Research Paper

The Effect of Six-weeks of Pilates Training With Music on Balance and the Quality of Life in Multiple Sclerosis Patients

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ABSTRACT

Purpose: Patients with multiple sclerosis face challenges associated with their physical aspects. This study evaluates the effect of six weeks of Pilates training with music on balance and the quality of life in multiple sclerosis patients.

Methods: The study's sample were 29 women with multiple sclerosis, in the age range of 20 to 30 years with a disability level 2-5 and divided into three groups. The initial test group conducted Pilates workouts for six weeks. Every workout consisted of three components, warm-up, Pilates exercise session, and cooldown. Participants in the second experimental group exercised with music, while the control group only performed their daily activities. Next, the participants underwent a post-test phase, utilizing the tool that was referenced. Analysis of covariance and Fisher least significant difference post hoc analysis were conducted to evaluate group differences and determine statistical significance ($P<0.05$).

Results: According to the statistical analysis, there were significant differences in the components of static and dynamic balance and the quality of life between the experimental and control groups. Furthermore, there was no notable distinction in the results between the Pilates workout regimen with music and without music. However, Pilates without music outperformed in all three aspects.

Conclusion: The quality of Pilates exercises was regarded as significantly necessary during the Pilates exercises program with music, and precision should be required when using music appropriately to increase effect.

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Highlights

- Pilates workouts accompanied by music significantly affect the static balance of multiple sclerosis (MS) patients.
- Pilates workouts accompanied by music significantly affect the dynamic balance of MS patients.
- Pilates workouts accompanied by music significantly affect the quality of life of MS patients.

Plain Language Summary

In multiple sclerosis, the transmission of messages sent from the nervous system is reduced or completely stopped. This issue can cause many mental and physical problems. In addition to drug therapy, the benefits of regular exercise for these patients have been well-established. In addition to Pilates exercises, music is one of the most effective tools for improving balance. This research investigated the effect of six weeks of Pilates and music exercises on the balance and quality of life of MS patients. The results demonstrated no significant difference between the Pilates exercise program with and without music in any of the variables. The quality of Pilates exercises was regarded as significantly necessary during the Pilates exercises program with music, and precision should be required when using music appropriately to increase effect.

Introduction

Multiple sclerosis (MS) is an immune system-mediated demyelinating disease, resulting in physical, cognitive, and depressive symptoms in twice as many women as men aged 20-50 years [1]. Previous studies indicated that about 11 to 15 persons in 1000 have MS. Based on the World Health Organization (WHO) studies, this ratio is 4 to 5 persons among 10000 in Iran [2].

The disease's occurrence in youth increases social and economic problems for the patient, their family, and the community [3]. These patients' weakness of limbs, fatigue, and motor disorders affect their function. In addition, 85% of MS patients experience motor problems [4]. Balance is considered to maintain optimal body posture in static and dynamic positions and is a criterion for the whole body's function. Additionally, the sensory information obtained from somatosensory (proprioception), vestibular, and visual systems affects balance maintenance [5]. The presence of dynamic balance in a person is one of the critical factors of triumphant gait, and most MS patients consider imbalance as the most challenging symptom of the disease, which is regarded as the initial cause of disorder in going and falling [6]. Around 20% of these falls may lead to newer problems such as fracture and infection, and motor restrictions in patients [7].

Furthermore, the quality of life in these patients is considered less and is influenced negatively by motor disorders and fatigue, according to previous studies [8, 9]. Mental and physical issues affect the quality of life of the person. They are considered as the factor limiting physical activity, which results in depending on person to others and an indirect increase in the severity of the disease in these people [10].

Despite the advancements in medical science in recent years, there is currently no definitive and eradicating therapy for MS disease, and most of the current therapeutic approaches result in decreasing symptoms or disease processes [11, 12]. In this regard, sports can be applied as complementary therapies, along with pharmaceutical approaches [12]. Considering the lack of definitive treatment using new medicines and their high costs and side effects, non-pharmacological approaches can be practical and accepted by patients easily [13]. Appropriate and particular exercise and physical activity for this group of patients can probably be effective in advancing their motor and cognitive capabilities. The usefulness of regular exercises for these patients was specified well [13-15]. Most of the exercise therapy studies focus on exercise in water, plyometric exercises, and aerobic and strength exercises or a combination of both while implementing various exercises, such as yoga, tai chi, and Pilates used as complementary therapy in exercise therapy, among utilizing mind and body [16].

