

Comparing the effects of selected TRX and Pilates training on balance parameters, fatigue index, and quality of life in female patients of multiple sclerosis

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Abstract

Purpose: This study was conducted aiming to investigate the effect of selected TRX and Pilates training on balance parameters, fatigue index, and quality of life in female patients of multiple sclerosis. **Method:** In this study, 30 female patients with MS in Isfahan city with an average age of 37.41 ± 7.57 years and a history of MS of 11.31 ± 3.77 years and an Expanded Disability Status Scale of 0.84 ± 1.81 were placed in three groups including control, TRX and Pilates groups. The training program consisted of eight weeks including 3 sessions of 60 minutes of exercise per week. In order to investigate balance, fatigue, and quality of life, the Berg test, Fatigue Severity Scale, and Multiple Sclerosis Quality of Life were used respectively. SPSS version 25 software was used for statistical analysis. **Results:** The results of this study have shown that both exercise programs have led to a significant improvement in the mean parameters of balance ($P < 0.005$), fatigue ($P < 0.005$), and quality of life ($P < 0.001$). **Conclusions:** Considering the noticeable impact of these training protocols on the quality of life, balance and fatigue, these interventions can be considered as an efficient and cost-effective methods to improve health condition in MS patients.

Keywords: Exercise, Multiple sclerosis, Pilates, TRX, Fatigue, Balance.

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INTRODUCTION

Multiple Sclerosis (MS) has been widely known as an autoimmune, inflammatory, chronic, and progressive disease in which the immune system attacks the nerve cells of the brain and spinal cord, leading to the damage of the myelin sheath and axon of these cells (Lassmann, 2019). What highlights the attention to this disease is its growing prevalence in recent years. According to a recent study, it has shown that more than 2.8 million people are estimated to live with MS worldwide (Walton et al., 2020). It has also been reported that the prevalence of MS in Iran in 2013 was 60 per 100000 and also it has been proven that women are 2 to 3 times more likely to suffer from MS than men (Azami et al., 2019). The main physical and mental problems connected to MS include imbalance, fatigue, speech and vision disorders, muscle spasms and weakness, pain, lack of concentration, tremors, dizziness, reduced ability to walk, and ataxia, as well as depression and cognitive impairment. These symptoms can lead to abnormal walking or inactivity (Lassmann, 2019).

Physical activity and regular exercise have been widely considered as a non-therapeutic and cost-effective way to prevent non-communicable diseases in the elderly (Kushkestani et al., 2022; Kushkestani, Parvani, Bathaezadeh, et al., 2020; Kushkestani, Parvani, Moghadassi, et al., 2020; Kushkestani, Parvani, Nosrani, et al., 2020; Kushkestani, Parvani, & Rezaei, 2020). A growing number of studies have indicated that exercise training can be considered an efficient way to improve health conditions in MS patients (Dalgas et al., 2013). To now, the effects of various types of exercises including aerobics, strength training, yoga, and Pilates have been investigated in these patients (Dalgas et al., 2009). Total Body Resistance Exercises (TRX) is kind of a resistance exercise without weights that was first developed to improve the activation of core muscles as a therapeutic and rehabilitation purpose (You et al., 2015). TRX has been highlighted to be an effective strategy for improving the performance of the neuromuscular system, muscle strength, and increasing functional capacity (Gaedtke & Morat, 2015). In a study aiming at the role of TRX training in 11 elderly people with MS, Gadtek, and Murat have shown that this exercise pattern can improve strength, balance, and walking patterns (Gaedtke & Morat, 2015). The result of another study correlated TRX training to walking speed and dynamic balance in MS patients (Kordi et al., 2011). Pilates is another

training method to improve the muscular function of people with balance and walking disorders. In fact, Pilates is a combination of stretching and strength movements that are performed during a safe range of motion of the joints and under controlled speed with high concentration and deep breathing (Chen et al., 2020). The optimal effect of Pilates in MS patients includes strengthening the immune system, increasing the level of physical fitness in a way of freeing the mind from negative thoughts, reducing spinal and back pain, increasing flexibility, improving fitness, balance, and strength, the functioning of the respiratory system, strengthening the function of the cardiovascular system and finally reducing fatigue and increasing the ability to perform daily tasks (Guclu-Gunduz et al., 2014). It has also been reported that Pilates training can potentially trigger balance function by improving muscle movements in MS patients (Shanazari et al., 2013).

