ORIGINAL ARTICLE

The Comparative Effects of Stretching with Aerobic and Aerobic Exercises on Fatigue in Multiple Sclerosis Patients: A Randomized Controlled Clinical Trial

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Abstract

Background

The physical activity for people with MS largely affects the amount of fatigue. Increased appropriate physical activity tends to decrease the amount of fatigue. The aim of this study was to compare the effect of aerobic and aerobic with stretching exercises on fatigue in people with MS.

Methods

The randomized controlled clinical trial was conducted on the members of the MS Society of Tehran, Iran. 120 subjects were admitted between November 2009–April 2011; they were diagnosed with clinically definite multiple sclerosis and Expanded Disability Status Scale scores 1.0 to 5.5 and randomly assigned to two exercise groups and one control group. Outcome assessment was performed at baseline and the end of 3 month period using a checklist containing some demographic, disease variable and fatigue severity scale. The exercises consisted of stretching with aerobic and aerobic exercises. Data were analyzed using SPSS software, version 18.0.

Results

Independent *t* test showed that there are significant differences between the two exercise groups in the pretest ($P<0.005$). Analysis of Variance showed that there were significant differences between the exercise groups before and after the intervention ($P<0.001$).

Conclusion

Stretching with aerobic exercises showed significant improvement in fatigue compared to aerobic exercises alone.

Trial Registration Number: IRCT201203069219N1

Keywords: Multiple Sclerosis; Fatigue; Stretching; Aerobics; Exercise

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Introduction

Multiple Sclerosis (MS) is the most common neurological cause of debilitation in young people and affects about 500,000 people in the United States. Worldwide, the incidence is approximately 500,000 people suffering from disease in the U.S.[1] Currently, prevalence of MS in Iran is estimated to be 50 in 100,000.[2]

Sign and symptoms of MS include parasthesias, visual impairment, cognitive impairment, fatigue, motor weakness and problems in the bladder, bowel and sexual function. Onset typically occurs between ages 20 and 40. Fatigue is the most common symptoms of MS (50-60%)**.** Most patients reported that the fatigue they attribute to MS is different from their prior experiences.[3] For example, 67% of MS patients reported that fatigue was a major factor in limiting their social and occupational responsibilities as compared with lack of such reports among healthy adults.[4] The severity of fatigue in MS certainly distinguishes it from that which generally occurs among healthy people. MS fatigue disrupts multiple aspects of general well-being.[4,5] The acute phase is variable and unpredictable, with most patients experiencing episodic clinical exacerbations and neurological decline.[6] Fatigue is a daily experience for many MS patients, lasting six or more hours and often worsening in the end of the day.[7]

Despite significant progress in the development of disease-modifying drugs, pharmacological therapy alone does not represent optimal care in MS.[8] Exercise, a low-cost and non-invasive intervention has recently been recognized as a feasible form of self-management for those afflicted with the disease.[9] Current evidence indicates that regular exercise is beneficial in MS.[10] In a chronic disease, such as MS the primary goal of exercise is to maintain and improve functional independence.[11] Physical exercise for MS patients has been controversial in the past, because may have negative effects on the disease. So in order to minimize fatigue, people with MS limit their physical activity.[12] This limited physical activity can lead to further limb weakness, muscle spasm and fatigue in patients.[13,14] Studies of physical exercise among people with MS have shown increased fitness, decreased fatigue and improved quality of life. Also many studies focus on the effect of exercise on MS patient in Iran. For example, the results of a study showed that there are significant differences ($P<0.001$) in lifestyle in two groups and self-care program as a nursing intervention can cause health promotion in MS patients.[15]

Findings of another Quasi-experimental design in order to determine the effects of applying Energy Saving Techniques in the patients with MS-related fatigue showed a decline in the fatigue level after applying Energy Saving Techniques. The mean level of fatigue before applying the techniques was 5.36 and after that it decreased to 4.58.[3]