Using the Pilates exercise method challenges the sensory, skeletal, nervous and muscular systems required for dynamic balance [17]. It helps develop trunk muscles and restore muscle balance by strengthening,

stretching, and breathing. Additionally, Pilates exercises result in increasing physical function (flexibility, muscular strength, endurance, power and cardiorespiratory fitness) and motor control (control of trunk, static and dynamic stability and beauty of movement) [18]. Limited studies were conducted on the effect of these exercises on MS patients by representing the effectiveness of Pilates exercises on physical and cognitive factors. Guclu-Gunduz et al. (2014) found that eight weeks of Pilates exercises improved the muscular strength of lower and upper limbs, mobility, and balance in MS patients in the experimental group compared to the control group [19]. Based on the results of another study, 12 weeks of Pilates significantly increases dynamic balance in female MS patients, similar to exercises in water [20]. Abasıyanık et al. showed that eight weeks of Pilates exercises were superior to the home exercise program in walking endurance, postural stability, core stability, respiratory, and cognitive functions [21]. People suffering from this disease are facing many problems that limit the patients' participation in health promotion activities and, as a result, increase secondary complications and limit their independent lives, which ultimately harms their quality of life. Physical, psychological, social, and economic dimensions of quality of life undergo many changes in chronic diseases [22].

In addition to Pilates exercises, music is one of the most effective tools for increasing concentration and attention. Listening to music can improve self-control, physical movements, movement balance, and bodily states [23]. In a study, researchers reported positive effects of music on the acquisition of balance in people with Parkinson's disease [24]. In another study, researchers investigated the effect of the focus of attention and the combination of focus and music on static and dynamic balance learning in attention deficit hyperactivity disorder (ADHD) children. They concluded that using instructions and music affects the balance performance of these children and improves their balance scores [25].

Due to limited studies in this area [19-21, 26] and considering the studies conducted on Pilates exercises, assessment of using music, and effects of these exercises on body and mind, the present study compares the effect of Pilates exercises with and without music on balance function and the quality of life in MS patients. Based on the previous studies, this question is proposed whether using music, along with Pilates exercises, can affect the amount of balance (motor skill) and quality of life in participants as a positive factor or may influence negatively or fail to affect the balance of MS patients as considerable over-load.

Materials and Methods

Data collection method

Female volunteers were invited and registered to participate in the present study by referring to the MS association in Sabzevar City, Iran. After recalling and inviting participation by the confirmation of specialist physicians, 29 female patients aged 20-50 years were selected through convenient sampling. The inclusion criteria of the present study were the expanded disability status scale (EDSS) between 2-5, which specialist physicians determined through conducting examinations related to the diagnosis of MS disease, such as magnetic resonance imaging or computed tomography scan and the functional tests related to balance, strength, gait capability, and vision and tactile testing (to the extent that patients can do exercises), age range of 20-50 years, regular menstrual cycle, absence of other diseases (heart problems, diabetes, epilepsy and other particular problems that limited the implementation of exercises), non-participation in regular sports program and consumption of almost similar medicine.

After the early registration of participants, a dating meeting was held to introduce the study's overall design, nutrition program, and pharmaceutical program, as well as to conduct cardiovascular-respiratory tests for entering the study and completing the consent form. Further, the initial anthropometric and demographic data, including age, height, weight and the percentage of subcutaneous fat, were recorded.

The patients were divided into experimental and control groups based on leg muscles' strength homogenization. Leg muscles' strength was measured using a dynamometer. Regarding the first day, tests and the exercise process were explained to the participants in each group. Further, all participants were pre-tested using a stabilimeter and dynamic balance test and they completed the quality-of-life questionnaire. Furthermore, they were homogenized based on the early strength test and randomly divided into three groups: Two experimental groups (n=10 in each group) and a control group (n=9). Then, the participants were post-tested using the mentioned tool after six weeks.

