A Comparison of 12 Weeks of Pilates and Aquatic Training on the Dynamic Balance of Women with Mulitple Sclerosis

Sayyed Mohammad Marandi, Vahid Shayegan Nejad, Zohreh Shanazari, Vahid Zolaktaf

Department of Neurology, Isfahan University of Medical Sciences, Isfahan, Iran

Correspondence to:
Dr. Sayyed Mohammad Marandi,
Department of Exercise Physiology,
University of Isfahan, Isfahan, Iran.
E-mail: s.m.marandi@spr.ui.ac.ir

Date of Submission: Jun 10, 2012

Date of Acceptance: Sep 09, 2012

How to cite this article: Marandi SM, Nejad VS, Shanazari Z, Zolaktaf V. A comparison of 12 weeks of pilates and aquatic training on the dynamic balance of women with mulitple sclerosis. Int J Prev Med 2013;4 (Suppl 1):S110-17.

Original Article

ABSTRACT

Background: Multiple Sclerosis (MS) is a disabling chronic disease of the nervous system in which the myelin system of the central nervous system is deteriorated. The objective of this study is to understand the effect of Pilates exercises and aquatic training for a 12 week period on the dynamic balance of MS patients.

Methods: The research method is semi-experimental. As a result, among the female patients visiting the MS clinic of Kashani hospital in Esfahan, 57 patients with disease intensity levels between 0 and 4.5 were taken as samples. The average length of the disease was 8 ± 2 years, 20;40 years old, and they were randomly divided into three groups of Pilates exercise group, aquatic training group, and the control group. The exercise schedule for the experiment groups consisted of 12 weeks, three sessions per week, and 1 hour for each session. The dynamic balance of the patients, before and after the exercises was measured by Six Spot Step Test.

Results: The adjusted mean differences of Timed Up and Go Test (TUGT) scores of the experimental groups are significantly different ($P<0.05$). Therefore, it can be said that Pilates exercise interventions and aquatic training can significantly increase the dynamic balance of the examinees in the post-experiment stage.

Conclusions: Performing the Pilate exercises and aquatic training increases dynamic balance of the MS patients. Considering the role of dynamic balance on physical fitness and enabling the person in doing is daily chores and routines, and its direct effect on the quality of life, it leads the specialists in applying these exercises as a supplementary treatment along with the medicinal treatments for MS patients.

Keywords: Aquatic training, dynamic balance, multiple sclerosis, pilates

INTRODUCTION

Multiple sclerosis (MS) is one of the most common neural diseases that mostly happen in young adults and more commonly in women. The main pathology of the disease is the existence of some demineralization areas (CNS) that causes a physical performance disorder. Clinically speaking, the CNS stricken areas appear gradually. The disease initially starts with some vision

problems like dimness, body balancing problem, stinging, and numbness in various organs. It then develops through its natural course as recurring, recovered, and primary and secondary progressive stages. If the brain stem gets involved, it will have some symptoms like dizziness, hearing problems, sensation disorder in the V nerve path and moving in the direction of VII nerve.[1]

MS can cause some damages to the protective cover of the axons nerve. Although, it is possible that some of the damage to the myelin protective layer be recovered but any kind of damage to the axon nerve will be permanent and irrecoverable. If the brain cannot neutralize the damage to the nervous path, the physical activity under the control of that nerve may permanently be lost.[2]

The unharmed nerve path with healthy myelin cover, transfers the neural signal in the specific path quickly and without any energy waste, but a nerve with deteriorated myelin cover, this neural signal is transported with delay, energy waste, and out of the intended path. This will cause problems in harmonic, quick, coordinated movements of the person's body.[3]

The balance or positional stability is the ability to maintain a state and showing reaction to a permanent force. Many of our body's physical characteristics allow us to show reactions.[4] In all forms of standing, sitting, and lying down, having balance is essential for doing coordinated moves. To maintain the balance for a good body performance, many parts of the brain areas are needed to cooperate with each other. Cerebellum is the main center for controlling balance, eyes, ears and all the nerves that go through hands and legs are also important for keeping a balance. Any problems in any of these areas can create some disorder in body's balance.[3]

Having balance is a sample reactive movement that is dependent on the integrity of the receptive stimuli from the sight senses and movement systems.[5]