Another researcher suggested that exercise therapy may be beneficial for patients with MS in terms of physical fitness, activities of daily living and outcomes related to mood.[13] The results of this study confirmed that exercise is safe for MS patients and should be recommended for those with mild to moderate disability.[16] The exercise program must be individual. Excessive physical activity is not tolerated because it may cause small increase in temperature and exacerbate the disease. Positive effects of exercise on fatigue are more related to weakness and spasticity of patients.[17] Findings of a study showed that patients who underwent aerobic exercises had a significant reduction in fatigue level and quality of life improvement.[18] A study showed that MS patients who were mildly disabled had reduced limb endurance and an impaired cardio-respiratory response to self-paced walking that might have been related to cardiovascular dysfunction and breathing control alternation and this alternation may play a key role in the impaired exercise tolerance of MS patients.[19] The reported studies show the advantages of exercise on fatigue in MS patients but it is important

to determine what type of exercises has appropriate effect on declining of fatigue. Therefore, and because there were no similar studies in Iran to compare the type of exercises on fatigue in these patients, this study aimed to compare the effect of aerobic exercises and stretching with aerobic exercises on fatigue in MS patients.

Materials and Methods

This randomized controlled clinical trial was conducted on the patients at Iranian MS Society of Tehran from November 2009–April 2011. The study protocol was approved by the Ethics Committee of the Tehran Medical University of Science. Informed consent was signed by the participants before entry to the study. Sample size was calculated as 34 participants using this formula: $n=[Z_1-(\alpha/2)+Z_1-\beta]^2(p_1q_1+p_2q_2)/(p_1-p_2)^2=[(1.96+1.28)^2(0.88x0.12)+(0.55x0.45)]/(0.88-0.55)^2\approx34$ for each group but due to attrition related to lack of regular exercise we selected 40 patients in each group. ($\beta=0.05$, $\alpha=0.05$) So the participants of this study consisted of 120 MS patients assigned randomly in three group. In this way, the first patient who referred to MS society as aerobic group, the second patient as aerobic with stretching exercises group and the third patient as a control group. Thus aerobic exercises group (N=40), aerobic with stretching exercise group (N=40) and control group (N=40) were selected (figure 1). The inclusion criteria for participants were as fallows: 1- confirmed diagnosis of clinically definite MS (relapsing- remitting type), 2- Kurtze Expanded Disability Status Scale (EDSS) score of 1-5.5 (20), 3- no history of any medical condition that would preclude participation in the prescribed training programs such as cardiac conditions or in a relapse-stage of their disease process, 4- independently mobile, with or without walking aids and 5- age between 20 and 45. Neurological impairment and disability were evaluated using Kurtzke's Functional Systems Scales and EDSS,[20] by two experienced neurologists. Fatigue severity was evaluated using fatigue severity scale based on Fatigue