Measurement of demographic data and disability index

The height and weight of participants were determined by using a tape measure (Komelon [South Korea] Company with 1/16th of an inch or 1-mm sensitivity) on the

wall and a digital scale (Etekcity [China] Company with 0.1 pounds (~0.05 kg) sensitivity), respectively.

Body composition

The body fat percentage and waist-to-hip ratio related to participants were measured using a body composition analyzer (In Body 3.0, South Korea). To this end, all participants were asked to refer to the laboratory of physical education in the university as overnight fasting. After turning the device on, the participants were requested to drain the bladder using wipes to humidify their feet and foothold on the device. Then, they should go on a foothold, take handles, and keep them until the charts of the device end after entering the required data by the tester. Finally, the obtained data were printed and used [27].

Expanded disability status scale

EDSS measures the severity of physical, neurological, and muscular disability in MS patients. The scores of the scale range from 0 to 10, in which 0 and 10 represent the lack of physical disorder in the field of systems function and very severe disability, respectively [28]. The patients with the maximum score of five were selected in the present study.

Static balance

Static balance was assessed using a stabilimeter (Iranian Danesh Salar Company). This device measures and analyzes body oscillations indirectly based on the reaction of static level to the forces caused by changing the center of gravity in person. The data related to body movement are used in different parameters two-dimensionally during standing with open and closed eyes as instantaneously and visually. This instrument's minimum acceptable reliability and validity is 0.70, and its maximum acceptable reliability is 0.90 [29]. Regarding the method of measuring static and dynamic balance, the prerequisites for testing, including calibrating the device and providing required explanations about the overall testing process to each participant, were conducted after turning on the stabilimeter. Then, each patient went on the device for 30 s with his dominant leg as bare leg and looked at a specific point mounted on the wall by considering his height. Since each head movement displaces the center of gravity, a specific point is considered to prevent his eye movements from affecting his surroundings [30]. The mean of rate changes in the body movement of participants obtained by averaging diversion in four directions was used in the present study.

Balance test of timed up and go

Dynamic balance was evaluated using timed up and go (TUG). Considering the test's method, the participant should get up from a seat and handle-less without using his hands, return, and sit on their seat after crossing an eight-foot path (2.44 m). Regarding the present study, the participants were asked to do this activity with more speed and skill without running, and finally, overall time was recorded as their score. Due to the unfamiliarity of participants with the method of performing the test, they trained the test three times before recording the tests. Then, each of them conducted the test thrice and the meantime (s) were recorded as their score [31].

The dynamometer (HBM test and measurement [Hottinger Brüel & Kjaer GmbH], Germany) was applied for assessing to assess the strength of leg muscles and early homogenization of groups [32].

Music

Classical instrumental music with moderate intensity, confirmed by the Pilates association, was used in the present exercise program. These types of music give extraordinary relaxation to the athlete during the exercise and cause the pressure on the heart to decrease during the exercise. Also, the one engaged in Pilates eliminates all the mental preoccupations and turns this exercise into a meditation.

Quality of life

The quality of life was assessed by using a standard questionnaire containing 36 questions in the eight scales of public health (n=5), physical function (n=10), emotional health (n=5), physical pain (n=2), energy and happiness (n=4), social function (n=2), and the role of physical and mental health in limiting activities (4 and 3 questions, respectively). Regarding the calculation of responding to the questionnaire questions, the responses were first scored from 1 to 5 based on the Likert scale, where scores 1 and 5 represent the terrible and great status of participants, respectively. Then, the scores were converted into eight components ranging between 0 to 100. Finally, the mean sum of cases was calculated as the score of the intended scale regarding the quality of life, and the higher scores indicate a better quality of life [33].

Exercise program

The exercise program was implemented for six weeks under the supervision of an exercise physiologist and 60-

min sessions were held each week. The first experimental group performed Pilates exercises for six weeks. each week, three 60-min sessions were conducted under the supervision of a Pilates instructor in the morning. each exercise session was divided into three parts: Warming up (10-15 min), doing Pilates exercises (35-40 min) and cooling down (10 min) (Table 1). The exercise were started by simple movements and then their intensity and complexity increased and then their intensity and complexity increased.