To the best of our knowledge, there has been no research aiming to compare TRX and Pilates training on balance, fatigue index, and quality of life of MS patients. So, in the present study we aimed to Compare the effects of selected TRX and Pilates training on balance parameters, fatigue index, and quality of life in female patients of multiple sclerosis.

METHOD

Patients

This study was conducted with a pre-and post-test design in two experimental and one control groups. The study population consisted of 30 MS patient women with the average age of 20-52 from MS Association of Isfahan province with Expanded Disability Status Scale (EDSS) grade = (0-4) who were selected voluntarily. The subjects first completed the consent form and participated in the study coordinating with the medical management of the center. The criteria for being included in the study involved not having participated in regular exercise within 3 to 5 months prior to the study, having no orthopedic, cardio-respiratory, metabolic, or high blood pressure diseases according to the patient's medical records, not being pregnant, not smoking, and having no conditions that would hinder the subject's ability to continue with the research. Subjects were excluded if either their menstrual cycles had

started or not participating in three training sessions consecutively. The first session included familiarizing the patients with the details of both the exercise protocol and the specific goals of the research. Then, the patients were randomly divided into three groups of 8: TRX, Pilates and control (without exercise intervention).

Training protocols

TRX training protocol was performed for 8 weeks and included 9 movements (Mid row, T deltoid fly, squat, hamstring curl, TRX quadruped stance, backward lung, hip abduction, lateral lung, and, crunch) with four levels of execution from simple to difficult. The main focus of these exercises was triggering core muscles and legs, which were designed with the aim of improving muscle strength and endurance, central stability, postural control, balance, coordination, proprioception, and neuromuscular control. The subjects performed the training for 24 sessions (3 sessions each week, with the duration of the exercises in the first and second weeks being 30 to 40 minutes and in the fifth to eighth weeks 50 to 60 minutes). The work-rest ratio was 1 to 2. This exercise training is a pilot and modified form of the Gaedtke, A. and T. Morat and Wesley D. Dudgeon study (Dudgeon et al., 2015).

Pilates training started from the basic level and gradually expanded with complementary exercises, performed from lying down to sitting and standing movements. After 20 minutes of counseling, the subjects were placed on the tatami mat and were familiarized with specific stretching exercises, the ability to control the body while performing movements and the correct way to perform upper and lower body exercises. The Pilates training consisted of eight weeks and three training sessions of 30 to 40 minutes each week in the first two weeks and 45 to 60 minutes in the final weeks, and the subjects performed 8 to 12 movements in each training session.

Anthropometric measurements

The anthropometric indices including height and weight were measured using a height measuring device and a scale of the Seca model made in

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Germany with an accuracy of 0.1 cm and 0.1 kg, respectively. Also, to determine the subcutaneous fat percentage, the Ketch method was used measuring three points around the body (abdomen, thigh, and arm) (Burlyayeva et al., 2022).

Balance test

The Berg balance test was used to evaluate balance in patients. This test consists of 14 stations and the score of each stage is from 0 to 4. Doing the correct movement with perfect balance gets 4 points and imbalance and inability to perform the movement gets 0 points. A subject has perfect balance when he scores 56 points. Berg's test can measure the form of dynamic or static balance - both - (Cattaneo et al., 2006).

Fatigue evaluation

The fatigue Severity Scale questionnaire (FSS) was used to evaluate the level of fatigue in patients. This questionnaire is one of the most reliable scales for measuring the intensity of fatigue in MS patients. The reliability and validity of this test were measured by Krupp et al. in 1989 and its internal consistency was reported as $r=0.95$ (Rossier & Wade, 2001). The validity of this tool in Iran also was measured by kafi et al. and, Internal consistency of FSS with Cronbach's alpha was equal to 0.93 (Kafi et al., 2012). FSS consists of 9 questions and its purpose is to evaluate the severity of fatigue in multiple sclerosis patients. Its scoring range is based on a five-point Likert scale. The scoring range of the options according to the points of each option is as follows; (The score is 0-7 for each question that measures fatigue in general. The sum of these scores shows the severity of the patient's fatigue) (Rossier & Wade, 2001).

