Available online at www.pelagiaresearchlibrary.com

Pelagia Research Library

Pelagia Research Library

European Journal of Experimental Biology, 2014, 4(1):38-43

European Journal of Experimental Biology
Pelagia Research Library

ISSN: 2248 –9215
CODEN (USA): EJEBAU

The effect of aquatic exercise on balance of adults with multiple sclerosis

Ali Barbar, Reza Bahadoran and Yaser Ghasemzadeh

Department of Physical Education and Sport Science, Gonabad Branch, Islamic Azad University, Gonabad, Iran

---

ABSTRACT

Multiple sclerosis (MS) is a chronic and debilitating disease in which the central nervous system (brain and spinal cord) is destroyed. The most common complications of this disease are fatigue, lack of balance, cramps, tremor, diplopia, pain and unsteadiness of gait. This study investigated the effects of 8-week aquatic exercise on balance in Adult with Multiple Sclerosis. In research, semi-experimental design with pretest-posttest control group has been used and 60 male patients attending MS society. The subjects (with MS 2 <EDSS> 5 and 20-50 years old) were randomly assigned into experimental and control groups. Training program for aquatic group was carried out for 8 weeks (three sessions of one hour per week) while the control group did not receive any intervention. The Patients' static and dynamic balances were measured by Balance system before and after the exercise. The obtained data were analyzed by covariance method (ANCOVA). The results showed significant differences in the adjusted mean static and dynamic balance and in the experimental group in comparison with control group. Aquatic exercise increase balance in adult with multiple sclerosis. Therefore, this technic could be used as a complementary treatment alongside medications for multiple sclerosis patients.

Key words: Multiple Sclerosis, Aquatic Exercise, Balance

INTRODUCTION

MS is a demyelinating inflammatory disease of the CNS with subsequent destruction of myelin, oligodendrocytes and axons.[1] It shows a distinct sexual bias with women having MS almost. 2.5-times more often than men.[17] The disease process involves the activation and transport of inflammatory cells into the brain. The exact sequence of events that lead to myelin and axonal damage are yet to be defined, but increased activation of natural killer cells to attack myelin proteolipid protein characterizes the pathogenesis of MS.[18] The clinical sequelae of demyelination provides the basis for diagnosis and treatment. Disease patterns in MS are progressively more disabling, including: relapsing remitting, primary progressive, secondary progressive and progressive relapsing, respectively.

Demyelination compromises nerve fiber function by slowing axonal conduction velocity. Axonal injury or death may also occur.[19] Altered conduction in demyelinated motor and sensory tracts within the CNS can disturb gait and balance, increase the risk of falls and reduce daily lifestyle activity. Balance and coordination are compromised when demyelination also affects the proprioceptive, visual and vestibular pathways. Vertigo, imbalance, incoordination, gait disturbances and spastic movements all contribute to mobility problems. Muscle weakness and fatigue, one of the most prevalent symptoms in MS, further reduce walking tolerance and contribute to the need for ambulatory assistance. Furthermore, atrophic changes associated with decreased voluntary physical activity further contribute to the decline in muscle strength, functional capacity and quality of life. Individuals with MS, therefore, face profound physical and psychological challenges as they negotiate the course of their disease.

The impact of MS on activities of daily living is influenced by the patient's functional capacity, disease progression and symptom management with pharmacological agents. As shown in table I, controlled exercise testing studies indicate that MS is associated with reduced levels of muscle strength,[20-23] speed,[24] endurance[25] and cardiorespiratory fitness[26-28] when compared with healthy subjects. Improving fitness in MS patients should help, therefore, to minimize their disability. Importantly, wide variation in physical capacity between patients necessitates testing for strength, flexibility and cardiorespiratory endurance in order to personalize the exercise prescription.

