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Investigating the Effect of Aquatic Aerobic Training on the Speed of Walking in High and Low-Degree Multiple Sclerosis Patients

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Abstract

Background and objective: Multiple Sclerosis (MS) is a chronic disease afflicting the central nervous system and destroying the myelin sheath of the central nervous system. The most common complications of MS are fatigue, Muscle cramps, Chills, squint, imbalance and gait disorders. This study aims at investigating the effect of aquatic aerobic training for 8 weeks on the speed of walking in female MS patients with high and low-degree Multiple Sclerosis.

Materials & Methods: In this quasi-experimental study**,** 46 female MS patients were randomly assigned into 4 groups based on the degree of Illness and age range. The participants' average duration of illness was 4 ± 1 years, and their age ranged from 20 to 25 years. They were divided in two experimental groups with EDSS 1-4 (15 people) and EDSS 4.5-6.5 (11 people) and two control groups with high and low EDSS (10 people). The experimental group participated in the training program for 8 weeks, three sessions per week with the intensity of 40-50 percent of the maximum heart rate. The speed of walking (SOW) was measured in both the experimental and control groups before and after the exercise. Then the collected data was analyzed using independent and paired t-test.

Results: The results of the study showed that there was a significant improvement in the SOW in the two experimental groups after 8 weeks (High EDSS $P<0/044$ and low EDSS $p<0.003$). Accordingly, we observed a significant difference between the SOW in patients with high EDSS and low EDSS ($p<0.001$).

Conclusion: As the results of this study indicate, aquatic aerobic exercise can improve the SOW in MS patients, particularly those with high degree MS. Thus, we recommend that therapists use aquatic aerobic exercises as a supplementary treatment beside medical treatments for MS patients.

Keywords: Multiple sclerosis, Aquatic exercise, Speed of walking

Introduction

Multiple Sclerosis (MS) is a progressive autoimmune disease afflicting the central nervous system including brain and spinal cord. The complications of MS include destroying the myelin sheath and the formation of scar, which disturb the nervous and electric currents [1, 2]. Ranked beneath trauma, MS is the second major cause of nervous disability during young age and adulthood. Yet the true causes of this disease is still unknown [3, 4]. Currently, the disease has also come to afflict people under 20 with women twice as much afflicted as men [5]. MS may impose severe numerous impacts on the lives of patients. Indeed, people may be afflicted in their prime when they are prone to get married and start a new life and course of activity. The most common causes of MS include: losing the performance or senses in the limbs, fatigue, muscle or physical weakness, muscle cramps, squint, and gait disorder [6, 7, 8]. Fatigue is the most common indicator of MS [9]. For long, therapists used to advise the MS patients not to participate in sports activities because some patients would report inconsistencies in the Disease symptoms during physical activities due to body temperature increase. The other reason as to this ban was the misconception that refraining from sports activity would save the energy for daily routines. However, over the last decade, exercise has been confirmed as having positive effects on MS patients. Recently, it has been demonstrated that the deterioration or intensification of sensory symptoms in over 40 percent of the patients after taking exercise would be temporary and would become normal up to 30 minutes after exercise in almost 80 percent of the patients [10]. Also, controlling symptoms during physical activity programs may increase the patients' participation in

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exercise programs [11].

Nowadays, MS, causing physical disability and motion disorders, is dramatically increasing throughout the world, to the extent that it has been called the century disease. Physical education, obtaining an outstanding position among the bodies of knowledge, has come to be an undeniable, necessary knowledge which can be used as a supplementary treatment with diabetic, cardiovascular, MS and arthritis patients. The complications of MS may appear during 20 to 40 years of age. Tarraghi et al. (2007) reported the mean age of affliction to be 27.12±8.03- [12].

There is a population of 3.5 million MS patients in the world. In the United States, the prevalence of MS has reached 90 per 100,000 people, which requires a fund of over 10 million dollars to look after the patients. The prevalence of MS in Iran is estimated to be 57 in 100,000 people [13]. According to the report by the society for MS patients, there are almost 40,000 MS patients in Iran, the number of whom has been increasing. Khorasan Razavi society for MS has already identified 1400 MS patients 900 of whom benefit from the society supports. As there is no certain cure for MS, patients have to rely on the treatments which solely repress the symptoms [14].