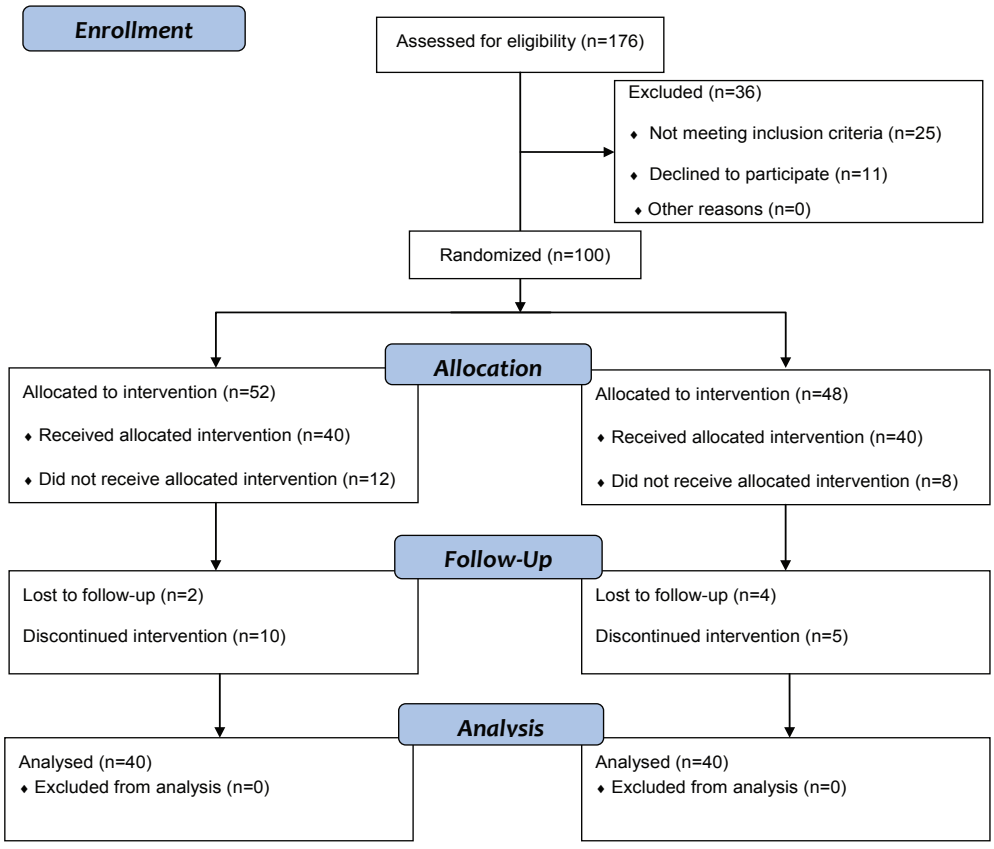

Figure 1: The flowchart of the design and protocol of the study.

Severity Scale (FSS), a nine-item questionnaire (Each item is rated on a 7-point Likert scale) in MS patients in three groups.[21] Exclusion criteria included: 1- irregular exercise 2- relapse phase of the diseasewhen the patient was not capable of doing exercise regularly. Twelve patients in the aerobic with stretching exercises group and eight patients in the aerobic exercises group were excluded from the study and new participants were replaced (figure 1).

Also since the symptoms associated with MS, including numbness, contusion, headache, etc. can affect the fatigue level, the three groups were matched according to demographic characteristics and symptoms associated with the disease.

The questionnaire was assessed by a panel of 12 experts to establish content validity. The reliability of the scale has been confirmed in another study in Iran(r=0.87).[22] MS Patients' fatigue level was evaluated at baseline and at three months in MS society of Tehran, Iran. The exercise intervention lasted for 12 weeks. At the time of baseline visits, the patients were advised to avoid any greater changes in their physical activity habits during the next three months. These patients contacted three times a week for follow-up exercises. Each training session lasted 30 minutes that consisted of a 10 minute waking, 10 minute bicycle riding, and then 10 minutes of treadmill with 1 m/s speed in aerobic exercises group. In stretching with aerobic exercises group, the subjects performed stretching exercises of their upper and lower limbs and trunk muscles (side-to-side neck stretch, triceps stretch, hamstring stretch, etc) for 15 minutes before 30 minute aerobic exercises and in the control group no intervention was performed. Each patient had a checklist for doing exercises and if he/she did regular exercises in each session, the checklist was filled by researcher.

Data were examined at the first reassessment for between group differences. Data from the second reassessment were analyzed for within group differences. Sample characteristics were summarized using descriptive statistics. A one-sample kolomgrorov-smirnov test was performed to test for normal distribution; for within group comparisons, t test and for between group comparisons, paired t test, were run. P value of 0.05 was considered as significant. ANOVA was used to detect pre-intervention variations on between groups. With $P<0.05$ decision fatigue level. Data were analyzed using SPSS software (version 18; SPSS Inc., Chicago, IL, USA).