Balance is also referred to as the ability of the body for combining the visual data with the data from the semi-circle channels inside the internal ear and the data from the muscular receptors.[6] Our visual sense reports to us in what status our body is. The sensing-moving data from our internal body receptors tell us in what position our body limbs and body parts are with respect to each other.[5] In fact, body balance relates to vestibular, coordination intact visual.[7]

Weak balance and frequent fallings cause patients to develop a fear of falling down and eventually will affect the quality of the patient's life. These disorders will lead to an increase in the patient's dependency on others for doing their daily routines, and reducing their social relationships and loss of confidence for being able to do their daily chores.[8]

Balance disorders in MS patients are very common and restrain them from doing exercise activities. The balance reduction in MS patients is due to a weak judgment and power reduction and control of movements. The bone fracturing danger due to falling downs is 2 to 3.5 times more common in MS patients than in healthy people.[7]

There are many ways for controlling the problems caused by balance disorders. Aiding equipment, doing exercises in water, or doing exercises in sitting position instead of standing are among examples for effective solutions that can be useful. Since there are many factors involved in adjusting the body balance, it is important to notice that almost all exercise activities have high positive effect on maintaining the body balance.[2]

Arian and colleagues[8] conducted a study on the body balancing in MS patients using clinical-practical experiments. In this study, 40 patients with MS from the MS society of Khoozestaan province (south west of Iran) and 40 healthy patients, as the control group, were evaluated and compared. The results of this study showed that the MS patients are weaker in all the balance tests than the patients in the control group. In fact, these patients have some balance disorders.

Soltani and colleagues[9] studied the effect of selected aerobic exercises in water on balance improvement in MS patients. The samples were divided into two experimental (15 people), and control (10 people) groups. The experimental program for the experimental group was applied for 8 weeks and three sessions per week. In the end, the researchers concluded that doing selected aerobic exercises in water will lead to some improvements in multiple sclerosis patients.

Freeman and colleagues,[10] in their research, called "training the central strength based on the Pilates exercises in MS patients" focused on the effects of Pilates exercises on lack of balance and activity in MS patients, and concluded that these exercises in comparison with the control group are

effective on improvement of the physical status of the MS patients.

Masoodi Nejad and colleagues,[11] in their research, studied the effect of selected composite exercises on women MS patients' balance and performance. Their findings showed that those composite exercises were effective on improving their balance and performance.

Sosnoff and colleagues investigated the movements, balance, and neural and muscular coordination in patients with MS They studied 52 patients for 12 weeks.[12] The study's results showed that by passing time, the physical disability in patients will increase and the muscular stamina, walking speed, balance, and nervous-muscular coordination will be reduced. An intervention is needed to prevent this to happen.

Charlton and colleagues,[13] in an article called "the results of a structured evaluation of effects of exercise in MS patients". This pilot program included some power, endurance, and flexibility exercises assigned to 11 MS patients. The findings showed that all the participants were content with the class. They enjoyed the class and had a lot of motivation for continuing the class. In addition, their flexibility, strength, balance, coordination, and psychological mood showed improvement.

Cattaneo and colleagues,[14] observed the effect of a balancing exercise program on MS patients. The results of the study indicated a significant progress in static balance of the examinees. The dynamic balance of patients, after a period of exercise did not have a significant progress, but the probability of their falling downs was reduced.

Jakson and colleagues,[15] in a semi-experimental study and by using the ANOVA statistical method for repeated data, selected 14 MS patients who had not had any other special diseases and any other exercise program participation. These patients followed a 6-week exercise program with some supervision and control and a 6-week exercise at home. The balance level of the patients was measured before and after the exercise periods. The results showed that the balance was significantly improved in patients with low to moderate level of the disease, after the completion of the exercise period.

Kath and colleagues,[16] in their study concluded that sport exercises is positively correlated with physical and mental health of the people and that patients, who had physical exercises, had better social performance and physical performance for doing their daily routines.

Hitherto, a number of researches have been conducted on the effects of water activities on patients with MS, but there have not been any studies on the effects of Pilates exercises on MS patients and more specifically on the dynamic balance of MS patients. Considering the fast growth in the number of MS patients in Iran, and especially in Isfahan, the researchers are much interested in discovering the effects of these two types of exercise on the dynamic balance of the MS patients.