It is necessary for MS patients to maintain their muscles' tenacity and the motion in their joints through taking exercises. Exercise is also useful for the patients as improving their health and performance [15]. Taking regular aerobic exercise may have certain benefits to the MS patients including: improving abilities, good temper (psychological status) and the ability to cope with routines [16]. Sport activity is one of the ways by which to help MS patients. Concerning the physical disability, imbalance and poor motion in MS patients, therapists are recommended to use selective aerobic training for these patients. In this connection, hydrotherapic exercises are particularly beneficial to MS patients. Since MS patients suffer from inactivity and its complications, strengthening muscles and water exercises can prevent muscle atrophy in these patients and result in positive effects on motion disability. It may even lead in a decrease in their muscles' spasticity. For many, taking exercise is equivalent to pressurizing the body to the threshold of pain. However, this is not an appropriate definition since it has been demonstrated that taking exercise to the threshold of pain may increase fatigue and weakness in MS patients. Affected by this view, some MS patients refuse to take any exercises.

Despite medical advancements over the last years, there is still no certain cure for MS and most of the current treatments are to repress the symptoms or lower the rate of progression; therefore, the early diagnosis and timely control of MS may significantly help avoid severe complications and uncontrollable progression of the disease to a great extent [13]. MS is mostly prevalent in indo-European people while it is not considerably widespread in black and yellow races [17]. With regard to the fact that Iranian people are of indo-European origin, it is necessary to conduct more investigations in MS and to come up with procedures so as to control its complications [5]. According to the U.S National Center on Physical activity and Disability for Multiple Sclerosis, "although MS disturbs physical and psychological health, it has been confirmed that regular sport activities and stretch and flexibility exercises would improve physical and psychological health" (as cited in Atashzadeh et al., 2003, 18). Therefore, it is necessary to conduct studies to help develop knowledge and explore physical education along with introducing this field as a supplementary treatment besides medical treatments in order to improve the patients' physical health, the quality of life in dealing with multiple sclerosis, and to fight the inconsistent nature of MS and control its unfavorable complications including trembling, imbalance, dizziness and muscle cramps. Besides, it is essential to conduct studies to explore the adjustment of the immune system in order to help avoid the devastation of myelin and the central nervous system white matter before the nerve axons can be harmed. Following this line of research conducted in other parts of the world and doing further studies in Iran in order to help the MS patients benefit from exercise as a supplementary treatment would provide the patients with new hopes and help alleviate their physical and mental sufferings. With regard to the dramatic increase in the number of MS patients, treatment expense, and the severe complications of MS on the life quality of patients, exercise can play a significant role in controlling the MS complications such as fatigue as well as improving the life quality of patients. Sharcot (1868) was the first researcher who studied MS patients. Romberg et al. (2004) found that an aerobic training program for 23 weeks can relatively improve the speed of walking in MS patients [20]. Husted et al. (1999) also devised an 8-week course of exercise for 30 MS patients and observed a significant improvement in the patients' speed of walking [21]. Wiles et al. (2001) studied the effects of a 4-week aerobic training program on 42 MS patients and found a relative improvement in their speed of walking [22]. Lord et al. (1998) conducted a study to compare two types of sports

therapy for MS patients with gait difficulty to improve their walking. The participants in either of the groups improved significantly in their responsiveness. There was no significant difference between the two groups in time-limited 10 meter walking, the length of step, and balance. O'connell et al (2003) conducted a randomly-controlled program to investigate the effects of sports therapy on medium-degree MS patients and found no significant relationship between the MS intensity and the speed of walking.

With regard to research findings indicating the positive effects of physical activities on MS patients, we decided to conduct a study which, besides medical treatments, drew on an 8-week selective aquatic aerobic training program to help reduce the MS symptoms and improve the patients' speed of walking. The question is whether selective aquatic aerobic training has a significant effect on the patients' speed of walking.

Method

This was an applied, quasi-experimental research. From among a population of 100 patients (100 patients whose MS affliction was approved by a neurologist, and who were under medical treatment), we randomly chose a sample of 46 and assigned them into 4 groups. All of them had medical files in private clinics in which they were under treatment. There were two experimental groups, one with high EDSS (10 members) and the other with low EDSS (15 members). There were also two control groups with high and low EDSS (each with 10 members for whom the average affliction period was 4±1 years, and their age ranged from 20 to 50).

