

The effects of aquatic, isometric strength-stretching and aerobic exercise on physical and psychological parameters of female patients with fibromyalgia syndrome

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Abstract. [Purpose] There are various treatment modalities for fibromyalgia syndrome (FMS), which is characterized by widespread pain and fatigue. The aim of this study was to investigate the effects of aquatic, aerobic and isometric strength-stretching exercises on the physical and psychological parameters of patients with FMS. [Subjects and Methods] Seventy five female patients with FMS were randomly selected and divided into three groups. Patients (18–50 years) were treated for 3 months using one of three methods: a home-based isometric strength and stretching exercise program (ISSEP), a gym-based aerobic exercise program (AEP), and a pool-based aquatic aerobic exercise program (AAEP). Items evaluated were: the number of tender points, Visual Analog Scale (VAS), Fibromyalgia Impact Questionnaire (FIQ), the Six-Minute Walk Test (6MWT), SF-36 physical and mental health scores, and the Beck Depression Inventory (BDI). [Results] The results revealed that AAEP was the most effective treatment of the three. All of the groups showed significant improvements in all variables between pre-and post-test, except the mean values of VAS and BDI in ISSEP. [Conclusion] The results suggest that aquatic aerobic exercise program is more effective than AEP and ISSEP in the treatment of FMS.

Key words: Fibromyalgia, Exercise, Treatment

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INTRODUCTION

Fibromyalgia syndrome (FMS), which is characterized by widespread pain and fatigue, is a disease that affects the connective tissues and locomotor system^{1–3)}. Patients with FMS also suffer from weakness, fatigue, lack of energy, sleep disturbances, waking up tired in the morning (non-restorative sleep), and stiffness. While complaints especially in cold weather increase with the change of seasons, patients' work is affected and they experience, a decrease in their quality of life⁴⁾. It is reported that the incidence of fibromyalgia is 3.4% among women and 0.5% among men, and 70–80% of patients are women⁵⁾.

Although it may be observed at any age groups⁶⁾, FMS is often observed in sedentary women between 30–50 years of age⁷⁾. It is reported that muscle oxygenation changes, and psychological, biochemical, hormonal and immunological

factors are involved in the pathogenesis of FMS⁸⁾.

Psychological disorders are observed in nearly 30–40% of FMS patients⁹⁾. In addition, irritable bowel syndrome, tension-type headaches, perfectionist personality, premenstrual syndrome, sicca, female urethral syndrome, and Raynaud like symptoms are all associated with FMS^{10–12)}.

The American College of Rheumatology (ACR) suggested some criteria for the classification of fibromyalgia in 1990. According to the criteria, widespread pain lasting longer than 3 months (pain in the right and the left side and in the lower, and upper back must be located in the axial skeleton) and tenderness in at least in 11 of 18 tender points are symptomatic of FMS⁵⁾. In addition, hyperemia and skin discoloration are observed at the tender points of patients with FMS^{10–13)}.

There is no suggested cure for fibromyalgia, as in the treatment of common chronic illnesses, so informing and educating the patients about the illness should be the focus of treatment¹⁴⁾. Numerous studies have shown that low intensity physical activity and exercise including stretching, swimming, walking, jogging, and cycling are beneficial for patients with chronic pain and FMS, increasing fitness levels, reducing the spread of pain and tenderness, improving the quality of life, and reducing depression levels^{15–22)}. Muscular strength, endurance, and the aerobic fitness levels of

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FMS patients are lower than those of healthy controls^{23–25}). Thus, it is important to provide well-structured exercise programs and physical activity for FMS patients in order to reduce their sedentary life style.

In the study of Gowans et al., 20 female patients were assigned to pool exercise twice a week for 30 minutes, while a control group did not do any exercise. There were significance changes in Fibromyalgia Impact Questionnaire (FIQ), fatigue, pain, and improvement in disease symptoms between the control and experimental groups. The experimental group patients also maintained their wellbeing level after three months⁹).

