

# A Comparison between Pilates Exercise and Aquatic Training effects on Muscular Strength in Women with Multiple Sclerosis

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## ABSTRACT

**Background & Objective:** Multiple Sclerosis is a disabling chronic disease of the nervous system characterized by damage to myelination in the central nervous system. The goal of this study was to understand the effect of Pilates exercise and aquatic training for a 12 week period on the muscular strength of MS patients.

**Methodology:** Our method was semi-experimental, therefore, among the female patients visiting the MS clinic at Kashani University Hospital, Isfahan, Iran, 57 patients with disease intensity levels between 0 and 4.5 were selected as samples. The patients age ranged from 20 to 40 years with disease history period of  $8 \pm 2$  years. We randomly divided them into three groups, namely Pilates exercise group, aquatic training group and the control group. The exercise schedule for the experiment groups included 12 weeks, three sessions a week. Each session took one hour. 'Patients' muscle strengths were measured by a dynamometer before and after the exercise.

**Result:** The adjusted mean differences of patients' dominant and non-dominant hands strengths scores in the experimental groups were significant. ( $P < 0.05$ ).

**Conclusion:** It seems that Pilates exercise and aquatic training both significantly increase muscular strength in MS suffering women. Therefore it would be prudent to offer such activities in addition to medical treatment to provide them with a higher quality of life.

**Key Words:** Multiple Sclerosis, Pilates, Aquatic training, Muscle strength.

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## INTRODUCTION

Multiple sclerosis (MS) is a progressive chronic demyelination of the central nervous system with different progression courses and various signs and symptoms. The American MS Association, in 2001, announced that 2.5 million people all around

the world were suffering from this disease and that 200 new cases were added to this population every week. Moreover, 80% of such patients had some degrees of disability.<sup>1</sup> Similar to all other autoimmune diseases, MS is more common in women than in men. In fact women are twice more affected by MS than men.<sup>2</sup> The disease activity puts profound effects on patients' lives via preventing them from several normal daily routines.<sup>3</sup> The most important problems with MS are fatigue, depression, involuntary muscle contraction, and sexual disorders.<sup>4</sup> Among the movement disorders are muscle stiffness, muscle weakness, and limb stiffness.<sup>5</sup> Muscle weakness can lead to diminished power in one or a group of muscles. The electrical signal conduction abnormality in MS is known to be due to destruction of myelin which covers spinal and brain nerves.<sup>6</sup>

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Different studies showed that exercise therapy, if done correctly, can help MS patients. Some such benefits are improvement in physical conditions, better performance in daily routines, psychological and spiritual well-being, greater compliance for medical therapy, and better control of the disease symptoms.<sup>5</sup> In order to keep healthy and active, all muscles need exercise. It is important to know which exercises are most suitable for improving muscle conditions in such patients.<sup>6</sup>

Mot<sup>7</sup> in a study titled "physical activities and irreversible disabilities in multiple sclerosis patients" concluded that exercise could cause a slowdown in the progressive process of movement impairment and an improvement in their psychological performance.

One of the new exercise styles is Pilates. Pilates exercise (contrology science) was introduced and developed in 1920 by Joseph Pilates, however in Iran it was first introduced in 2006.<sup>8</sup> It consists of a collection of specialized exercises encouraging the use of mind in controlling the muscles.<sup>9</sup> Pilates exercises include stretch-power movements that take place in the range of joint movements and with a controlled speed and along with concentration and deep breaths.<sup>10</sup>

Atash zadeh Shoorideh et al<sup>11</sup>, in a research on the effects of exercise on the quality of life and performance of daily activities in women with MS showed that exercise sensibly decreased fatigue in these patients. Taylor and colleagues<sup>12</sup>, applied some progressive resisting exercises on 9 patients with MS, who had an average age of 45 years and had physical disability levels of low to moderate. According to the results of this research, the muscular power of hand, endurance of leg muscles and speed of running showed a significant improvement in a two-minute test. Durstine and colleagues<sup>13</sup> claimed that exercise could improve the short-term fitness, personal performance, strength, endurance, aerobic preparedness, fatigue tolerance, and flexibility in MS patients. Exercise is also associated with minor improvement in walking in MS patients especially when it was supervised by an expert.

Docu and colleagues<sup>14</sup> studied the effects of a sport rehabilitation program in MS patients. They reported positive results in patients' performance. According to the results of this study, endurance exercises with low to moderate intensity and resistance exercises with moderate intensity had better results compared to no exercise state. Asano<sup>15</sup> in his research "exercise program and physical activity for MS patients" made an assessment on the effect

of exercise interventions on the improvement of MS patients. The results of this study showed that physical activities made an increase in self-confidence, promoting an active life, preventing accidents, injuries and fatigue and also an increase in strength, endurance and flexibility of the people. Charlton and colleagues<sup>16</sup> in an article titled "the results of a structured evaluation of effects of exercise in MS patients" showed that all the participants enjoyed improvement in their flexibility, strength, balance, coordination, and psychological mood.

