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Comparing Pilates and Physioball Exercise Regimens on Balance and Motor Control in Women with Multiple Sclerosis

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Abstract

Background: *Multiple sclerosis (MS) is a chronic, progressive autoimmune and central nervous system disease. By damaging the myelin sheaths that insulate nerve cell axa, MS disrupts neurological function, leading to various complications, particularly balance disorders. The aim of this study was to the compare the effectiveness of eight sessions of either pilates or physioball exercise on balance and motor control for women with MS.*

Methods: *Thirty patients with MS, who were recruited from the MS Society of Tehran using availability sampling. Participants were randomly assigned to one into three groups: pilates exercises (PE), physioball exercise (PBE), or a control group (CG). PE and PBE group members completed a corresponding eight-week training program, consisting of three supervised sessions per week, for 15 to 45 minutes each session. During the same time period, the CG performed their usual daily activities. A sharpened Romberg's test was used to measured static balance, and motor control was evaluated by the timed up and go test. Both tests were administered to all participants prior to and following the intervention. Repeated measures analysis of variance was used to evaluate the data, with a significance level of $P<0.05$.*

Results: *Participants in the PE and PBE conditions showed significantly greater improvements in mean balance and motor control scores compared to CG members. However, no significant differences in mean balance or motor control scores were observed when comparing the PBE and PE groups.*

Conclusions: *While both the PE and PBE programs correlated with improved balance and motor control among MS patients compared to the CG. By considering the effectiveness of these training programs, we recommended them as preventive intervention against falls and related injuries.*

Keywords: Multiple sclerosis, Pilates exercises, Physioball, Balance, Motion control.

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Introduction

Multiple sclerosis (MS) is a chronic, progressive autoimmune disease of the central nervous system that affects the brain and spinal cord. This disease is characterized by demyelination of nerve cells and the formation of scar tissue, which disrupts signal conduction and other processes.[1] This disease's prevalence is rapidly increasing worldwide and known as the disease of the century. The American MS Association, in 2001, announced that 2.5 million people worldwide were suffering from this disease, and 200 new cases were identified weekly. Moreover, 80% of MS patients had some degree of disability.[2,3] The prevalence of MS in Iran is estimated to be 15 to 30 cases per 100,000 persons. The prevalence of MS in women is two to four times higher than male prevalance. The onset of the disease usually occurs between 20 and 40 years of age.[4] The most common consequences or outcomes of the MS include the loss of motor function or tactile sensation in a given area of the body, fatigue, muscle weakness, physical weakness, blindness in one eye, uncoordinated movement, lack of balance and difficulty walking.[5,6] More than 85% of MS patients suffer from walking impairments and imbalance. Imbalance decreases functional independence, and the exacerbation of disabilities. An increased risk of falling may also occur,[5] which in turn can cause psychological problems like a lack of confidence and a fear of falling again. It may also lead to physical problems such as premature fatigue and physical injury.[7] Therefore, the motor function is essential for daily activities.

Various pharmacological and non-pharmacological therapies can be used to improve physical and mental performance in patients with MS, these therapies are important, because the definitive treatment to cure or alleviate MS have not yet been reported.[8,9] Due to the lack of a definitive treatment, the high costs of new drugs, and the numerous side effects of drugs, non-pharmacological therapies may be more easily accepted by patients.[8] Exercise and physical activity is one of the most important non-pharmacological methods to help improve the independence and daily function in patients with MS. In recent years, the benefits of exercise have been demonstrated for MS patients and studies have shown that proper exercise therapy can be effective in improving their physical and mental health.[10] The exercise needs of patients with MS is determined with an emphasis on their physiological history, their disease symptoms, and their activity levels.[11] Although some studies have examined aerobic exercises, strength training, balance training, yoga, and aquatic physical training for patients with MS,[12] the effects of exercises such as pilates exercises (PE) and physioball exercise (PBE) have not been studied as therapies, so there is limited information on their efficacy.