Further, the range of stretching, time and repetition of movements gradually increased with the participants' progress and new exercises were added to each session compared to the previous session. The speed of progressing exercises related to all participants was at the same level. Further, they were recommended to do exercises as long as they did not feel pain and discomfort. The training intensity was determined using the Borg scale, in the first sessions between 4-5, in the next sessions 6-7 and in the last sessions 8-9. Furthermore, exercises were conducted in the sleeping position first, then sitting and standing [31]. Most exercises focused on the downer limb, and a 30-s rest period with inhaling and exhaling between movements was considered (Table 1). The second experimental group implemented these exercises with the music confirmed by the Pilates association. Finally, the patients in the control group only did their daily activities during the exercise course. Table 1 represents an example of a session of the Pilates exercise program.

Statistical analysis

Descriptive statistics were used to summarize collected information and recognize the community more so that the data could be analyzed. Further, statistical hypotheses were tested using inferential statistics, and data distribution was estimated to be normal based on Kolmogorov-Smirnov and the Levene tests. Analysis of covariance and Fisher least significant difference post hoc test were used to compare groups and specify their difference. The calculations were conducted using the SPSS software, version 22 and the significance level was $P<0.05$.

Results

The Kolmogorov-Smirnov test showed normal data distribution ($P>0.05$). Demographic and clinical characteristics of the participants are shown in Table 2. Meanwhile, Table 3 provides the Mean±SD of the pre-test and post-test findings in experimental and control groups. The static and dynamic balance measurement was based on deviation and time, respectively.

As shown in Table 4, a significant difference is observed between the groups in the post-test based on the results of the analysis of covariance ($P=0.02$) in static balance. Considering this significant difference, the least significant difference post hoc test and the paired comparison of groups, the control group significantly differed from Pilates exercise with ($P=0.004$) and without music groups ($P=0.008$). In contrast, no significant difference was observed between Pilates with ($P=0.421$) and without music groups, although the pilates group's mean scores were higher than the control group.

Table 1. An example regarding a session of the Pilates exercise program

Exercise Type	Warming Up	Static Stretching Movements	Strengthening Movements on Leg Muscles	Balancing Movement	Sitting Movements	Cool Down
Explanations	Raising leg in standing position with toe-point and flexing leg, rotating leg, circumduction leg	Side stretching, upper trunk rotation, adding a leg to trunk movement and raising leg from the side (abduction), balancing movements, elevating hands to shoulder level, raising a leg, small oscillations from side	Squat hand movement to the sides, Squat movements bilateral, squat movements with elevating hands	- Different T-balancing movement, first with the flexed leg at 90o to the back (T-balance)- Smoothing leg back (full T-balance), positioning in balance status, opening and flexing leg back	Different Tizear movement	Using stretching movements, such as upper trunk stretching, resecting, rotating spine in a sitting position, mermaid stretching movement
Exercise time	10 min	10 min	10 min	10 min	10 min	10 min
Number of repetitions of exercise	6-10	6-10	6-10	6-10	6-10	6-10

Table 2. Demographic and clinical characteristics of the participants' variables

Demographic Variables	Mean±SD		
	Pilates With Music Group (n=10)	Pilates Without Music Group (n=10)	Control Group (n=9)
Age (y)	39.53±7.51	39.6±6.83	38.6±6.71
Body mass index (BMI)	23.86±5.44	24.25±5.55	24.13±4.63
Weight (kg)	60.8±13.3	60.9±12.1	59.7±11
Height (cm)	162.34±9.74	159.60±5.35	155.60±4.19
Illness duration (y)	6.8±0.1	6.2±1.1	6.6±1.4
EDSS	3.1±0.5	3.2±0.1	3.8±1.1

EDSS: Expanded disability status scale; SD: Standard deviation.

PHYSICAL TREATMENTS

Table 3. Descriptive statistics related to pre-test and post-test in experimental and control groups

Groups	No.	Mean±SD					
		Dynamic Balance		Static Balance		Quality of Life	
		Pre-test	Post-test	Pre-test	Post-test	Pre-test	Post-test
Pilates	10	8.02±0.2	5.94±0.32	4.54±0.47	2.15±0.31	90±5.14	96.40±4.52
Pilates with music	10	10.23±0.61	8.11±0.45	6.14±0.96	3.44±0.6	90.40±3.56	95.70±4.73
Control	9	9.31±0.58	8.31±0.38	6.16±1.95	4.99±0.85	86.55±4.71	90.11±3.29