METHODS

This study is a clinical practical and semi-experimental and focuses on the effect of 12 week of Pilates exercises and aquatic training on the muscular strength of women with MS sampling was conducted randomly and 57 women with MS with a disability index (Expanded Disability Status Scale-EDSS) of less than 4.5, who visited Kashai hospital in Esfahan, were selected. After the sampling was done, participants were divided in three groups of 19 people each. Next, they were briefed about the goals of the study and asked to fill out a form to participate in this study.

The exercise program for the aquatic training group included a series of water activities in the water for a period of 12 weeks and three sessions per week and 1 hour per session. The plan for each session started with a 10 minutes of walking in the water followed by stretching, power and endurance activities. In the final 10 minutes of each session, some cool-down and balance movements were performed.

The exercise program for the Pilates exercise group included a series of exercise activities for a period of 12 weeks and three sessions per week and 1 hour per session. The plan for each session started with a 10 minutes of simple stretching movements to warm up followed by the main part of the exercise plan including stretching, power, muscular nervous coordination, and balance moves. In the final 10 minutes of each session, some cool-down stretching movements were performed. After the finish of the exercise course and in the post-experiment period, the dynamic balance of all the three groups was measured by Six Spot Step Test and the results were analyzed.

It is important to mention that all the three groups continued a similar medicine-based therapy during the 12 weeks of the exercise course. The participants with more than six sessions of absence (out of the 36 sessions) were eliminated from the program. In the end, the data for 15-people groups were analyzed.

Tools and measurement method

Dynamic balance was measured by Six Spot Step Test. This test, is a comprehensive test to measure lower body function in people with MS compared to other walking tests because assesses various factors such as balance and coordination. In this test, the patient walks as quickly as possible from one end to the other of a delineated rectangular field that has been preset with cylindrical blocks, kicking the blocks out of their marked circles. The test-retest reliability was found to be high, with no evidence of practice effects. The SSST demonstrated high correlation with the EDSS ($r = 0.80$).[17]

Findings

Table 1 shows the number-descriptive indexes for the dynamic balance based on the assessment stage and group membership type.

As you can see in Table 1, the average score of right leg dynamic balance for post-experiment examinees of pilates group is 6.54, for aquatic training group is 6.40, and for the control group is 12.65. These values, for the left leg, were for the Pilates group is 6.25, for aquatic training group is 6.26, and for the control group is 12.49. The associated standard deviations for these values are also presented in Table 1.

Table 1: Number-descriptive indexes for the dynamic balance based on the assessment stage and group membership type

Variable	Pre-experiment			Post-experiment		
	Freq.	Mean	Std. Dev.	Freq.	Mean	Std. Dev.
Right leg dynamic balance						
Pilates	15	9.82	2.87	15	6.54	1.93
Aquatic Training	15	8.57	3.64	15	6.40	1.82
Control	15	10.64	4.17	15	12.65	6.05
Left leg dynamic balance						
Pilates	15	9.07	2.53	15	6.25	2.16
Aquatic Training	15	9.12	4.31	15	6.26	1.95
Control	15	10.16	3.76	15	12.49	4.63

Table 2 shows the results of a covariance analysis for determining the effects of Pilates exercises and aquatic training on the right leg dynamic balance of examinees in the post experiment stage.

As seen in Table 2, the pre-experiment right leg dynamic balance scores have no significant correlation with those of the post-experiment stage. By controlling this relationship, it can be observed that the adjusted mean differences of right leg dynamic balance scores of the experimental groups are significantly different ($P < 0.05$). Therefore, it can be said that Pilates exercise interventions and aquatic training can significantly increase the dynamic balance of the examinees in the post-experiment stage. The square root of Eta or the level of effectiveness shows that in sum, introduction of Pilates exercise interventions and aquatic training causes an increase by 36.3% in dynamic balance of the examinees in comparison with the control group examinees. The statistical power of 99.1% is a sign of high statistical accuracy and sufficiency of the sample population size for testing this hypothesis.

The adjusted means for the dynamic balance of the examinees and the results of the following tests for comparing the right leg dynamic balance in the participant patients are shown in Table 3.

As seen in Table 3, the difference between the adjusted mean for Pilates group and the control group is -5.96. This mean difference is statistically significant ($P < 0.05$); therefore, we can conclude that Pilates exercises can make a significant increase in the dynamic balance of right leg in MS patients in comparison with the control group.

As seen in Table 3, the difference between the adjusted mean for aquatic training group and the control group is -5.88. This mean difference is statistically significant ($P < 0.05$); therefore, we can conclude that aquatic training can make a significant increase in the dynamic balance of right leg in MS patients in comparison with the control group.