Alina investigated the relationship between functional capacity and a self-report of quality of life with the practice of regular exercise by patients with FMS, and found that intervention elicited²⁶) significant differences in the quality of life and functional capacity between the regular exercise group and the no-regular exercise group. A significantly lower score for functional capacity in the Health Assessment Questionnaire (HAQ) was found in the no-regular exercise group, while higher values were observed in the regular exercise group for the physical functioning ($p < 0.001$) and bodily pain ($p < 0.05$) domains of SF-36. There were no significant differences between two the groups in the physical, general health, vitality, social functioning, emotion and mental health domains, and Alina concluded that regular exercise had a positive impact on the functional capacity and quality of life of patients with FMS²⁶).

Cedraschi et al. observed 164 FMS patients during a 6-week pool exercise program. The patients practiced relaxation techniques 2 times a week for 6 weeks. Each session consisted of 45 minutes and the FMS patients in the exercise group were followed for 6 months. Their FIQ anxiety scores showed a significant improvement compared to the control group⁷).

In a study of 50 patients with FMS by Altan et al., the patients were divided into experimental and control groups and performed balneotherapy pool workouts. The experimental group performed a two-week training program of 2 × 35 minutes sessions/week consisting of aerobics, flexibility and relaxation exercises. The control group did not participate in any exercise program and were only treated with spa therapy. The experimental group showed a significant level of depression. In both groups, significant improvements in pain intensity stiffness, and fatigue were observed²⁷). In the studies conducted by Verstappen et al. and Gowans et al., FMS patients were tested after exercise treatments including aerobics and pool exercises^{10, 11}). The exercise groups showed improvements in overall well-being compared to the control group, and both study groups reported that the exercise program had not only a corrective effect on posture during sitting or standing upright, due to strengthening of the muscles, but also decreased pain through more balanced muscle contraction¹²).

Various exercise modalities such as ground-based, water-based, aerobic, pool or aquatic balneotherapy, and hot water spa are used in the treatment of patients with FMS^{28–31}). Especially, balneotherapy (hot water therapy), isokinetic strength stretching, aerobic and strengthening exercises are commonly used for the reduction of pain^{29, 31}). However, the

implementation of these exercises are generally based upon the availability of facilities, so water-based exercises are very rare in Turkey.

This study compared the effects of home-based isometric strength and stretching, gym-based aerobic and pool-based aquatic exercises programs on the physical and psychological parameters of patients with FMS.

SUBJECTS AND METHODS

The data were collected from fibromyalgia patients who were diagnosed by a specialist in the clinic of Physical Medicine and Rehabilitation Department, Faculty of Medicine, Cukurova University. Among the 107 patients recruited for the study, 32 were excluded because: 9 were postmenopausal, 10 were over 50 years, refused to participate in the study, one had a cardiovascular problem, one had Cushing syndrome, and one was under 18 years. The study was approved by the local ethics committee. After informing all the subjects about the design and the risks of this study, they gave written consent prior to participation in the study.

The patients were randomly assigned to one of three exercise program groups and matched by age and their symptoms of FMS.

The exercise training programs comprised aerobic gymnastic, isometric strength-stretching, and aquatic exercises, all of which aimed to increase flexibility, and muscular and aerobic endurance based on graded activity.

Seventy-five female patients with FMS according to the ACR definition between the ages of 18–50 (35.0 ± 8.8) were randomized into three groups. The first group ($n: 25$) performed a home-based isometric strength and stretching exercise program (ISSEP) lasting 15 minutes per day. The second group ($n: 25$) attended a gymnastic-based aerobic exercise program (AEP) with group therapy two times per week³²). The third group ($n: 25$) attended a pool-based aquatic aerobic exercise program (AAEP) with group therapy two times per week. The durations of the exercise programs were 40 minutes for AEP and AAEP in first month, 45 minutes in the second month and 50 minutes in the third month. All the exercise programs lasted 3 months. The primary outcome measure was pain Visual Analog Scale (VAS). The secondary outcome measures were: health status FIQ, the Six-Minute Walk Test (6MWT) for endurance³³), quality of life scores represented by SF-36 physical and mental component scores³⁴) and depression as assessed by the Beck Depression Inventory (BDI)³⁵). The intensity of exercise was determined according to the Karvonen method and was generally 60–80% of a subject's maximal heart rate. Heart rates were measured eight times at regular intervals during the exercise program to monitor loading level during aerobic exercise programs.