Quality of life

Multiple Sclerosis Quality of Life (MSQOL)-54 Instrument was used to evaluate the quality of life in the subjects. This questionnaire is specific to patients with multiple sclerosis, its validity and reliability have been measured in Iran, and the internal consistency with Cronbach's alpha was 0.96 (Ghaem et al., 2007). This questionnaire contains 54 questions, 18

of which are in 14 areas specific to MS patients: physical performance, performance limitation due to physical problems, performance limitation due to mental problems, social performance, health stress, sexual performance, satisfaction with sexual performance, pain, energy, understanding of health, general quality of life, health changes, cognitive function and psychological well-being and its 36 questions are related to general quality of life. The questions are 2 to 7 options in the form of a Likert. The final score is determined by the scores that are meant for the two combined areas. These include "physical health" and "spiritual-psychological health". The scores of all 14 areas and also two combined areas are from 0 to 100, where higher scores indicate a better situation (Ekström et al., 2011).

Statistical analysis

SPSS version 25 software was used for the statistical analysis. Also, to examine the normality of the data, the Kolmogorov-Smirnov test was used. In order to evaluate the homogeneity of variances and Intra-group and inter-group changes, Lon's test and analysis of covariance were used respectively.

RESULTS

Table 1 shows the individual characteristics of the subjects and the distribution of age, height, weight, degree of disability, and duration of MS.

Table 1: Physical characteristics (mean and standard deviation) in three groups of multiple sclerosis female patients.

Group	Age (Year)	Height (cm)	Weight (kg)	EDSS (1-4)	MS background (Year)
TRX	41.12 ± 3.6	162 ± 6.84	65.18 ± 10.2	1.68 ± 0.79	11.12 ± 3.6
Pilates	33 ± 6.56	162.25 ± 6.02	58 ± 10.63	2.06 ± 1.05	12.62 ± 3.24
Control	38.12 ± 9.68	159.37 ± 3.02	67.25 ± 15.91	1.68 ± 0.7	10.18 ± 4.45

As can be seen in Table 2, the results of inter-group covariance analysis indicated a positive and significant effect of TRX ($P < 0.003$) and Pilates ($P < 0.003$) training on the balance of MS patients. In fact, we have shown

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that 8 weeks of Pilates and TRX training have led to a significant increase in balance in MS patients. As well, there was no significant difference in balance between TRX and Pilates groups after the intervention.

Table 2: Comparison of mean balance score between groups

Groups	Mean Difference	Std. Error	P-value
Pilates – TRX	-0.220	1.767	0.902
Pilates- Control	6.172	1.864	0.003*
TRX - Control	-5.952	1.794	0.003*

The difference of fatigue score between group after the intervention has provided in Table 3. As can be seen, there was a significant difference of fatigue score between TRX ($P < 0.001$) and Pilates ($P < 0.001$) with control group. We also have shown that there was no significant difference of fatigue score between Pilates and TRX groups after 8 weeks of training.

Table 3: Comparison of mean fatigue score between groups

Groups	Mean Difference	Std. Error	P-value
Pilates – TRX	0.869	3.650	1.000
Pilates- Control	-17.855	3.705	0.001*
TRX - Control	16.986	3.936	0.001*

As can be seen in Table 4, the results of inter-group covariance analysis indicated a positive and significant effect of TRX ($P < 0.003$) and Pilates ($P < 0.001$) training on the quality of life of MS patients as well as no significant difference in balance between TRX and Pilates groups after the intervention.

Table 4: Comparison of mean quality of life between groups

Groups	Mean Difference	Std. Error	P-value
Pilates – TRX	-0.412	0.775	1.000
Pilates- Control	3.686	0.810	0.001*
TRX - Control	-3.274	0.825	0.003*

DISCUSSION

In the present study, we have shown that 8 weeks of TRX and Pilates training have led to a significant increase in balance, and, quality of life, and a significant decrease in the fatigue index of female MS patients. The results of the balance test in the present study were consistent with the findings of Gaklogunds et al. (Guclu-Gunduz et al., 2014) and inconsistent with the research of DeBolt et al and, Dodd et.al (DeBolt & McCubbin, 2004; Dodd et al., 2011). One plausible explanation for the disparity in our findings is the duration of the intervention, as well as the volume of the TRX training, both of which may have an impact on the process of adaptation. Dodd et al.'s study on the effect of TRX training on the walking performance of MS patients has shown that the walking performance and the walking speed in 2-minute walking tests improved significantly after 22 weeks (Dodd et al., 2011). One of the reasons for improving balance after resistance training is increasing the strength of lower limb muscles (Fragala et al., 2019). Scientific reports have indicated that the main reason involving an increase in strength in the first few weeks of resistance training is the occurrence of physiological adaptation in the nervous system (Fragala et al., 2019). As the nervous system becomes more compatible with resistance training, muscle coordination increases, and as a result, it facilitates physical performance (Hortobágyi et al., 2021). MS patients consume more energy to do the same tasks compared to normal people, and this leads to increased fatigue and lower quality of life in affected people (Kuhlmann et al., 2023). Therefore, reducing fatigue in MS patients can increase functional capacity in these people (Kargar, 2010). In another study, Larmonth et al. reported an increase in the level of daily physical activity, balance, and leg strength following 12 weeks of TRX training in MS patients. They found a significant improvement in the score of the Berg scale and walking speed (Mohamed, 2016). It is worth considering that in the existing literature, the role of TRX training patterns in static or dynamic balance changes in women with MS is not so clear. In this regard, Abaspour et al have reported the positive effect of 8 weeks of combined exercises on the balance and performance ability in 20 female MS patients (Abaspour et al., 2020). Also, in Barker et al. meta-analysis study, the Pilates training group had a higher average balance score and a lower frequency of falls than the control group, which was in line with the results of the present study (Barker et al., 2015). On the other hand, Sandroff et al. have