To carry out the study, one day before the program was started, the patients came together. Then the researchers informed them of the exercise types, the intensity of exercise, and the number of iterations per session. Next, the experimental and control groups participated in the pre-test in which their walking speed and Expanded Disability Status Scale (EDSS) were measured and recorded.

The training program for the experimental group consisted of an 8-week aerobic training program 3 sessions each week with 50 to 60 percent maximum heart beat rate. The heart beat was measured during the exercise activity using Polar watch. At the end of program, after each EDSS stage, all groups were given the walking speed test. Then the results were analyzed. Besides, all the group members were using medicines during the program.

To test the speed of walking*:* 10 and 14 meter tests were used. In these tests, the first and last two meters are not considered in measurements.

Kurtzke's Extended Disability Status Scale questionnaire: this questionnaire measures different status and performances pertaining to the central nervous system. This questionnaire would mark the MS patient between 0 and 10 based on the damage inflicted upon the central nervous system. The greater the damage the bigger the obtained mark will be. In this study, the Kurtzke's EDSS mark was between 1 and 6. The validity of EDSS test has been approved by Kurtzke [19]. As to the analysis of the data, descriptive statistics was used to tabulate the data, calculate the means and standard deviations. To compare the means, dependent and independent t-tests were used. The level of significance used to show the statistically significant differences was set at 0.05. In the course of statistical analyses, SPSS software was utilized.

Results

According to the data presented in table 1 and table 2, selective aquatic aerobic training significantly improves the speed of walking in patients both with high and low-degree Multiple Sclerosis (p=0.003). The training program could successfully increase the speed of walking in low and high-degree MS patients as much as 0.711 and 13.805 seconds on average, respectively.

The results also indicated that the training program has been more beneficial to high-degree patients as their walking speed significantly exceeds that of the low-degree patients (p=0.017) - (table 3).

Table 1: Comparative test of walking speed in low-degree patients

The walking speed of low-degree Patients (seconds)	**Experimental group**		**Control group**		**The two groups' t values**	
	SD	**Mean**	**SD**	**Mean**	**Control group**	**Experimental group**
Pre-test	1.287	6.822	1.340	6.733	P=.496	P=0.003
Post-test	1.273	6.110	1.688	7.069	T=-0.757	T=3.673
The difference between Pre-test/post-test results	0.749	0.7111	1.448	-0.3463		

Table 2: Comparative test of walking speed in high-degree patients

The walking speed of high-degree Patients (seconds)	Experimental group		Control group		The two groups' t values	
	SD	Mean	SD	Mean	Control group	Experimental group
Pre-test	37.043	33.278	21.996	22.450	P=0.087	P=0.044
Post-test	18.634	19.474	23.369	23.866	T=-1.920	T=2.307
The difference between Pre-test/post-test results	19.844	13.805	2.363	-1.435		

Table 3: Covariance and the mean difference between the two experimental groups

The two groups' test of covariance			Independent t-test for comparing the means of the two groups			
t	**P value**	**Result**	**T**	**df**	**P value**	**Mean difference**
16.051	0.001	**The two groups covariance accepted**	2.573	24	0.017	13.0934

Discussion

Many researchers have conducted studies to investigate the effect of aquatic exercises on MS patients in different parts of the world. However, there have not yet been many studies to cover the issue in Iran, and so the reference materials for this study were all in English. As a limitation to this study, the Extended Disability Status Scale (EDSS) ranged from 1 to 6. There were also some limitations that restricted the sample to 46 people. These included: the impossibility to use male participants due to their small population, the participants' ages ranging from 20 to 50, and keeping the disease secret by some patients. The advantages of regular aerobic exercise for MS patients include: improving the patients' abilities, developing the temper (psychological status) and the ability to deal with daily routines [16].