PHYSICAL TREATMENTS

Table 4. Summary of the results of analysis of covariance related to the assessment of variables in post-test regarding the study groups

Resources		df	Means Square	F	P
Static balance	Pre-test	1	4.63	1.33	0.05*
	Group	2	15.88	4.37	0.02*
Dynamic balance)	Pre-test	1	12.04	11.32	0.02*
	Group	2	6.93	6.55	0.005*
Quality of life	Pre-test	1	286.12	38.19	0.0001*
	Group	2	31.30	4.17	0.02*

Notes: *P≤0.05.

PHYSICAL TREATMENTS

Based on the results in Table 4, the groups are significantly different in post-test (P=0.005) in dynamic balance. A statistically significant difference was observed between the control group and Pilates exercise with (P=0.023) and without music (P=0.001) by considering this significant difference, LSD post hoc test and the paired comparison of groups. At the same time, there was no significant difference between Pilates exercises without and with music groups (P=0.347), although the mean scores of the Pilates group were better than the control group.

Furthermore, according to Table 4, a significant difference in quality of life is observed between the groups in the post-test (P=0.02). Considering the significant difference between the least significant difference post hoc test and the paired comparison of groups, the control group significantly differs from Pilates exercise with (P=0.04) and without music groups (P=0.009). Ad-

ditionally, no significant difference was observed between Pilates without and with music groups (P=0.42), although the mean scores of the Pilates group were better than the control group.

Discussion

Based on the results of the present study, a Pilates exercise course without music improves static and dynamic balance and the quality of life in MS patients significantly. The findings of the balance test in the present study align with those of some other studies [19-21, 26, 34, 35], while they are inconsistent with those of DeBolt et al. [36]. Considering the significant relationship between balance and the strength of upper and lower trunk muscles, [13] an increase in the general strength of these muscles resulted in enhancing physical mobility and balance. In addition, DeBolt et al.'s results were inconsistent due to their exercise program's features, intensity and nature [36]. They focused on increasing the strength of downer trunk muscles [36], while the study of Filipi et al. (2010) and the present study highlighted improving the general muscular strength in exercise programs, leading to the enhancement of motor function [34]. Since Pilates exercises can increase strength, they are considered an influential factor in improving postural stability by enhancing the strength of lower limb muscles and core stability [37]. Since progressive strengthening exercises improve joint position sense in injured joints by increasing the sensitivity of muscle spindles and over-load, applied in the present study's exercise sessions, the participants' balance increased and progressed significantly compared to the control group. Considering the dependency of downer limbs on their upper limbs and the importance of balance in MS patients, Pilates exercises can effectively increase the strength of leg muscles and downer limbs, especially extensor and flexor muscles [37].

Based on the present study's findings, Pilates exercises with music significantly affect the static and dynamic balance of MS patients, which aligns with those of some studies. de Dreu et al. (2012) found that exercise therapy with music improves motor balance and gait capability in Parkinson's patients, which can be achieved following the coordination between patient movement with the rhythm of music and the enjoyable nature of therapy [38]. Atigh et al. (2013) mentioned that the presence of music significantly influences the cooperation and motivation for implementing motor movements and accelerates improving the implementation of balance skills [39]. Considering the effect of Pilates exercises and music on the balance of participants and the consistency between the present study and those conducted by de Dreu et al. (2012) [38] and Atigh et al. (2013) [39], the participants of the present study utilized these benefits compared to the control group and no descriptive effect was observed in their function, regardless of the type of participants.

In another study, researchers investigated the effect of the focus of attention and the combination of the focus of attention and music on learning the static and dynamic balance of ADHD children. They concluded that using instructions and music affects the balance of these children and improves grades [40]. The research mentioned in the field of the effect of music on balance is also in line with the findings of this research, regardless of the type of subject. Although the positive effects of music on balance on other subjects have been mentioned in past research [38, 41], considering that in this research, no control group only listens to music, it cannot be acknowledged that the effect is caused by playing music or in the case of He commented on the effect created by the music.

