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Effect of Three Types Exercise on Equilibrium in Persons with Parkinson's Disease

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Abstract: The aim of the present study was to investigate and compare the influence of three exercising methods (rhythmic, medicine ball and stretching-supplying exercises) on the equilibrium of Parkinson's patients. In this study, 50 male Parkinson's patients with the mean age of 61.2±3.4 and middle disease intensity (the third H&Y scale) were selected and were randomly divided to four groups with alternative: rhythmic exercising group (N=11), medicine ball exercising group (N=12), stretching-supplying exercising group (N=12) and control group (N=15). Then, the exercising groups performed their special exercising programs for 10 weeks, three sessions per week, while the control group did not participate in any regular exercising program. All the patients took their medications under their specialists' supervision during the study. To measure the balance, Berg Balance Scaling (BBS) was used and dependent t-test and one-way ANOVA test along with LSD post hoc test were applied for within-group and between group measurements, respectively. The results of this study showed that the three different exercising programs significantly influenced the patients' equilibrium; but, the effectiveness of each was different. This study revealed that rhythmic exercises have more effect than other two exercising programs (medicine ball exercises P=0.030, stretching-supplying exercises, P=0.008) on the equilibrium improvement of the Parkinson's patients. The effectiveness of these two methods on the equilibrium of Parkinson's patients was almost identical (P=0.530). Therefore, based on the findings of this investigation, it can be said that doing physical activities like rhythmic exercising, medicine ball exercising and stretching-supplying exercises can improve the equilibrium in Parkinson's patients. In this regard, rhythmic exercising was more effective than other two exercise types. Thus, it seems that it is more appropriate to perform rhythmic exercises as a method of movement therapy (besides drug therapy) for rehabilitating Parkinson's patients.

Key words: Parkinson's disease · Equilibrium · Rhythmic exercises · Medicine ball exercises · Stretching · Supplying exercises

INTRODUCTION

Parkinson's disease is one of the most common destructive diseases of central nervous system which is accompanied by the gradual destruction of nigrostriatal nerve cells. About 10 million elderly are suffering from this disease worldwide and, by 2020, with the increase in the number of elderly population, it is expected that 40 million people will suffer from this progressive neurological condition. This disease is considered as the second most common devastative neurological disease after Alzheimer's [1, 2]. The neurological characteristic of this disease is the destruction of dopaminergic neurons which exist in the dark matter in the midbrain; however, its clinical symptoms are usually revealed after the destruction of 80% of dopaminergic neurons in the dark matter [2, 3]. These neural cells secrete a matter called dopamine. When the dopamine-secreting cells die in the brain, other controlling centers of body movements work irregularly and this disorder in the body control centers

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create Parkinson's symptoms [4, 5]. The symptoms of the Parkinson's are mild in the initial stages and can only be observed on one side of the body and, in some cases, they do not even require treatment. One of the most common symptoms of Parkinson's is the tremor in body organs while resting; however, some of the patients never face such a problem. This tremor can negatively affect the patient's mood more than any other physical limitation. Bradykinesia, instability, stiffness and tremor are of the initial symptoms of this disease [3, 6-8]. Therefore, the aim of treatment is not to eliminate symptoms but to control its side effects. This can help the patients act independently and control the Parkinson's disease in a proper manner. This disease is not eliminated but controlling its side effects can prevent from the patients' disability to most extent. Research has shown that regular exercises can prevent from the occurrence of orthopedic problems related to the initial symptoms of this disease and performing movement therapy can be facilitative in this regard [5, 7, 9-12]. The aim of movement therapy for Parkinson's patients is to relearn the natural movements so that the patients can do most of the movements consciously, similar to the pre-disease period. Many of the conducted studies have investigated the effect of physical activity on the Parkinson's patients. For instance, Pacchetti and *et al.* (2000) showed that three months of music therapy had a significant effect on the improvement of abnormally slow movements of Parkinson's diseases [12].