examined the level of physical fitness and walking performance of patients with MS in adaptation to Pilates training. They have reported a significant difference between walking and stepping patterns in the control and experimental groups, but no difference in balance and walking kinematics has been seen (Sandroff et al., 2013).

In the present study, fatigue was significantly reduced in both the TRX and Pilates groups, and since fatigue is one of the most important reasons for low physical activity in MS patients, this issue can be connected with increasing the level of physical activity and having its countless benefits. The body of evidence has shown that resistance training increases functional capacities and leads to a decrease in fatigue levels and an increase in quality of life (Dodd et al., 2011; Fayazi et al., 2016). In this context, several studies in line with our results have reported that resistance training through neuromuscular adaptations and improving movement capabilities leads to a reduction in fatigue levels and an increase in the quality of life in MS patients (Ghaem et al., 2007; Hayes et al., 2011; Huisinga et al., 2011). Pittion et.al has also reported that the quality of life in MS patients increases along with the reduction of fatigue following resistance training, opening the theory that this improvement is mostly the effect of enhancing the neuro-muscular system function (Pittion-Vouyovitch et al., 2006). Improving the quality of life of patients in the present study can also be the result of improving mental health and increasing social capabilities in adaptation to exercise interventions.

In the present study, TRX and Pilates training led to a significant improvement in balance in MS patients. It seems that the two training patterns of Pilates and TRX can improve the walking patterns, and ultimately the functional abilities and balance of these patients through strengthening muscles and improving the stability of lower limb joints (Mohamed, 2016). Scientific evidence has proven that TRX training triggers a greater range of abilities such as postural stability, balance, coordination of one or more limbs, and finally coordination of the whole body. As a result, this training method may be more beneficial than other resistance training methods for MS patients (Mohamed, 2016). Performing this type of training in different ranges of motion, performing integrated multi-joint exercises, simultaneously exercising in all three body planes

sagittal, frontal, and horizontal, and optimally using the core muscles, creates a significant transformation of movement capabilities and improves the balance of MS patients. (Hamza, 2013). In our study, the walking speed of the two experimental groups was significantly higher compared to the control group, which was consistent with the results of Kalron et al. and Guner et al studies. (Guner & Inanici, 2015; Kalron et al., 2017). They have noted that the reduction in walking speed and stride length provides compensatory mechanisms following balance problems in the patient; So that by increasing balance following the use of unstable surfaces, it leads to improvement in walking speed and stride length of patients with MS.

CONCLUSIONS

The findings of this study have revealed that both TRX and Pilates exercise training had a significant impact in reducing fatigue and improving the quality of life and balance of MS patients. Considering the importance of balance and fatigue in MS patients and their obvious impact on the individual quality of life, accurate evaluation and appropriate treatment are necessary for it. Therefore, these complementary training protocols are recommended as a safe and cost-effective way to improve health in MS patients.

Limitations and suggestions

The limitations of the present study were the lack of control over the nutritional status and sleep patterns of the patients. Also, adjusting the level of physical activity in patients during the day can provide more accurate results regarding the effect of these types of exercise training on the investigated factors.

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Ethical consideration

This article is taken from a part of the Master's thesis on Exercise Physiology of Parisa Ghasemi, Bu Ali Sina University, Hamedan, and the research process did not create any unusual risks for the subjects. Also, before the beginning of the executive operation, the proposal of this study was approved with the code of ethics in human studies by the field of research and technology of Bo Ali Sina University under the number IR.BASU.REC.1398.008.

Declaration of interest

The authors declare that there is no conflict of interest in this study

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