Pilates is one of the most popular exercise methods for physical rehabilitation. PE is a form of precise, controlled training used to strengthen the stabilizer muscles of the body.[13] This training is based on a holistic approach where the correct implementation of six basic principles (concentration, control, centering, flowing movement, precision, and breathing) increases awareness of the body and reduces joint stress.[14] PE can be performed at different intensities commensurate with the individual's fitness level. Although there is no scientific evidence to support the effectiveness of PE in many pathological populations, specialists frequently use these exercises as a therapeutic strategy in older people with stroke and MS.[15]

Studies show that the use of a physioball can be effective in improving balance through improving core stability and activation of mechanoreceptors.[16] In these exercises the body naturally and automatically maintains its balance against the instability of the ball. The benefits of using PBE include increased muscular activity, and the co-activation and co-contraction of muscles.[17] Improved performance, strengthened stabilizer muscles throughout the body, and increased balance are some benefits of PBE which in some studies have been used to rehabilitate and improve the physical functioning of individuals.[18] Although in recent years the use of PBE in various fields of health and sport has attracted many enthusiasts,[19] the effects of this training on balance and motor control have not been studied in patients with MS. Due to the movement and balance problems in people with MS, evaluating the effects of these types of training on the balance and motor control of people with MS is a necessity. Extant studies show that PE and PBE are effective in improving balance and motor control in people with other diseases, but these results may not necessarily generalize to patients with MS. Therefore, the aim of this study was to compare the effectiveness of eight weeks of PE and PBE on the balance and motor control of women with MS.

Materials and Methods

The study used a controlled semi-experimental design, evaluated with pretest-posttest assessments. This study compared the effects of PE and PBE on improving static and dynamic balance of female patients with MS in MS society of Tehran. The statistical population consisted of all patients with MS in Tehran who were referred to the MS Society of Tehran. The size of this population is close to 6,700 people, with roughly 100 new referrals each week. A sample of 30 females affected by MS from this population, ages 20 to 60 years, who had expanded disability status scores less than or equal to 4 form were selected. Participants were randomly placed into one of three groups: control (N=10; age mean±SD: 34.4±7.9 years), PBE (N=10; age mean±SD: 33.8±7.14), and PE (N=10; age mean±SD: 34.3±6.93). Inclusion criteria for the study included confirmation of MS by a neurologist, confirmation of a lack of exercise limitations by a doctor, an expanded disability status score of less than or equal to 4on the physical disability scale, a lack of cardiovascular and metabolic diseases, no family history of epilepsy, a lack of psychiatric disorders, at least two months since the last relapse of disease, and lack of participation in regular physical activity during the previous 2 months ago.

A researcher-developed questionnaire was used to collect demographic information. The severity of disability of patients was measured using the expanded disability status scale (EDSS) by a neurologist. The EDSS is a method of quantifying disability in MS and monitoring changes in the level of disability over time. It is widely used in clinical trials and in the assessment of people with MS. This questionnaire measures the different states and functions of the central nervous system, including the functions of the pyramidal, cerebellar, brainstem, sensory, intestine, bladder, visual, and brain pathway systems. The EDSS score ranges from 0 to 10 depending on the degree of injury to the central nervous system in 0.5 unit increments. Higher scores represent higher levels of disability and therefore a more severe degree of the disease.[21] A Cronbach's coefficient of 0.95 has been reported for the Persian version of this scale.

The sharpened Romberg's sided test was used to measure static balance, performed with the eyes open and closed. The test procedure was as follows: the participant stood on her dominant leg, lifted up the other leg, and placed their hands on her waist. The time that the participant was able to maintain this position with her eyes open and with her eyes was calculated as her score. To become familiar with the test, participants practiced it a few times. Participants performed this test three times with open and closed eyes. The mean score of the three repetitions was calculated as their record. The reliability scores for the test with open and closed eyes have been reported as 0.90–0.91 and 0.76–0.77, respectively.[22]

The timed up and go (TUG) test was used to assess motor control. To perform this test, each participant raised herself from an armless chair without using her hands, moved down a three-meter track, returned, and sat in the chair again. In this test, the total time to run the three-meter track served as the score. All subjects were asked to complete this process as quickly as possible without running, and the total time of test was recorded. To become familiar with the test, subjects practiced it a few times. The record of this test was calculated similarly to the static balance test. Subjects performed this test three times, and their mean was recorded as their score. The inter-rater reliability of the test is.0.9 and predicts the risk of falling.[23]

In this study, a PE program was used that includes 10 strength training exercises (3 sets of 15 reps) and 10 stretching exercises (2 sets of 10 reps of 20 seconds). These exercises were performed three times a week for 15 to 35 minutes on a mat. At the beginning of the intervention, the training sessions lasted 15 minutes, increasing to 35 minutes by the end of the eight weeks. During the first session of PE, the principles of the exercises were explained and all subjects were given an overview of PE. These principles were followed in all sessions. Each exercise session consisted of three parts: the warm up, the main training, and the cool down. The ten-minute warm up includes training on the bicycle ergometer and exercise movements. The ten-minute cool down portion (for 10 minutes) included exercise movements and jogging.[24]