Arastoo and colleagues<sup>17</sup>, in their study on the effect of eight weeks of aerobic exercise and yoga on the Physiologic Cost Index in patients with MS showed that PCI dropped in patients with selected aerobic and yoga exercises while it rose in the control group patients.

Freeman et al<sup>18</sup>, in their paper "training the central strength based on the Pilates exercises in MS patients" focused on the effects of Pilates exercises on balance and activity in MS patients, and concluded that such exercises were effective on improvement of the physical status in MS patients.

Masoodi Nejad and colleagues<sup>19</sup>, studied the effect of selected composite exercises on female MS patients' balance and performance. Their findings showed that those composite exercises were effective on improving their balance and performance.

In this study, our main goal was to find whether Pilates and aquatic exercises could sensibly improve the physical status of women suffering from MS.

## METHODOLOGY

This was a clinical and semi-experimental study focused on the effect of a 12-week Pilates exercise and aquatic training program on the muscular strength of women with MS. A total of 57 women with MS and a disability index (EDSS) of less than 4.5 were randomly selected from the patients referring to MS Clinic at Kashai University Hospital, Isfahan, Iran. The selected patients were randomly divided into 3 equal groups. They were briefed on the goals of this study and asked to sign a letter of informed consent.

The exercise program for the aquatic training group included a series of water activities for a period of 12 weeks, with 3 one-hour sessions a week. Each session started with 10 minutes walking in water followed by stretching, power and endurance activities. In the final 10 minutes of each session, some cool-down and balance movements were performed.

Table-I: Number-descriptive indexes for the muscular strength based on the assessment stage & group membership type.

		Pre-experiment			Post-experiment		
		Freq.	Mean	Std. Dev.	Freq.	Mean	Std. Dev.
Dominant hand strength	Pilates	15	20.80	6.71	15	27.53	4.26
	Aquatic Training	15	24.47	5.10	15	25.93	5.21
	Control	15	19.80	5.73	15	16.73	7.03
Non-dominant hand strength	Pilates	15	18.90	4.68	15	24.23	5.64
	Aquatic Training	15	21.80	4.30	15	22.43	4.95
	Control	15	16.03	5.63	15	14.67	5.59

The exercise program for the Pilates exercise group included a series of exercise activities for a period of 12 weeks and three sessions every week. Each session took one hour. Every session started with 10 minutes of simple stretching movements to warm up followed by the main part of the exercise plan including stretching, power and muscular-nervous coordination and balance movements. In the final 10 minutes, some cool-down stretching movements were performed. When the 12 week study period was over, the muscular power of all the three groups were measured by a dynamometer and the results were analyzed.

It is important to mention that all patients in the three groups continued a similar medical therapy during the 12 weeks of the exercise course. Those who were absent for more than 6 sessions were excluded.

**Tools and Measurement Method:** Considering the fact that "hand grip" was used as an index for hand strength, the person must be in standing position, holding their arms next to their bodies and hold the dynamometer in their dominant hand, holding its handles by his fingers. Then, with maximum stress, the dynamometer's handles were pressed. The elbows and the wrists were not supposed to bend and the upper arms were not to be next to the body. Three rounds of moves with suitable time intervals were performed and the highest result was registered. This experiment was repeated for the non-dominant hand, too.

## RESULTS

As shown in Table-I, the average score after the 12 week course of study was 27.53 for Pilates group and 25.93 for the aquatic training group. The control group's average score was however 16.73. These values, for the non-dominant hand, were 24.23 and 22.43 for Pilates and aquatic training groups respectively. The control group's average score was 14.67. The associated standard deviations for these values are presented in Table-I.

As seen in Table-II, the pre-experiment hands strength scores of the non-dominant hand showed no significant correlation with those of the post-experiment stage. By controlling this relationship, it was found that the adjusted mean differences of non-dominant hand strength scores of the experimental groups were significantly different ( $P < 0.05$ ). Therefore, it could be assumed that Pilates exercise interventions and aquatic training may increase the non-dominant hand strength of the patients in the post-experiment stage. The square root of Eta or the level of effectiveness showed that introduction of Pilates exercise interventions and aquatic training made an increase of 33.9% in non-dominant hand strength of the patients compared to the control group patients. The statistical power of 98.3% is a sign of high statistical accuracy and sufficiency of the sample population size for testing this hypothesis.

Table-III shows the difference between the adjusted mean for Pilates group and the control

Table-II: Covariance Analysis to determine the effect of Pilates and Aquatic Training on the non-dominant hand strength.

Source of Changes	Sum of Squares	Degree of Freedom	Mean of Squares	F	Significance level	Level of effectiveness	Statistical Power
Pre-experiment	17.09	1	17.09	0.58	0.451	0.014	0.115
Group membership	619.70	2	309.85	10.511	0.000	0.339	0.983

Table-III: The paired comparison of non-dominant hand strength 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	24.23	Aquatic Training	22.06	2.18	2.0	0.293
		Control	15.04	9.19	2.0	0.000
Aquatic Training	22.06	Control	15.04	7.02	2.2	0.003

Table-IV: The results of a covariance analysis in order to determine the effect of Pilates and Aquatic Training on the dominant hand 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	11.39	1	11.39	0.35	0.554	0.009	0.090
Group membership	1023.11	2	511.56	15.95	0.000	0.438	0.999

group is 9.19. This mean difference is statistically significant ( $P < 0.05$ ); Therefore, we can conclude that Pilates exercises can make a significant increase in the strength of the non-dominant hand in MS patients in comparison with the control group.