MS patients are recommended to take stretch and yoga exercises. Motl et al. (2005) concluded that there was a relationship between the intensification of symptoms and less sports activities in MS patients. In their study, they examined the deterioration of symptoms in a period of 3 to 5 years and the reported physical activities by the patients in a sample of 51 MS patients. Accordingly, 31 patients reported the deterioration of their symptoms. Thus, the deterioration of symptoms significantly correlated with low physical activity. This provides a further evidence for the relationship between the deterioration of symptoms and low physical activity. Therefore, sports therapy can be used as a supplementary treatment besides medical treatments to reduce the MS symptoms [23]. In this regard, hydrotherapy plays a critical role because taking exercises in water improve body fitness. There are certain advantages of water exercises for these patients, the least of which is that the patients' weight considerably lowers in water and the water pressure from all around helps the patients keep their balance. Also one of the major problems of these patients while taking exercises is their temperature since as the body temperature increases, the nerve signals are disturbed and thus the disability prevails and the patient weakens. As the intensive exercise increases the internal body temperature, water would decrease the temperature in patients. Since under normal conditions, myelin sheath covers the nerves and protects them against the complications of increasing temperature, the lack of myelin sheath in MS patients may enhance the risk of neuronal short circuits in the central nervous system when the internal body temperature increases. As a result, the symptoms may intensify or new symptoms might arise. Taking exercise in water may also help the patients with maintaining and strengthening their muscles, providing oxygen for the brain, improving and maintaining the range of motion, a better control on muscles, improving the quality of life, keeping a better balance, energy and gaiety [24].

Fatigue is one of the most common complications of MS affecting two-thirds of the patients. Besides, more than half of the patients have already reported that fatigue is the most important complication of MS which causes

disability. Fatigue directly affects the speed and duration of walking in MS patients. As there is a direct relationship between the distance walked and the muscles' oxygen expenditure, an improvement in the walking distance may be due to the improvement in muscles' capacity to use the oxygen or the cardiopulmonary function in transmitting oxygen through blood into the muscles. In the present study, the patients' improvement of walking speed can also be attributed to a decrease in the patients' fatigue since there is a close relationship between the two. No doubt, every program should be compatible with the needs of patients so that it might be efficient and effective. To be invaluable, training programs should fulfill the needs of MS patients. With regard to the nature and recurrence of MS symptoms, it often entails spasms and severe muscle cramps. Of course, if training programs do not take these complications into account, they may result in the deterioration of symptoms [25].

Thus, MS patients are not recommended to take intensive physical exercises because intensive exercises would increase the body temperature and intensify the symptoms. Extreme fatigue may also intensify the factors that increase symptoms. Therefore, different types of sports therapy including: aerobic exercises, yoga and swimming are recommended for MS patients in order to reduce fatigue, improve the quality of life, the speed and duration of walking, reduce the physical weakness and disability, improve balance and resisting the disease [26, 27]. With regard to the fact that MS patients frequently fall down due to imbalance, fatigue and spasticity, they usually fear walking; thus, the improvements they make during the training programs may be as a result of overcoming their fears. An increase in the speed of walking may be due to gaining strength, balance and even the flexibility as a result of selective aquatic or stretch exercises because all these factors can affect the speed of walking.

The most important point here is that there is no other study with the same procedure and exercise types as the present research to share the results with. The results of the present and past studies can be used to devise training programs, particularly with selective aquatic exercises, to increase the speed of walking in MS patients. The results of t-test showed that the speed of walking in the pre-test and post-test significantly changed in the experimental groups. The main reason for increasing the patients' speed of walking in this study was due to the effects of selective exercises on muscles strength, increasing the need for motor units and activation of new motor units. Since the selective aquatic exercises up to 8 weeks after the beginning of the program induce structural adaptations and partial hypertrophy, the increase in the patients' walking speed in this study may be the result of such factors. A further reason is that most of these patients had no history of sports training and took the exercises as their first serious sports experience.

Consistent with the findings in this study, Romberg et al (2004) found that an aerobic training program for 23 weeks can relatively improve the speed of walking in MS patients [20]. Husted et al (1999) conducted an 8-week aerobic training program on 30 MS patients and reported a significant improvement in the patients' walking speed [20]. Wiles et al. (2001) studied the effect of a 4-week aerobic training program on 42 MS patients and found relative improvement in their speed of walking [22]. Contrary to the findings of the present study, White et al [28], Lord et al [29] and O'connell et al [30] found no significant improvement in the patients' speed of walking.

One of the factors that may have contributed to the improvement in the patients' speed of walking in this study may be the implantation of selective aquatic aerobic exercises and deciding the duration of program to be 8 weeks. Therefore, it seems necessary for MS patients to take collective aquatic exercises while considering the overload factor and working under the supervision of experts because these exercises are compatible with their physical limitations, imbalance and gait disorders.

Conclusion

Taking selective aquatic exercises may improve the speed of walking in MS patients. Therefore, the therapists are recommended to use collective aquatic exercises as a supplementary treatment besides medical treatments for MS patients.

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