The training program developed by Marshall and Murphy (2005) and Ascendis et al (2010) were used for the PBE group. This program included 13 exercises that were performed for eight weeks, three times a week, in sessions of 15 to 35 minutes. The exercises used in the protocol were specific spinal stabilization exercises, proprioceptive reeducation of the lumbar and pelvic regions and the lower limbs. Overload and gradual increase of each exercise's timing was identified and controlled according to the proper implementation and training load in previous sessions. The aim was to reach the repetitions of each exercise per set from the first week until the eighth week from 3 sets of 7 seconds to 3 sets of 20 seconds. During this period, the control group was asked to avoid strength and balance training.[14,17]

Analysis of variance (ANOVA) with repeated measures was used to investigate the effects of balance training on the outcome variables within each group and the differences between groups. Statistical analysis was performed using SPSS version 19. P-values of less than 0.05 were regarded as statistically significant.

Results

Table 1 shows the demographic characteristics of participants according to groups. Table 2 shows the mean difference between eyes open and eyes closed conditions for static balance and the motor control tests between the three groups. The results showed that there were no significant differences between the mean static balance scores for the eyes open and eyes closed conditions or the motor control of subjects in the PE and PBE groups at the post-test ($P<0.05$), but there was a significant difference between the mean static balance scores in eyes open and eyes closed conditions for the static balance test and the motor control test for participants between the PE and PBE groups and the control group in the post-test ($P<0.05$).

Table 1. Demographic information of subjects

Variables	Groups	Mean	SD
Age (years)	CG	34.4	7.9
	PBEG	33.8	33.8
	PEG	34.3	34.3
Weight (kg)	CG	61.6	7.2
	PBEG	60.3	11
	PEG	61.3	10.2
High (cm)	CG	163.6	3.5
	PBEG	164.5	2.2
	PEG	163.6	6.3

CG= control group, PBEG= physioball exercise group, PEG=Pilates exercise group

Figures 1, 2 and 3 show the mean and SD of the eyes open and eyes closed conditions of the static balance test and the DB for control, PE, and PBE groups, respectively.