Baatile and *et al.* (2000) investigated the effect of exercising on the life quality of Parkinson's diseases and demonstrated that 8 weeks of exercising can lead to the functional independence and life quality increase in the Parkinson's patients [9]. Hirch *et al.* (2003,2007,2009) indicated that strength and equilibrium can be increased in the Parkinson's diseases by exercising [11, 13-16]. After 12 weeks of strength training, Dibble *et al.* (2006) concluded that this training program can lead to hypertrophy of quadriceps muscles and increase of strength and movement ability in Parkinson's patients [2, 10, 17-19]. Skidmore *et al.* (2008) investigated the safety and ease of aerobic training on treadmill in Parkinson's patients. These researchers found that treadmill training was safe for this group of patients and could be easily done [20]. Moreover, studies by Bahram Yousefi *et al.* (2009) showed that 10 weeks of physical activities can lead to the improvement in the performance of daily activities in Parkinson's patients[21]. Therefore, these pieces of evidence show that movement therapy, occupational therapy and physiotherapy are effective methods for treating the Parkinson's disease [11, 22]. Investigations have shown that Parkinson' patients die as a result of motor poverty and lack of physical movement. It seems that, in such a condition, Parkinson's patients need regular and correct physical activities along with medications for decreasing the abnormality in their equilibrium and preventing from the development of diseases in order to improve their life quality.

Therefore, considering different effects of various physical activities on the improvement of Parkinson's diseases, the objective of this study was to investigate and compare the possible effects of three rhythmic exercising, medicine ball exercising and stretching-supplying exercising methods on the equilibrium of Parkinson's patients.

MATERIALS AND METHODS

Subjects: After the research call in Kashan and Aran and Bidgol cities, 50 patients with the average age of 61.2±3.4 years, 175.62±7.11 centimeters of height and 82.82±7.78 kilograms of body mass were selected from among the male Parkinson's patients who voluntarily participated in the study. These patients were chosen after eliminating the patients who were in the Parkinsonism syndrome group and those who had secondary complications, like cardiovascular diseases and so on, under the supervision of the specialist. They were randomly divided to four groups of rhythmic exercising (N=11), medicine ball exercising (N=12), stretching-supplying exercising (N=12) and control (N=15) groups with alternative. The reason of the diseases of these patients was unknown and the intensity of their disease was between 2 and 3 H&Y scales (Hoehn and Yahr Scales). Disease symptoms were evident on both sides of the body and difficulty in standing was the characteristic of these patients. It should be mentioned that these patients could independently do their daily activities. According to the neurology specialist, all the participants in this study took identical medications like Sinmit pills, Selegiline tablets, Amantadine capsules and Artan pills at similar dosage during the training period. The physical specifications of the participants of the four groups are shown in Table 1.

Physiological Measurement: A tape and digital scale were used for measuring the participants' height and weight, respectively. Body mass index was calculated by putting the figures related to height and weight in the equation (square of height in m + weight in kg). To measure equilibrium, Berg Balance Scale with 12 sections

Table 1: General specifications of the participants (mean±standard deviation)

		Indicator						
Dependent variable	Number	Mean of participants'age	Mean of disease duration	Disease intensity	Pre-test mean of equilibrium	Pre-test standard deviation	Post-test mean of equilibrium	Post-test standard deviation
Rhythmic	11	60.27	3.1	3	42.73	5.49	51.53	4.92
Medicine ball	12	61.45	3.2	3	44.20	6.05	47.33	5.66
Stretching-supplying	12	61.7	3.4	3	43.73	5.41	46.13	5.23
Control	15	60.86	3.2	3	43.87	5.28	43.11	6.12

was used. The validity of each section of Berg Balance Scale and the validity of between sections were 0.98 and 0.99, respectively. Also, its internal consistency using the Cronbach's alpha was reported as 0.96 [23, 24].

Exercising Programs: In this research, the exercising groups performed their special exercising programs for 10 weeks, three sessions per week. The exercising program of the stretching-supplying exercising group included 15 min warm-up by slow walking; then, static stretching movements which were taken from the Canada Parkinson Society were conducted for 10 min in total in the first session; every two sessions, 1 min was added to the stretching-supplying exercises in a step-like fashion by increasing the number of stretching movement sets in order to increase the time of stretching-supplying movement program to 30 min in total in the 10th week; at the end of each exercising session, the cool-down was performed for 15 min by soft walking.

The exercising program of medicine ball exercising group included 15 min warm-up by slow walking and medicine ball exercising for 10 min in the first session which increased to 30 min in the 10th week by adding 1 min of medicine ball exercising in a step-like fashion every two sessions. At the end of each exercising session, 15 min soft walking was performed as the cool-down. The rhythmic program also included 15 min warm-up by slow walking; then, the simple and slow rhythmic exercising program was performed for 10 min in the first session and it was increased to 30 min in total in the 10th week by adding a min rhythmic exercising in a step-like fashion every two sessions. At the end of each session, the cool-down was done for 15 min by soft walking. Rhythmic exercises mean rhythmical movements of hands and fe*et al*ong with soft rhythm and music, after which patients feel fresh.