Poor Balance

Maintaining dynamic balance relies on intact visual, somatosensory and vestibular input [72] combined with coordinated righting reflexes. The increased risk of falls in MS is complicated by poor judgment and compromised muscle strength and motor control.[73] Risk of fracture from falls in MS patients is 2- to 3.4-times higher than for a healthy control.[74] Cognitive deficits may also occur early in the MS disease course[75] and may impact information processing, attention, decision making, error correction and execution of function.[76] Changes in mental status may lead to poor judgment and slowed response time that contribute to fall risk.[77] Unfortunately, heightened awareness of injury risk and the fear of falling can further reduce mobility and quality of life.

Beneficial properties of water

The aquatic environment has unique properties that can be used to gain a range of exercise benefits, which are detailed below.

1. Buoyancy

Buoyancy is the upward pressure of water on the body, acting in the opposite direction to gravity. Buoyancy reduces body weight, which may assist people to move limbs through the full range of motion and reduce pressure on joints.

2. Turbulence

Turbulence is the irregular motion or swirling agitation of water. Turbulent water can provide an environment for static and dynamic balance training with minimal risk of injury. The level of challenge can be raised by increasing the water agitation (perform faster or larger movements of the body within the water).

3. Hydrostatic pressure

Hydrostatic pressure is the force exerted by water on an immersed object and is proportional to the depth of water. Hydrostatic pressure on limbs may help reduce swelling.

4. Resistance

Water is denser than air and provides greater resistance to movement. The more surface area that you present in the direction of the movement, the more resistance you create, and the more force needed to overcome that resistance. This property is important for strength training in water. Taking these properties of water into consideration when designing an aquatic exercise program can facilitate movement and vary the intensity of the exercises. In this way, exercise can be tailored to the needs of most people with MS.

MATERIALS AND METHODS

In research, semi-experimental design with pretest-posttest control group has been used and 60 male patients attending MS society. Initial screening included medical history and pretrial questionnaire, gathering data on age, time since diagnosis, course of the disease, and Expanded Disability Status Scale (EDSS). Inclusion criteria were MS diagnosis, age between 20 and 50 years, and EDSS between 2 and 5. Informed consent was obtained from each patient before entering the study. The subjects were randomly assigned into experimental and control groups. Training program for aquatic group was carried out for 8 weeks (three sessions of one hour per week) while the control group did not receive any intervention.

The sessions consisted of three sections as follows:
Warm up: This section included progressive aerobic activity. Before beginning the exercise programs, subjects were asked to measure their heart beat in 3 consecutive days when they are relaxed (mornings in the bed and before doing any activity) and report it to the research team which was estimated to be around 50-74% of their maximum heart rate. This is approximately equal to the percentage of VO2max with a standard deviation of 10; so, based on the estimated heart rate, age and severity of the disease, subjects were exercised.

Main plan: This section consists of three phases and 14 exercise in the water. One minute was considered for each movement. The subjects were asked to do movements with their maximum power. However, in case of pain, in order to maintain the health of patients, they were asked to do movements as far as the pain was tolerable.

Cool down: In order to improve the joints' range of motion, some flexibility movements (for 5 minutes) were practiced by patients at the end of each session depending on the muscle and the joint damage.

Main Aquatic exercise program
The main program is described in the following:

Phase I – Aquatic environment adaptation.
Exercise 1: Respiratory control.
- Positioning: Semi-seated position without posterior support, with immersion to the shoulder level. Shoulders at 90º flexion and with extended elbows.
- Activity: Slow and prolonged expiration through the mouth over the water, then with the mouth immersed, and subsequently with both mouth and nose immersed (2).

***Phase II – Stretching. Each stretching exercise was maintained for 30 seconds*.**
Exercise 2: Stretching of the hamstring muscles
- Positioning: Orthostatic position with back supported against the wall.
- Activity: Elevation of one of the lower limbs, maintaining knee extension and ankle dorsal flexion.

Exercise 3: Stretching of the triceps surae and iliopsoas muscles.
- Positioning: Orthostatic position with hands on the edge of the pool.
- Activity: Taking a large step forward, while maintaining the anterior knee in flexion, the posterior knee in extension, and feet in contact with the bottom of the pool.