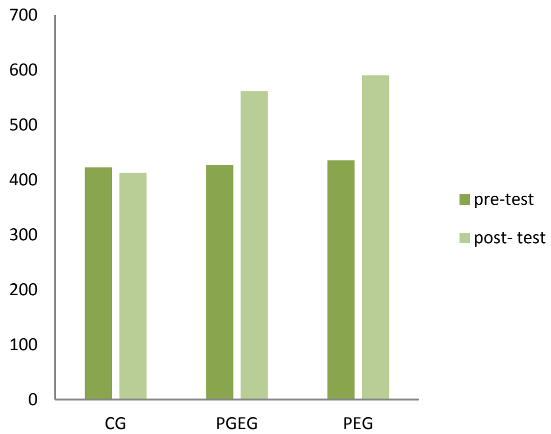

Figure1. SBOE of groups

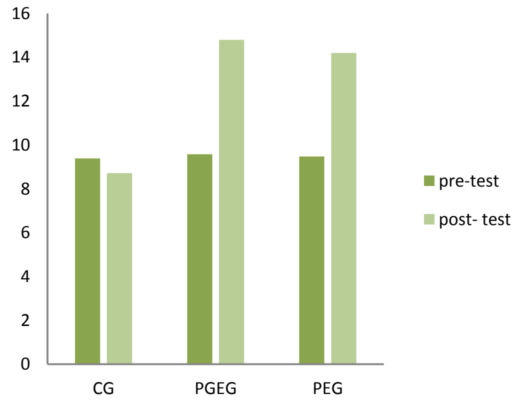

Figure 2. SBCE of groups

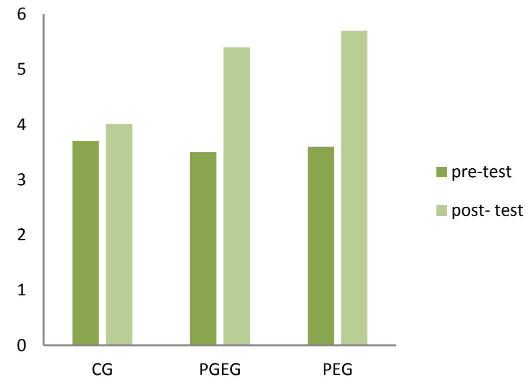

Figure 3. DB of control, PE and PBE groups

Discussion

The aim of this study was to investigate the effects of PE and PBE on the balance and motor control in women with MS. The results of this study showed that both training methods were effective in improving balance and motor control in the sample. The PE method improved eyes open static balance (35.63%), eyes closed static balance (52.53%), and motor control (56.19%). The PBE method also improved eyes open static balance (31.38%), eyes closed static balance (54.27%). and motor control (52.97%). The results of this study are consistent with the results of studies conducted by Guclu-Gunduz et al. (2014),[10] Marandi et al. (2013) [19]and Kalron et al. (2016). [15]Guclu-Gunduz et al. (2014) reported that balance, mobility, and upper and lower limb muscle strength improved in their Pilates group, but observed no significant differences between the control and experimental groups. Kalron et al. (2016) reported that both PE and physiotherapy increased walking speed, average step length, and balance in patients with MS, but found no significant differences between the two therapies. Marandi et al. (2013) also reported that both PE and aquatic exercise improved walking speed in patients with MS, but found is no significant difference between the two experimental groups. Freeman et al. showed that eight weeks of

PE can improve balance and mobility in MS patients with an expanded disability status score of 4–5. The study by Freeman et al. and the present study used the same 10 exercises, study design, and patient disability level. Freeman et al. reported that improved motor control and balance was due to strengthening the deep abdominal muscles and improving the stability of the central region.[25] In the present study, the central muscle strength was not evaluated, but based on the results of previous studies, it can be surmised that the core stability and body awareness of people who participate in PE can be improved, which could lead to improved motor control, balance, and mobility. Johnson et al. also showed that dynamic balance improved in healthy adults after 5 weeks of PE. Johnson et al. concluded that improved motor control and balance was due to the development of core stability.[26] In addition, they reported that error correction and the use of tactile stimuli during PE increase kinesthetic awareness and can help improve balance. In support of this claim, Harrington et al. showed that PE strengthens transverse abdominal muscle contraction in healthy individuals.[27] Critchley et al. also reported changes in the activation of the transverse abdominal muscle and internal oblique muscle via ultrasound after 8 weeks of PE, with two sessions per week.[27] In addition, Dorada et al. assessed changes in the size of the rectus abdominis muscle, internal oblique muscle, external oblique muscle, and transverse abdominal muscle by magnetic resonance imaging (MRI) in healthy adult women after 36 weeks of PE, and reported that PE increased the volume of these muscles, especially the rectus abdominis.[29] These studies showed that the central region can activate the prime mover muscles during PE. The results of the present study suggesting that improved balance is due to the development of core stability are consistent with the results of these studies.

PBE has been used in hospitals and has become accepted as one of the most popular physical therapies and preparation programs. One of the benefits reported with PBE is improved spinal stability and balance.[17] The results of this study showed PBE had a significant effect on improving static balance and motor control in patients with MS. The results of this study are consistent with the findings of the study Johnson et al. (2007) who showed that PBE improved abdominal muscle endurance, lumbar muscle endurance, the endurance and flexibility of lower extremity muscles, and balance in sedentary women. Anderson and Behm (2005) reported the proprioceptive system for synchronization of unconscious reflexes, which maintains balance, relies on information from joints and muscles.[18] Lehman et al. (2005) also reported that local muscles have higher proprioception and that PBE activates these muscles. This may be the reason for the substantial effect of PBE on balance.[19] In this regard, significant improvements in balance and motor control observed in this study are important evidence that PBE not only facilitates global muscles, but also local muscle groups in the central region of the body. With regard to the effects of PBE on balance and motion control, improvements may be achieved because of the placement of subjects on the ball and adjusting the weight distribution on the muscles and joints. In this situation, subjects can perform a wide range of movements without risk of injury. Disturbance of the forces of balance caused by placement on the ball can provide the proper activity to challenge systems involved in balance. The combination of the frequency and speed of movements may also help increase strength and endurance, and improve flexibility and reaction time, which have important roles in maintaining balance.

The results showed that there were no significant differences between the triple tests of static balance and motor control in the control, Pilates and Physioball groups in the post-test. Therefore, it cannot be conclusively stated whether PE or PBE are superior in improving balance and motor control for patients with MS. In order to obtain more information, more studies with larger sample sizes and longer therapeutic durations need to be performed. Both PBE and PE were found to have a significant effect on static balance and motor control among women with MS. Therefore, these training programs can be recommended to people with MS as a training method to prevent falls and subsequent injuries.

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Conflict of Interest

The authors declared that they have no conflict of interest.

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