Results

120 patients were assessed for eligibility for the study (87 females and 33 males). The demographic and disease variable of the subjects are summarized in table 1. The patients were predominantly women (72.5%). The mean age of the samples was 35.21±7.27 years. There were

Table 1: Demographic and disease data in subjects

Characteristic	N	%
Sex		
Women	87	72. 5
Men	33	27. 5
Marital status		
Single	48	40
Married	72	60
Job		
Employment	72	60
Unemployment	48	40
Disease duration (years)		
≤5	12	10
5-10	65	54
≥10	43	35.8
Using diseases modifying drugs		
Avonex	78	65
Ribif	102	90.8
Amantadin	75	62.5
Baclofen	104	86.7
Other drugs	83	69.2
Sign and symptom accompany with fatigue		
Appetite	94	78.3
Contusion	99	82.5
Mental rupture	67	55.8
Numbness	96	80
Mental disturbance	56	46.7
Impatience	66	82.5
Infirmity	104	86.7
Headache	52	43.3

no significant differences in demographic and disease variable of the subjects among three groups (P value all greater than 0.05) but there are no homogeneity in the fatigue level in the three groups. ANOVA test showed that there are significant differences in the three groups in the amount of fatigue before the study (P=0.005). Tests of between groups showed that the two exercise groups had no homogeneity before the study. After eliminating the confounding variable, pre-exercise fatigue analysis of variance, the effect of exercise on fatigue was investigated. ANOVA showed that there were no significant difference on fatigue between the two groups' post-test intervention (P=0.001) (table 2).

The mean measure of fatigue in aerobic exercises group was 42.95±15.02 and 35.1±16.46 before and after exercises, respectively. The *t* test showed, there was a significant difference between measure of fatigue before and after exercises (P<0.001). The paired *t* test showed significant difference in measure of fatigue before and after exercises (P<0.001) (table 3).

Table 4 show difference measure of fatigue between two groups (aerobic exercises group and stretching with aerobic exercises group) before and after exercise. This value defines as (FSS_1-FSS_2).

The results of *t* test showed that there is a significant difference in the amount of fatigue in the two groups before and after exercises (P<0.001). From table 3, FSS1-FSS2 value in most patients in the aerobic

Table 2: Post hoc comparison from pre intervention to post intervention

Variable	Parameter	Parameter value	SD	t	P value	95%Confidence Interval	
						Lower	Upper
Fatigue level	b (intercept)	-5.198	2.828	-1.838	0.07	-10.829	0.433
	Pre-post intervention difference	0.644	0.056	11.456	0.001	0.532	0.756

Table 3: The fatigue level in three groups before and after intervention

Fatigue level	Time point	Aerobic group N (%)	Stretching with aerobic group N (%)	Control group N (%)
Mild (10-39)	Pre-test	13 (32.5)	5 (12.5)	9 (22.5)
	Post-test	21 (52.5)	37 (92.5)	8 (20)
Moderate (40-54)	Pre-test	17 (42.5)	14 (35)	16 (40)
	Post-test	15 (37.5)	3 (7.5)	16 (40)
Sever (55-63)	Pre-test	10 (25)	21 (52.5)	15 (37.5)
	Post-test	4 (10)	0 (0)	16 (40)
mean±SD	Pre-test	42.95±15.02	51.35±12.83	48.17±14.83
	Post-test	35.1±16.4	28.17±10.32	47.65±14.4
P value	Pre-test=0.02			
	Post-test=0.001			

Table 4: Difference of fatigue level between two groups before and after exercise

FSS1-FSS2	Aerobic group N (%)	Stretching with aerobic group N (%)
(-3-0)	5 (12.5)	0 (0)
0-20	33 (82/5)	12 (30)
20-30	2 (5)	19 (47.5)
>30	0 (0)	9 (22.5)
mean±SD	7.85±9.44	23.17±6.71
P value	0. 001	

FSS_1=Fatigue Severity Scale before exercise; FSS_2=Fatigue Severity Scale after exercise

exercises group (82.5%) was<20 while in the stretching with aerobic exercises group, this value was between 20 and 30 (table 4).

We can see that no patient in the stretching with aerobic exercises group suffered from severe fatigue after exercises. However, in the aerobic exercises group, 25% of the patients suffered from severe fatigue before the study and still 10% of them suffered from severe fatigue after exercises.