Phase III – Static and dynamic exercises for balance. The speeds and frequencies indicated were approximate averages.
Exercise 4: Walking in circles hand-in-hand with sporadic changes of direction
- Activity: Walking sideways, facing forwards and backwards, alternating the direction from clockwise to anticlockwise, three times in each kind of walk (once for each kind of walk, speed: 0.40 m/s).

Exercise 5: Walking in line
- Positioning: Hand supported on the waist of the individual in front.
- Activity: Moving in the pool making circles and changes in direction. The activity was conducted by the physical therapist (Three times, speed: 0.40 m/s).

Exercise 6: Walking forward pushing lower members vigorously
- Activity: Walking with higher speed and propulsion (45 meters, speed: 0.50 m/s).

Exercise 7: Walking backwards. (45 meters, speed: 0.50 m/s)

Exercise 8: Lateral walk with large steps. (45 meters, speed: 0.55 m/s)

Exercise 9: Walking with one foot in front of the other
- Activity: Walking supporting one foot immediately in front of the other, and so on successively (45 meters, speed: 0.20 m/s).

Exercise 10: Walking with trunk rotation
- Activity: Walking forwards taking hand to opposite knee in flexion, alternately (45 meters, speed: 0.30 m/s).

Exercise 11: Walking with one-leg support pauses
- Activity: Walking and, at the physical therapist's command, maintaining one-leg support with the opposite knee in flexion for 10 seconds (12 pauses in 45 meters, speed: 0.50 m/s).

Exercise 12: Bilateral shoulder flexion-extension
- Positioning: Semi-seated position.
- Activity: Performing shoulder flexion and extension, while keeping the elbows in extension. Starting with maximum shoulder hyperextension and going until 90º flexion (10 repetitions, frequency: 12 repetitions per minute).

Exercise 13: Bilateral horizontal shoulder abduction-adduction
- Positioning: Semi-seated position, shoulders flexed at 90º extended elbows.
- Activity: Starting in adduction and going until 90º of horizontal abduction (10 repetitions, frequency: 12 repetitions per minute).

Exercise 14: Ankle pumping
- Positioning: Orthostatic position, with immersion up to the xiphoid process level.
- Activity: Extension of the knees associated with plantar flexion, maintaining this position for 5 s, and then knee flexion associated with dorsiflexion, also maintaining this for 5 s (10 repetitions, frequency: 3 repetitions per minute).

The Patients' scale of static and dynamic balance was measured by Balance system before and after the exercise. The obtained data were analyzed by covariance method (ANCOVA).

RESULTS

Table 1: Covariance analysis to determine the effect of the aquatic exercise in static balance with close eyes

Source of changes	Sum of squares	Degree of Freedom	Mean of squares	F	Significant Level
Static balance Pre-test	1.18	1	1.18	30.58	0/053
Static balance Post-test	2.12	1	2.12	21.54	0.000**
Error	2.97	57	0.052		
Sum	2610.81	60			

As seen in Table 1, 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 can claim that doing the aquatic exercise causes a significant increase in the MS patients' close eye balance compared with that of the control group.

Table 2: Covariance analysis to determine the effect of the aquatic exercise in static balance with open eyes

Source of changes	Sum of squares	Degree of Freedom	Mean of squares	F	Significant Level
Static balance Pre-test	1.79	1	1.79	10.86	0.177
Static balance Post-test	1.52	1	1.52	8.16	0.685
Error	240.30	57	0.42		
Sum	2610.81	60			

The table 2 shows the results of a covariance analysis to determine the effect of aquatic exercise on static balance of the examinees in the two groups. The result indicate that the there is no significant effect in static balance with open eyes on MS patients.

The table 3 shows that dynamic balance scores have significant increasing after intervention. Therefore, it can be said that aquatic exercise interventions can significantly increase the dynamic balance of the examinees in the post-experiment stage.

