in people who have inactive lifestyle (Marshall & Murphy, 2008). Body composition changes is one of the factors that can cause back pain in middle age, and aging, including increased body fat mass, especially in the abdominal region, and muscle weakness in the central regions of the body. With an increase in abdominal obesity, a compensating curve is created in the lumbar curvature, and increase in the

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upper body weight causes also a lot of pressure on the intervertebral discs, which causes back pain as well (Ebenbichler, Oddsson, Kollmitzer, & Erim, 2001). Due to the increase in the arches of the lumbar region, the center of gravity shifts forward which results in disturbance of the postural control and increased risk of falling, and ultimately mobility reduction in later periods (Wright & Perricelli, 2008). Pilates is One of the sporting techniques, which has been noticed by sports and rehabilitation professionals and has been widespread in recent years. This sport developed firstly by Joseph Pilates in 1880, has a set of specialized exercises that affect the body with the aim of increasing strength, endurance and flexibility and on the other hand, along with improving physical conditions, it helps to improve psychological problems such as attention and concentration (Critchley, Pierson, & Battersby, 2011). The reduction of muscle tissue in the middle of the body may increase the lumbar curve, which in turn can lead to a decrease in walking speed. If the walking speed reduction reaches less than 1 to 2.1 m/s, some problems arise for middle-aged and elderly people (Hoxie & Rubenstein, 1994). Despite the wide variety of therapeutic exercises, there are still no sufficient reasons for the superiority of one method to another. Through a study in a 2007, Cao et al. (2007) stated that regular and ongoing physical activity and exercise could effectively reduce the risk of falling, and promote the mobility and movement safety of older women (Cao, Maeda, Shima, Kurata, & Nishizono, 2007). In 2009, Irez also showed that it was possible to delay somewhat the motor activity of these people by doing regular physical activity in their lifetime (Irez, 2009). Iwamoto et al. (2009) found that exercise and physical activity might improve balance, flexibility, muscle strength, and walking ability in the elderly people (Iwamoto et al., 2009). According to the research conducted, it is clear that various research has been done on the elderly's sport, which it makes a necessity to take measures to provide the elderly life in the best way. Hence, the present study was conducted with the aim of the Pilates exercises effect on the selected motor control parameters and factors effective in which, in the inactive middle-aged women.

METHOD

This research was semi-experimental type with the pre-test and post-test designwith the 5.1 (with low physical activity within the past six month, Non-Specific Low Back Pain, percentage of body fat over 35, waist hip ratio over 95%) who visited the sport and health consulting center to receive the training program. So samples were divided into two experimental (n=22) and control (n=21) groups randomly. Three individuals of the experimental group gave up the program. To be informed about health status and readiness level of individuals, before beginning the exercising course, medical history questionnaire and a physical fitness readiness questionnaire (PAR-Q) were used, respectively, in which all tests of the experimental group were qualified to enter the exercising protocol. Physical readiness questionnaire (PAR-Q) consists of one sheet including seven questions of yes and no, designed for selection of individuals during participation in those physical activities which might be intensive for them. PAR-Q is suggested as the committee standard for entering the moderate-intensity training program. Questions designed for this questionnaire are about the cardiovascular health, joint discomfort, and blood pressure (Thomas, Reading, & Shephard, 1992). The experimental group carried out the Pilates exercises within three sessions per week during four months, whereas the control group involved their daily life activities. Data were analyzed by using the statistical independence-t and dependence-t tests in SPSS software.

Inclusion Criteria

Inclusion Criteria included the Tendency to participate in the research (signing the consent form), 40-50 age range, percentage of body fat over 35, waist hip ratio over 95%, conditions for entering the exercise protocol by the diagnostic questionnaire PARQ, no use of nerve drugs affecting balance, and not having a history of lower limb injury during the past year.

Ethical considerations

For the ethical review, this study was referred to ethics and research council of the Imam Khomeini International

University, and was conducted under number 17682 after obtaining a license from this committee. Before starting the study, the research procedure (research goal, how to measure variables, how to conduct the exercise program, and research period length) was explained to thesubjects. Completing the written consent, all participants voluntarily took part in the research.