Discussion

Our results showed that aerobic with stretching exercises can markedly improve the fatigue level of MS patients in a relatively short time. More specifically, the intervention produced improvements in the fatigue level of MS patients. The effect of exercise on fatigue in MS patient is a challenging issue. Regular exercise is a good idea for anyone, but for people with MS it is controversial because it may have negative effects on the disease.[12] The findings of this study showed that aerobic exercises decline the amount of fatigue in MS patients. Conflicting results of the pervious studies showed that aerobic exercises had no effects on fatigue in MS patients but it partially affected the health-related quality of life in patients.[23] Also, the results of another study showed that aerobic exercises affected the components of the physical dimension of the Sickness Impact Profile (SIP) and improvements in social interaction, emotional behavior, activity living

Aspects and total SIP score. No changes were observed for exercise or non-exercise groups on the FSS. Exercise had a positive impact on factors related to quality of life.[15]

On the contrary, the results of previous studies revealed that even moderate regular exercises helped to correct bladder control issues that are common problem in people with MS.[15] Studies showed that applying Energy Saving Techniques reduced the fatigue of MS patients. In agreement with the results of this study, the findings of another study in Iran indicated that participation in regular aerobic exercises improved daily living activities.[15,24,25] Maintenance of the improvements in fatigue due to exercise was difficult to assess in most studies due to lack of follow-up. However, some studies showed that individuals with MS have long been advised to avoid participation in exercise in order to minimize the risk of exacerbations and symptoms of fatigue.[9]

While there are claims that yoga may affect the underlying disease process in MS, our findings showed that stretching with aerobic exercises reduced the fatigue level in MS patients that supported the results of this previous study. Several controlled studies have shown that fatigue is reduced with exercise. In individuals with mild fatigue, non-pharmacological treatments including yoga, aerobic exercises, cooling therapy and energy conservation techniques such as yoga class or exercise class showed significant improvement in the fatigue level compared to the control group.[9,23]

Our study adds important insights on exercise response in MS. Previously, other randomized studies have examined the effects of regular exercises in MS patients.[23] Although our exercise period was shorter than that of other studies, the exercises were helpful in controlling the sign and symptom of MS in the subjects.

This article reported the effects of a combined exercise program (including stretching with aerobic exercises) for people with MS that could be initiated in a clinic and continued at home. The research findings support the hypothesis that exercise intervention would result in improved fatigue. Hence, increasing the physical activity levels of those with MS, although potentially challenging, is crucial for long-term health among this population. The findings showed that stretching with aerobic exercises have more positive effects on the fatigue of patients than aerobic exercises alone. Exercises can help the patients with spasticity, muscle weakness and gait disturbances. Spasticity is the uncontrolled contraction of the skeletal muscle. Likely,

aerobic with stretching exercises both cause energy conservation and improve spasm in the bladder and the other organs of the body. A nurse instructs MS patients the technique of active or passive stretching through full Range of Motion (ROM) to reduce spasticity. Passive stretching is the movement produced by another individual throughout unrestricted ROM while the patient is relaxed. There is no voluntary contraction on the part of the patient. This should be done to all spastic extremities several times a day. Regular repetition relieves the stiffness of spasticity and prevents contractures of the muscles. It can offer relaxation lasting from 30 minutes to several hours. In the active range of motion exercises, the nurse instructs the patient to actively move the joint in as wide a range as possible. If weakness is severe, the patient may need to be placed in a gravity eliminated position. As the patient's strength improves, the joint is permitted to move through gravity.[26]

One of the most important limitations of our study is that since fatigue is a subjective sign, its measurement is very difficult and it is affected by many variables such as emotional changes and other distressing symptoms associated with MS which were out of the control of researchers.

Conclusion

These findings strongly support the fact that exercise reduces fatigue in MS patients, specifically in stretching with aerobic exercise group. Thus since both the stretching and aerobic exercises are reported to improve fatigue levels, it is recommended that nurse and physiotherapists consider stretching and aerobic exercises that help to relieve a number of symptoms and complications that are commonly associated with MS.

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