It should be mentioned that one-hour exercising after taking medication was performed as a group by the participants of each group.

Statistical Methods: Statistical analysis of the data was performed for each group using the means and standard deviations. Then, the Kolmogorov-Smirnov test was used to ensure that the data were normally distributed. Dependent Student's t test was used for investigating within-group differences. Also, one-way analysis of variance (ANOVA) was applied for investigating between-group differences; in case statistically significant differences were observed, LSD post hoc test was used for locating the between-group differences. The statistical calculations of the research were conducted by SPSS software, version 15 and the significance level was considered as $\alpha<0.05$.

RESULTS

The results obtained from the Kolmogorov-Smirnov test showed that all the data were normally distributed. The results of the one-way analysis of variance (ANOVA) did not show a significant between-group difference in height, weight and equilibrium scores between the groups at the pre test stage (P>0.05).The obtained results demonstrated that equilibrium scores of the rhythmic exercising, medicine ball exercising and stretching-supplying exercising groups statistically increased after 10 weeks of exercising compared with the pre-test stage (before doing the exercises) by 20.59%, 7.08% and 5.04%, respectively; {the equilibrium of the rhythmic exercising group (P= 0.003), medicine ball exercising group (P= 0.004) and stretching-supplying exercise group (P=0.004)} which the equilibrium scores of the control group did not show any significant within-group differences at the time of research (P= 0.43) (Table 2). Moreover, The results of one-way analysis of variance demonstrated significant differences in the equilibrium scores of all the groups in the post-test stage (P= 0.001) and the results of the LSD post hoc test showed significant differences between the equilibrium scores of the rhythmic exercising group, medicine ball exercising, stretching-supplying exercise and control groups (P< 0.05). Furthermore, there was a

Table 2 : Comparison of the pre-test and post-test means of equilibrium in the four groups

Dependent variable		Statistical indicator				
		Sum of squares	Degree of freedom	Mean of squares	F	Significance level
Pre-test mean	Between groups	44.067	3	14.689	0.477	0.700
	Within groups	1726.267	56	30.826		
	Total	1770.333	59			
Post-test mean	Between groups	241.1	2	120.60	4.399	0.001
	Within groups	1172.8	42	27.92		
	Total	1414	42			

Table 3: LSD test for locating the difference between the post-tests of the groups

Dependent variable	Independent variable		Standard error	Mean differences	Significance level
Mean of equilibrium post-test	Rhythmic	Medicine ball	1.930	4.2	0.030
		Stretching-supplying	1.930	5.4	0.008
	Medicine ball	Stretching-supplying	1.930	1.2	0.530

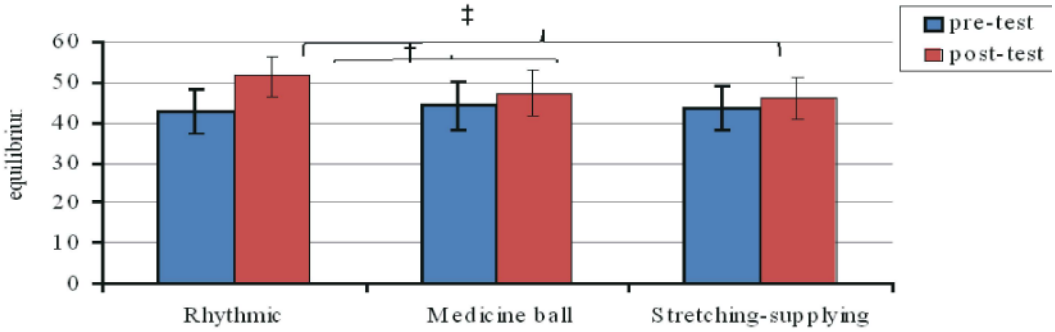

Fig. 3: Comparing the equilibrium means of patients (pre-test and post-test)
†Denote significant differences between Rhytmic group with Medicine ball group
‡ Denote significant differences between Rhytmic group with Stretching-supplying group

significant difference between rhythmic and medicine ball exercising groups (P=0.03) and stretching-supplying exercising group (P=0.008) ((0.03) in a way that equilibrium scores in the rhythmic group, medicine ball exercising and stretching-supplying exercising groups in the post-test were 7%, 9.07% and 19.53% more than those of the control group. At the same time, no significant difference was observed between the equilibrium scores of the medicine ball exercising and stretching-supplying exercising groups (P= 0.53).