Table 3: Covariance analysis to determine the effect of the aquatic exercise in dynamic balance

Source of changes	Sum of squares	Degree of Freedom	Mean of squares	F	Significant Level
Static balance Pre-test	12.42	1	12.42	5.16	0.016
Static balance Post-test	13.62	1	13.62	6.56	0.000***
Error	124.02	57	2.17		
Sum	59596.23	60			

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 scleroses 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 3, 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 exercise in water causes a significant increase in the dynamic balance of the examinees in the post-experiment stage. These findings were in compliance with those by Freeman and colleagues,[10] Masoodi Nejad 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.

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

REFERENCES

[1] Bakhshaei Mahdi, Froughipour Mohsen, Ismaili Habibollah, Rostami Vahid, Razmara Narjes. *J Ear, Throat, Nose*. **2007**;XIX(No. 47):27–32.
[2] Bayer Shrink Farma. Tehran: Jalal Publication; 1389. Introduction to multiple sclerosis 1, translation company Bayer Farma Shrink Office.
[3] Shaygannejad, Vahid, Sadr-Ameli, Mohammad Mashhad: Vazhiran publication; **2010**. Successful Living with Multiple Sclerosis.
[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. 6th ed. Tehran: SAMT; **2009**. Physical Fitness.
[7] White LJ, Dressendorfer RH. *Sports Med*. **2004**;34:1077–100. [PubMed]
[8] Rabeh AA, Shaterzadeh Yazdi MJ, Mohammadzadeh S, Shahin NG, Arastou AA. *Med J Jondi Shapour*. **2010**;9:35–43.
[9] Mahmoud S, Mahmoud HS, Abbas N, Ahmad Z, Marziyeh A. *J Nurs Midwifery Mashhad*. **2009**;9:107–13.
[10] Freeman J, Fox E, Gear M, Hough A. *BMC Neurol*. **2012**;12:19. [PMC free article] [PubMed]
[11] Monireh MN, Hossein S, Hossini F. WASJ. **2012**;16:1019–26.

[12] Sosnoff JJ, Socie MJ, Boes MK, Sandroff BM, Pula JH, Suh Y, et al. *PLoS One*. (e28021) **2011**;6 [PMC free article] [PubMed]
[13] Charlton ME, Gabriel KP, Munsinger T, Lorene RN, Schmaderer PT, Healey KM. *IJMSC*. **2010**;12:92–6.
[14] Cattaneo D, Jonsdottir J, Zocchi M, Regola A. *Clin Rehabil*. **2007**;21:771–81. [PubMed]
[15] Kurt J, Mulcare JA, Donahoe-Fillmore B, Fritz HI, Rodgers MM. *Int J MS Care*. **2007**;9:111–7.
[16] Smith C, Hale L, Olson K, Schneiders AG. *Disabil Rehabil*. **2009**;31:685–92. [PubMed]
[17] Béthoux F, Bennett S. *Int J MS Care*. **2011**;13:4–14.
[18] Allahbakhshian M, Jaffarpour M, Parvizy S, Haghani H. *ZJRMS*. **2010**;13:29–33.
[19] Hanjani SL, Ansari KS. *RJMS*. **2011**;22:17–24.
[20] Stevens JA, Olson S. *MMWR Morb Mortal Wkly Rep*. **2000**;49:1-12.
[21] Salzman, AP. Evidence-based aquatic therapy for proprioceptive-training. The Aquatic Resources Network. Atri's Aquatic Symposium; Set **1998**: H95-9.
[22] ouris P, Southard V, Varga C, Schauss W, Gennaro C, Reiss A. *J Geriatr Phys Ther*. **2003**;26(1):3-6
[23] Lord SR, Matters B, George RS. *Aust J Ageing*. **2006**;25(1):36-41
[24] Devereux K, Roberston D, Briffa NK. *Aust J Physiother*. **2005**;51(2):102-8.