Physical activity measurement

After the necessary explanations and introductions to testers, the physical activity level was used through the physical activity questionnaire in order to evaluate the physical activity of testers. Including 16 questions, this questionnaire is drawn up in three parts related to leisure time, sports activity, physical activity regarding the job. Internal reliability of the questionnaire is reported 0.79, by Cronbach's alpha test.

Physical composition measurement

Obesity variables like the whole body obesity: Percentage of body fat (PBF); and visceral obesity: Waist hip ratio (WHR) and visceral fat were measured by using the body composition analyzer (manufactured by South Korea, model In Body 320).

Functional Tests

To measure the subject,s speed, they were asked to walk a ten-meter pass with the maximum speed. In this research, each tester repeated the test twice, the best score of whom was calculated. The individual's speed walking was acquired by dividing this figure by the given distance, in terms of meter per second. Before beginning the exercises, the test time up and go (TUG) was performed with reliability of 99%, to predict the falling risk for the dynamic balance measurement of both control and experimental group participants (Lopopolo, Greco, Sullivan, Craik, & Mangione, 2006). To perform the test, the participate stands up from a chair without a handle, without using his/her hands, and after walking a three-meter pass, returns and seat on the chair again (Buchner et al., 1997).

Exercise Protocol

Basic explanations were given to the experimental group at the beginning of each training session on how performing the movements. The first 10 minutes of each exercise session was appertained to the Pilates respiratory movements. Specific exercises were performed in a 40-minute interval, and finally returning to the initial state and cooling down for 5 minutes. Exercises were performed in the first week to increase the body general fitness; the second and third weeks with the goal of increasing strength (exercising by weight), increasing flexibility (with wood), stretching exercises; and the forth in the eighth weeks a combination of strength, flexibility and stretching exercises were done. In the third and fourth months, this cycle was repeated as a combination of all movements performed in previous phases (Critchley et al., 2011).

Data analysis

In this study, Shapiro-Wilk test was used to evaluate the normality of the data, and then independent t-test and dependent t-test were used for data analysis. Finally, data were analyzed by software SPSS version 21. $P \leq 0.05$ was considered as the significance level.

RESULTS

The results of paired t-test showed that the muscle mass of the Pilates group was significantly increased after the intervention ($P=0.03$). On the other hand, all obesity variables in the experimental group had a significant improvement after the training intervention ($P \leq 0.05$) (Table 1).

Results of dependent t-test are shown in Fig 1, balance of the experimental group subjects (Time up and go) was significantly improved (p=0.002, t= 6.21). However, there was no significant difference in the control group (p=0.603, t= 0.47). It is worth mentioning that independent t-test results showed that there was no significant difference between both experimental and control groups in the pre-test of the test (p=0.51), but there was a significant difference between both experimental and control groups in scores of post-test of time up and go test (p=0.001).

As shown in Fig 2, there is a significant difference in

Table 1. Body Composition Variables before and after exercise intervention

Variable	Group	Pilates		Control	
		Pre test	Post test	Pre test	Post test
Body Composition	Height (cm)	159.4±2.3		158.7±1.8	
	Weight (kg)	73.1±1.6	70.11±1.9***	73.6±1.6	74.1±1.4
	Percentage of body fat (%)	37.3±0.9	35.1±1.1***	37.1±1.1	37.3±1.1
	Muscle tissue (kg)	27.1±1.4	28.3±1.1*	27.2±1.1	27.3±1.2
	WHR (Waist hip ratio)	0.93±0.12	0.89±0.09**	0.93±0.10	0.93±0.13
	Visceral Fat (cm^2)	107±4	102±3*	108±6	107±5