DISCUSSION

Most of studies have suggested movement therapy and exercising for Parkinson's patients [12]. Car and Shepherd demonstrated that movement therapy and exercising along with drug therapy are essential and necessary for the patients [3, 6-8]. Some studies have shown that exercising programs can increase the levels of dopamine and metabolism in Parkinson's patients, which leads to their lack of dependence on others. Investigations have revealed that physical training influences the mortality rate caused by this disease through preventing from body weakness. In addition, increase of the movement domain, increase of strength and improvement of life quality as a result of doing physical exercises have been proved in most studies [11, 13-16].

In this regard, research findings have shown that performing three methods of rhythmic exercising, medicine ball exercising and stretching-supplying exercises for 10 weeks has a significant effect on the equilibrium of Parkinson's patients. It seems that one of the reasons for the possible equilibrium improvement in the patients is the involvement of more muscle cords and increase of muscular strength and endurance as a result of exercising. One of the effective methods for the changes or adjustments is the adjustment of dopamine secretion and improvement of acetylcholine activity during and after exercising. The findings of the studies showed that running on the treadmill maintained the level of brain dopamine and improved their movement functions.

Also, the findings of these researchers showed that when the exercising activities stopped, the dopamine level decreased and Parkinson's symptoms were intensified [3, 20]. In fact, endurance improvement and, to some extent, muscular strength of the patients, as a result of three selected exercising methods, were the possible causes of the improvement in their equilibrium. In general, exercising leads to the deployment of attention and concentration. Performing movements, like stretching-supplying movements and medicine ball exercising, require less attention and nerve-muscle coordination while performing rhythmic movements requires more nerve-muscle coordination.

The findings of the present research showed that the equilibrium of the patients in the rhythmic group compared with the medicine ball exercising and stretching-supplying exercising groups improved by 8.87% and 11.7%, respectively. The conducted investigations in this regard have stated that one of the reasons for the creation of Parkinson's disease is the decrease of dopamine and abnormal activity of acetylcholine. Therefore, this disorder weakens the nerve-muscle coordination and creates abnormalities in the equilibrium of Parkinson's patients [3, 6-8]. In fact, doing rhythmic movements is a practice for reinforcing attention and concentration and improvement of nerve-muscle coordination. Additionally, the music along with exercises can increase the attention of most people and, to some extent, distract them from fatigue; as a result, these findings were in line with the results of Pacchetti and Skidmore [12, 20].

Other findings of this research included the almost equal effectiveness of the two medicine ball and stretching-supplying exercising methods on the equilibrium of the patients. One of the possible reasons for the effectiveness of stretching-supplying exercises on the equilibrium of patients is that these exercises prevent from the excessive contraction of the soft tissues around the joints and stop their flexibility. Also, these exercises increase the patients' endurance and lead to their general welfare. Additionally, stretching exercises support ligament and muscle strain and prevent from postural abnormalities. As far as equilibrium improvement is concerned in this group, the type of selected stretching exercises can be pointed out. In this research, static stretching exercises were used. The superiority of this type of stretching exercises over dynamic ones can be mentioned as follows: there is lower risk of muscle threatening in static stretching because of the restrictions on the excessive stretch of involved joints and more control. Most researchers believe that dynamic stretching causes muscle soreness, especially in non-athletes, while static stretching is not like this. A group of researchers believe that less energy is required in static stretching. Also, if stretching is sufficiently maintained in a static manner, it can create muscle relaxation after exciting Golgi tendon organs [8,14,16]. Thus, considering these reasons, the effectiveness of these types of exercises on the patients is justifiable. Moreover, this research showed that, similar to other exercising methods, medicine ball exercising had significant effect on the equilibrium of the patients. The possible reasons for this kind of results can be attributed to the involvement of more muscles, increase of endurance and strength and improvement of flexibility in the patties' joints which lead to the improvement of equilibrium. Therefore, the results of this study were in line with the findings of Baatile *et al* (2000), Hirsch *et al* and Dibble *et al* [2, 9-11, 13-19].

CONCLUSION

In general, the findings of this study showed that all of the three selected exercising methods improved the equilibrium of Parkinson's patients. The only difference was that the effect of rhythmic exercising on the equilibrium was more than those of other two methods. Therefore, these exercising methods, with a special emphasis on rhythmic exercising, can be used for better improvement of the equilibrium of patients along with drug therapy. Here, the medium intensity of the diseases of the participants should be pointed out which was the main limitation of this study; this implies that the findings can only be generalized to this type of patients. More studies are required for the Parkinson's patients with more intensive diseases since these patients have more difficulties in maintaining their equilibrium.

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