As it can be seen in Table 3, the adjusted mean difference in Pilates exercise group and aquatic training group is -0.08. This mean difference is statistically insignificant; therefore, we can conclude that aquatic training or Pilates exercises

cannot make a significant change in the dynamic balance of right leg in MS patients in comparison with the control group.

Figure 1 shows the linear chart of the adjusted means for the right leg dynamic balance, based on their group membership type.

Table 4 shows the results of a covariance analysis to determine the effect of Pilates exercises and aquatic training on the left leg dynamic balance of the examinees in the post experiment stage.

As seen in Table 4, the scores for left leg balance in the pre-experiment stage has insignificant relation with those of the post-experiment stage. By controlling this relationship, it can be observed that the difference in adjusted means for the left leg balance in the experimental groups is significantly different ($P < 0.05$). As a result, we can conclude that the intervention of Pilates exercises and aquatic training causes a significant increase in the left leg balance in the post-experiment stage. The square root of Eta shows that overall the interventions of Pilates exercises and aquatic training increase the left leg balance by 47.5% in comparison with that of the control group. The statistical power of 100% indicates the very high accuracy and sufficiency of the sample size for testing this hypothesis.

The results of the following tests for comparison of the left leg balance in post-experiment stage are presented in Table 5.

As seen in Table 5, the adjusted mean difference between the Pilates exercise group and control group is -6.23. This difference is statistically significant ($P < 0.05$); therefore, we can claim that doing Pilates exercises causes a significant increase in the MS patients' left leg balance compared with that of the control group.

And as seen in Table 5, the adjusted mean difference between the aquatic training group and control group is -6.23. This difference is statistically significant ($P < 0.05$); therefore, we

Table 2: Covariance analysis to determine the effect of Pilates and aquatic training on the right leg dynamic balance

Source of changes	Sum of squares	Degree of freedom	Mean of squares	F	Significance level	Level of effectiveness	Statistical power
Pre-experiment	71.97	1	71.97	1.24	0.272	0.029	0.193
Group membership	337.68	2	168.84	1.67	0.000	0.363	0.991

Table 3: The paired comparison of right leg dynamic balance based on the patient's group membership type in post-experiment stage

Base group	Mean	Group under comparison	Mean	Mean difference	Standard error	Significance level
Pilates	6.52	Aquatic training	6.6	−0.08	1.4	0.955
		Control	12.47	−5.96	1.4	0.000
Aquatic training	6.6	Control	12.47	−5.88	1.4	0.000

Table 4: The results of a covariance analysis in order to determine the effect of pilates and aquatic training on the left leg dynamic balance of the examinees

Source of changes	Sum of square roots	Degree of freedom	Mean of square roots	F	Significance level	Effectiveness level	Statistical power
Pre-experiment	0.01	1	0.01	0.00	0.970	0.000	0.050
Group membership	379.75	2	189.88	18.57	0.000	0.475	1.000

Table 5: The comparison of paired left leg dynamic balance of the examinees based on their group membership type in the post-experiment stage

Base group	Mean	The compared group	Mean	Mean difference	Standard error	Significance level
Pilates	6.25	Aquatic training	6.26	−0.00	1.2	0.997
		Control	12.48	−6.23	1.2	0.000
Aquatic training	6.26	Control	12.48	−6.23	1.2	0.000

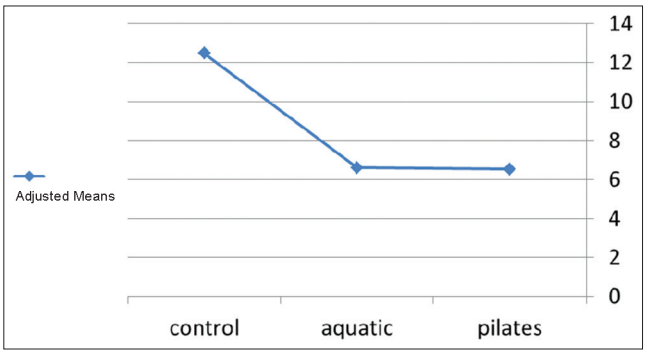

Figure 1: The linear chart of the adjusted means for the right leg dynamic balance, based on their group membership type