As seen in Table-III, the difference between the adjusted mean value for the aquatic training group and the control group is 7.02. This mean difference is statistically significant ( $P < 0.05$ ); Therefore, it seemed that aquatic training could make a significant increase in the strength of the non-dominant hand of our MS patients in comparison with the control group. The adjusted mean difference in pilates exercise group and aquatic training group is 2.18. This mean difference is statistically insignificant; therefore, we can conclude that aquatic training or Pilates exercises cannot make a significant change in the strength of the non-dominant hand in MS patients in comparison with the control group.

Table-IV shows the scores for dominant hand power or strength in the pre-experiment stage had insignificant relation with those of the post-experiment stage. By controlling this relationship, we observed that the difference in adjusted means for the dominant hand strength in the experimental groups were significantly different ( $P < 0.05$ ). As a result, we assumed that the intervention of Pilates exercises and aquatic training could possibly increase the dominant hands' strength in the post-experiment stage. The square root of Eta showed that the overall interventions of Pilates exercises and aquatic trainings increased the dominant hand power by 43.8% compared to that of the control group. The statistical power of 99.9% indicated a very high accuracy and sufficiency of the sample size for testing this hypothesis.

As seen in Table-V, the adjusted mean difference between the Pilates exercise group and the control group was 10.89. This difference was statistically

significant ( $P < 0.05$ ); Therefore, we thought that Pilates exercises could increase patients' dominant hand strength compared to that of the control group.

And finally as presented in Table-V, the adjusted mean difference between the aquatic training group and the control group was 9.61. This difference was statistically significant ( $P < 0.05$ ); Therefore aquatic training seemed to benefit patients' dominant hand strength compared to that of the control group.

Moreover, the adjusted mean difference between the aquatic training group and the Pilates group was 1.28. This difference was statistically significant. Therefore, it looked as if doing the aquatic training or performing the Pilates exercises had not made an increase in the MS patients' dominant hand strength.

## DISCUSSION

Multiple sclerosis is one of the most common debilitating and demyelinating diseases of the central nervous system.<sup>20</sup> Weak holding of the hands can also be the result of some other central or peripheral nervous system diseases. It can also be due to the painful disorders of the hands.<sup>21</sup>

As shown in Tables II, III, IV and V, the pre-experiment scores of the dominant and non-dominant hands in the control group showed no significant difference with those of the post-experiment results; however, the scores of both dominant and non-dominant hands in the experiment groups showed significant difference with those of the post-experiment results ( $P < 0.05$ ). Therefore, it seems that Pilates and aquatic training interventions made some significant muscle strength in our patients after the completion of the experiment. These findings are in accordance with those by Atashzadeh Shoorideh and his colleagues (2003)<sup>11</sup>, Taylor and colleagues (2006)<sup>12</sup>, Durstine and

Table-V: The comparison of paired dominant hand strength 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	27.45	Aquatic Training	26.18	1.28	2.1	0.554
		Control	16.57	10.89	2.1	0.000
Aquatic Training	26.18	Control	16.57	9.61	2.2	0.000

colleagues (2008)<sup>13</sup>, Doco and colleagues (2009)<sup>14</sup>, Aseno (2010)<sup>15</sup>, Charlton and colleagues (2010)<sup>16</sup>, Arastoo and colleagues (2011)<sup>17</sup>, Masoudi Nejad and colleagues (2012)<sup>19</sup>, Mot (2010)<sup>7</sup> and Freeman and colleagues (2012).<sup>18</sup> The paired comparison of the hand strength in the patients indicated that Pilates exercises had a more significant effect compared to the control group.

Hence we can conclude that Pilates exercises made a significant increase in MS patients' hand strength compared to the control group. This finding is in agreement with those by Charlton and colleagues (2010)<sup>16</sup>, Freeman and colleagues (2012)<sup>18</sup>, Masoudi Nejad and colleagues (2012)<sup>19</sup> about the effectiveness of Pilates exercises on muscular power and physical performance. Pilates exercises must be accompanied with mental awareness and concentration so that they can be effective on the internal systems and body's physiological factors.

However, no significant difference was observed between Pilates exercises and aquatic training, and we can say that both Pilates and aquatic training did put a significant effect on the muscle power of the MS patients. In addition, the difference between the two methods was negligible.

### CONCLUSION

The results of this study demonstrate that the aquatic training and Pilates exercise are among the most effective exercise types for MS patients. Therefore, specialists are advised to suggest these exercise programs as supplements to the medicinal treatment plans for MS patients.

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