***: p≤0.001, **: p≤0.001, *: p≤0.05

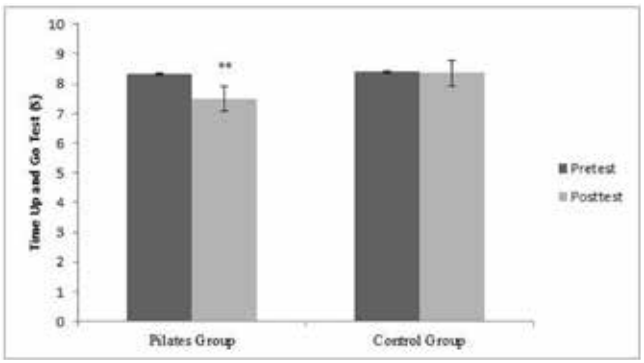

Figure 1. The effect of Pilates Exercise in Balance Performance
****. p≤0.01**

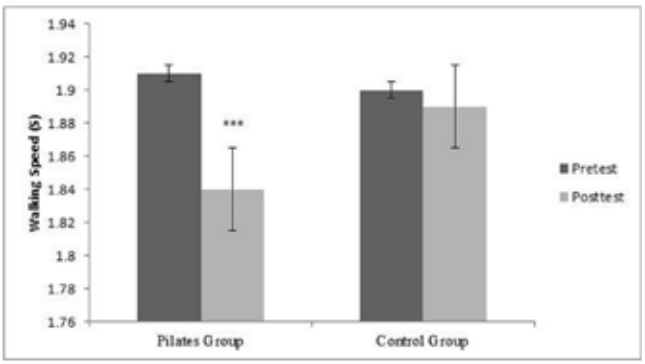

Figure 2. The effect of Pilates Exercise in Speed Performance
****. p≤0.01**

pre-test and post-test of a10-meter walking speed in the experimental group (p=0.001, t=5.801), whereas that was no significant difference for the control group (p=0.958, t=0.054). Results also showed that there is no significant difference between both experimental and control groups in pre-test of a 10meter-walking speed, but there is a significant difference in the post-test scores on post test (p=0.001).

DISCUSSION

The purpose of this study was to investigate the effects of Pilates exercises on variables that could affect the motor control indices like the body combination, balance performance and walking speed all which contribute to functional autonomy in life. The results showed that abdominal obesity WHR and visceral fat, as well as improved balance and walking speed. Awareness of body components, conscious use of the muscles, awareness of muscle messages and the joint motion range, which are the basic principles of Pilates exercises, could prevent excessive trauma, stretching and pressure on the muscles. By combining the body concentration and maintaining the proper body alignment, principle of Pilates stretch helps to stretch muscles in the complete range of motion needed for the muscle balance, and at the same time the contraction, that is done with the body support. Improvement of balance condition and walking speed was consistent with the results of Iwamoto et al. (2009), but it contradicted by part of the results of a study which concluded that land endurance exercises did not have a significant effect on the walking speed (Hortobágyi et al., 2015). Although the nature of the training program used in the research is similar, the difference in the outcomes could be resulted from ignoring some factors such as the level of readiness of testers, physical activity level, motivation, gender, age, height, weight. In addition, differences observed in the research can be attributed to two methods of research and other variables. Although muscle strength decreases with age (Khadijeh Irandoust & Taheri, 2015), it can be improved in the middle aged. Performing the sports exercises compensates the age-

related functional changes and keeps independency during the middle ages for a longer time. The Findings of the study suggest that regular physical activity reduces body fat storage, as well as increasing the muscle strength and endurance, and the ability to do daily activities. Muscular atrophy, which is associated with age, can be delayed or reversed through the strength training and Pilates (Khadije Irandoust & Taheri, 2016). Considering that the Pilates exercise is a new sport in our country, and on the other hand, its required facilities are very easy to use and perform anywhere, therefore it is suggested to use it for increasing the functional readiness, including speed, balance and body composition. Regarding the results of this study, Pilates exercises can reduce the percentage of visceral fat, and cause the improvement of balance condition, and walking speed in the middle aged. It must be noted that there are some mportnant issues which make the generalizabity of results more difficult. Its highly recommended to recruit more subjects in future. All in all, participation in Pilates sports activities continuously has the capability to increase the potential for a better motor control in middle-aged women. As a result, these exercises can be used along with other middle-aged rehabilitation programs.

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