Since both experimental groups' static and dynamic balances improved with no significant difference, both exercise approaches can increase these balances. However, the effect of exercise type on increasing the scores related to the static and dynamic balance test of participants is more remarkable when considering the superiority of their mean in the pilates without music group compared to those of Pilates with music group. Most of the improvement observed in both groups was caused by performing a Pilates exercise program, and their difference can represent that playing music simultaneously with these exercises may attract participant attention to music and reduce their scores. Accordingly, using music can lead to less change in the amount of balance among MS patients.

Based on the results of the present study, Pilates exercises with and without music led to a significant decrease in the degree of physical disability and its improvement in patients, which is inconsistent with the findings of White et al. [42] and consistent with those of Ciampi et al. and Grazioli et al. [12, 43]. The different types of MS disease, history of disease, and type of exercise are regarded as the reason for the ineffectiveness of exercises in the study conducted by White et al. Clinical pieces of evidence indicated that controlling and improving the symptoms of MS is challenging in its three types among four types instead of relapsing-remitting MS [12].

The results of the present study showed that Pilates exercises enhanced the quality of life, which aligns with many studies [44-48], although only aerobic exercises

were conducted in most of these studies. Based on previous studies, the quality of life in MS patients increased due to the effect of exercises on their motor and neural-psychological systems [46, 49]. Considering the present study's findings, physical pain and physical and mental restriction in acting decreased after six- weeks of Pilates exercises, which was associated with increasing patients' mental and physical health. Thus, it is probably regarded as a reason for enhancing the quality of life in the present study. The results of the present study are not in line with those obtained by Newman et al. (2007) and Rampello et al. (2007) [4, 50] due to the difference in the type, intensity, and session number of exercise.

Regular participation in the present study's exercise program can be considered one of the possible mechanisms for improving the quality of life in these patients. Despite the contradiction between MS disease and the physical and mental health status of MS patients, regular sports activities can result in increasing health levels in both physical and mental fields based on previous studies in this regard [44, 51]. Additionally, if a person is sedentary, they can apply less energy to the activities, and consequently, his muscular mass and function decrease; these factors can play an essential role in decreasing the quality of life in patients [52]. However, inactivity due to the fear of falling endangers muscle function, movement capability, and physical preparedness in most individuals [53], leading to their sedentary lifestyle. These factors enhance the increasing risk of diseases such as heart problems, osteoporosis, obesity and diabetes in these patients and consequently are regarded as factors for decreasing their quality of life [54]. Sports exercises can positively affect the quality of life in MS patients by setting the amount of neurotransmitters in neurons and consequently balancing and homogenizing the neural function of a person and reducing mental abnormalities [55].

Further, they lead to compatibilities in the brain and spinal cord and, thus, an increase in the recall capability of motor units. A person can do movements better by enhancing the recall of motor units by the brain [56]. Finally, improving the balance can be regarded as one possible reason for enhancing the present study's quality of life. Thus, improving balance and balancing exercises enhances the quality of life in these patients based on previous studies [57, 58].

Conclusion

Considering the significant effectiveness of Pilates exercises with and without music on the balance and quality of life of MS patients and considering that no significant difference was observed in the comparison of the two exercise groups, it can be said that the use of both types of exercise is suggested. Also, considering the superiority of scores in the Pilates group without music, it seems that, if possible, in sports clubs, including Pilates clubs, along with exercise, the quality is desirable for people with MS who have no experience in participating in these exercises. Consider training sessions more than using music. It is suggested that in future studies, the effect of these exercises on other movement factors of patients with MS should be measured, and if possible, larger samples and a narrower age range should be used to make the results more generalizable.

Ethical Considerations

Compliance with ethical guidelines

The present study was approved and recorded by the Ethics Committee of Sabzevar branch, Islamic Azad University, Sabzevar, Iran (Code: IR.IAU.S.REC.1398.001). The informed consent form was completed in the present study. The study's objective was explained to the participants completely and they were assured of the confidentiality of the data.

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Authors' contributions

Conceptualization, supervision and writing the original Draft: Zahra Estiri and Mohammad Reza Shahabi Kaseb; Methodology, statistics analysis and funding: Zahra Estiri and Mitra Khademosharie; Investigation and data collection: Maryam Sadat Salehi Kalateh Sadat; review and editing: All authors

Conflict of interest

The authors declared no conflict of interest.

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