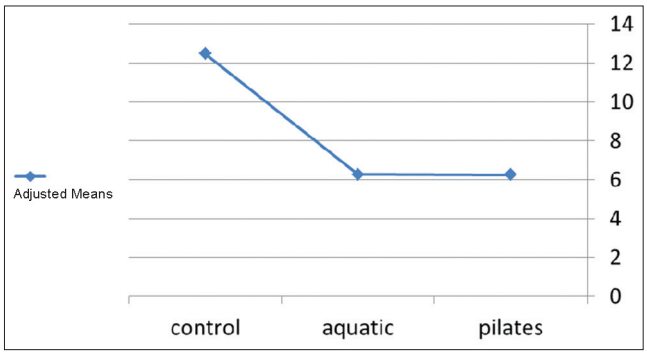

Figure 2: A linear chart of the adjusted means of the patient's left leg dynamic balance of the examinees based on their group membership

can claim that doing the aquatic training causes a significant increase in the MS patients' left leg balance compared with that of the control group.

And as seen in Table 5, the adjusted mean difference between the aquatic training group and the Pilates group is -0.00. This difference is statistically insignificant, Therefore, we can say that doing the aquatic training or performing the Pilates exercises does not cause a significant increase in the MS patients' left leg dynamic balance.

Figure 2 shows a linear chart of the adjusted means of the patient's left leg dynamic balance scores.

DISCUSSION

MS is one of the most disabling and demineralization diseases of the central nervous system.[18] The name of this disease points to two of the most characteristic of the disease: The number of areas involved, and sclerosed plaques and regions.[19]

Although these patients are unable to find a way to solve their problems and get access to an approach for improving the quality of life and their health, doing exercises is not very common among the MS patients and only 28.6% of them have approved the effectiveness of sport exercises. This is while doing exercises has a close relationship with the quality of physical and mental health of the people and patients who had had some physical activities, had a better performance in their social and personal duties.[16]

As shown in Table 2, the pre-experiment scores for dynamic balance has a significant relationship with those of the post-experiment and also the dynamic balance scores of the examinees of the experiment group were different ($P < 0.05$). Therefore, we can say that Pilates exercises and the exercise in water causes a significant increase in the dynamic balance of the examinees in the post-experiment stage. This is while the dynamic balance before conducting the study in the three groups showed no significant difference. These findings were in compliance with those by Freeman and colleagues,[10] MasoodiNejad and colleagues,[11] Charlton and colleagues,[13] Jackson and colleagues,[15] Soltani and colleagues,[9] Kath and colleagues,[16] and not in compliance with those by Kateno and colleagues.[14] Of course, in his studies, following some exercise interventions, the static balance of the examinees showed a significant increase but the dynamic balance did not have any significant changes. Considering the data in Table 3, the paired comparison of the dynamic balance of the examinees indicate that the Pilates exercises, given the control group data, had significant effect, and we can say that doing Pilates exercises cause a significant increase in the MS patient's dynamic balance, compared with the control group. This increase in dynamic balance of the patients in this research can be the result of doing Pilates exercises and the 12-week exercise period. This is also the result of determining the Pilates exercise level, since the exercises started from level 4 and in the second month considering the patients conditions and the principle of overload downgraded to level 3 and in the end of the month to level 2. In the end, the physical condition of the patients and the dynamic balance of the patients increased. These results were in compliance with those by Freeman and colleagues[10] and MasoodiNejad and colleagues[11] based on the effectiveness of sport exercises on the dynamic balance of the MS patients. In addition, sport exercises In water, considering the data from the control group, had a significant effect and we

can say doing sport exercises in water causes a significant increase in the dynamic balance of the MS patients, compared with those in the control group. This is compliant with the results by Soltani and colleagues.[9] The reason for the improvement in the patients' dynamic balance in this research may be the result of doing exercises in water and selecting the exercise period to be 12 weeks. Thus, participating in these exercise programs in a collective form and considering the overload principle and with some supervision on the way for performing the exercises in MS patients seems to be essential. This is because the physical constraints, lack of balance and balance in walking make walking in water easier. Lower body weight in water makes doing exercise programs easier and the water resistance helps improve the patient's body balance. Eventually, exercise in water causes an increase in endurance and performance quality and ability for doing daily activities and better body balance.

The findings of this study show that doing exercise in water and Pilates exercises by MS patients is completely possible and easy. By doing these techniques, a significant improvement occurs in the dynamic balance of the patients, in such way that doing exercise in water and Pilates exercises will lead to higher body balance in patients. Thus, it can be claimed that both types of the exercises have had positive effects on increasing the dynamic balance of the patients; however, there is no significant difference between the results of the two types of exercises. In conclusion, the specialists in the field are recommended to use these exercises as a supplementary treatment along with medicinal treatment plans for MS patients.

ACKNOWLEDGMENTS

The authors of this article would like to express their appreciation to the authorities and employees of the MS clinic in Kashani hospital in Esfahan and, in particular, to the dear patients who helped us collect this data by their participation in the study.

REFERENCES

1. Bakhshaei Mahdi, Froughipour Mohsen, Ismaili Habibollah, Rostami Vahid, and Razmara Narjes. Auditory-balance system involvement in patients with multiple sclerosis, J Ear, Throat, Nose.Vol. XIX, No. 47: 2007. p. 27-32.
2. Bayer Shrink Farma. Introduction to multiple sclerosis 1, translation company Bayer Farma Shrink Office, Tehran: Jalal Publication; 1389.
3. Shaygannejad, Vahid and Sadr-Ameli, Mohammad. Successful Living with Multiple Sclerosis, Mashhad: Vazhiran publication; 2010.
4. Spires SN. Comparison of the effects of aquatic and land-based balance training programs on the proprioception of college-aged recreational athletes. A Thesis for MSEd., Baylor University; 2010.
5. Alaei Sh. Effects of aquatic training on dynamic balance, muscle strength and quality of life of elderly women, Master's thesis, Physical Education and Sports Science College, University of Isfahan; 2010.
6. Gaeni AA, Rajabi H. Physical Fitness. 6th ed. Tehran: SAMT; 2009.
7. White LJ, Dressendorfer RH. Exercise and multiple sclerosis. Sports Med 2004;34:1077-100.
8. Rabeh AA, Shaterzadeh Yazdi MJ, Mohammadzadeh S, Shahin NG, Arastou, AA. Study of body balance in patients with multiple sclerosis in Khuzestan province, using clinical tests of balance function. Med J Jondi Shapour 2010;9:35-43.
9. Mahmoud S, Mahmoud HS, Abbas N, Ahmad Z, Marziyeh A. Effects of aerobic training on improving the water balance in selected patients with multiple sclerosis. J Nurs Midwifery Mashhad 2009;9:107-13.
10. Freeman J, Fox E, Gear M, Hough A. Pilates based core stability training in ambulant individuals with multiple sclerosis: Protocol for a multi-centre randomized controlled trial. BMC Neurol 2012;12:19.
11. Monireh MN, Hossein S, Hossini F. Effects of selected combined training on balance and functional capacity in women with multiple sclerosis. WASJ 2012;16:1019-26.
12. Sosnoff JJ, Socie MJ, Boes MK, Sandroff BM, Pula JH, Suh Y, *et al*. Mobility, balance and falls in persons with multiple sclerosis. PLoS One 2011;6:e28021.
13. Charlton ME, Gabriel KP, Munsinger T, Lorene RN, Schmaderer PT, Healey KM. Program evaluation results of a structured group exercise program in individuals with multiple sclerosis. IJMSC 2010;12:92-6.
14. Cattaneo D, Jonsdottir J, Zocchi M, Regola A. Effects of balance exercises on people with multiple sclerosis: A pilot study. Clin Rehabil 2007;21:771-81.
15. Kurt J, Mulcare JA, Donahoe-Fillmore B, Fritz HI, Rodgers MM. Home balance training intervention for people with multiple sclerosis. Int J MS Care 2007;9:111-7.
16. Smith C, Hale L, Olson K, Schneiders AG. How does exercise influence fatigue multiple sclerosis? Disabil Rehabil 2009;31:685-92.

17. Béthoux F, Bennett S. Evaluating walking in patients with multiple sclerosis: Which assessment tools are useful in clinical practice? Int J MS Care 2011;13:4-14.
18. Allahbakhshian M, Jaffarpour M, Parvizy S, Haghani H. A survey on relationship between spiritual wellbeing and quality of life in multiple sclerosis patients. ZJRMS 2010;13:29-33.
19. Hanjani SL, Ansari KS. Multiple sclerosis. RJMS 2011;22:17-24.

Source of Support: This study was conducted as a thesis funded by Isfahan University,Isfahan,Iran, **Conflict of Interest:** None declared.