All of the subjects completed the three-month exercise program. Three-minute loadings with 30 seconds rest between three sets of low to moderate intensity were repeated in the first month of the exercise program (3×3). In the second month 30 seconds high intensity loadings with 30 seconds rest period between four sets were performed after three minutes of low intensity loading (3×4). With reducing rest intervals from 30 to 10 seconds, three-minute loadings

of five sets were repeated in the third month of the exercise program (3×5).

SPSS (Statistical Package for Social Sciences) for Windows version 13.0 was used for the statistical evaluation of the data. Descriptive statistics were calculated and the chi square test, Mann-Whitney U test and Kruskal-Wallis test were used for two-and three-group comparisons. The Wilcoxon test was also used for pairwise comparisons of pre- and post-test. A 0.05 significance level was used for statistical significance.

RESULTS

Demographic characteristics of the patients including age, weight, height, mean symptom duration, mean tender point count and educational level were similar. Baseline values of the patients' VAS, BDI, FIQ, 6MWT and SF-36 scores were also similar among the three groups. The results are presented in Table 1. The comparisons of the pre-and post-test results of each group are presented in Table 2.

For VAS, the ISSEP group had the lowest mean score before the exercise program, while the AAEP group had the lowest score after the 12-week exercise program. For BDI, the AAEP group had the lowest mean value before and after 12-week exercise program. For FIQ, the AEP group had the lowest mean score, while the AAEP group had the lowest value after the 12-week exercise program. For 6MWT, the AEP group had the highest mean value before and after the exercise program. For mental component scores of SF-36

(MCS), the AAEP group had the highest mean score before and after the exercise program. For physical component scores of SF-36 (PCS), the AEP group had the highest mean score before and after the exercise program.

VAS and BDI values showed significant differences in their pre-and post-test values in all three groups, while FIQ, 6MWT, MCS and PCS values showed no significant differences between pre-and post-test in the ISSEP group. On the other hand, the results of both the AEP and AAEP groups showed significant differences in FIQ, 6MWT, MCS and PCS between pre-and post-tests.

DISCUSSION

Fibromyalgia syndrome is a chronic musculoskeletal disorder with generalized muscular pain characterized by fatigue and tenderness at specific tender points along with commonly associated symptoms such as altered sleep, cognitive and emotional disturbances (anxiety and depression), increase of disability and decrease of quality of life. Researchers suggest that the effective treatment for fibromyalgia should include medication with lifestyle changes and alternative treatments⁽²⁸⁾. Thus, this study aimed to determine which exercise program among isometric strength and stretching, and aerobic and aquatic exercises programs is the best at reducing the symptoms of fibromyalgia^(36, 37).

VAS was compared among the three groups and, both the aquatic (AAEP) and gym (AEP) groups showed statistically significant improvements compared to the isometric

Table 1. Comparison of the primary and secondary outcome scores at baseline and after 12 weeks of training

Variables	Groups	n	Baseline		After 12 weeks	
			Mean Rank	Mean \pm SD	Mean Rank	Mean \pm SD
VAS/mm**	ISSEP	25	35.7	68.2 \pm 11.8	57.6	70.4 \pm 12.5
	AEP	25	37.5	70.0 \pm 12.9	28.4	48.2 \pm 8.8
	AAEP	25	40.7	71.5 \pm 13.1	28.1	48.0 \pm 9.3
BDI**	ISSEP	25	41.9	19.4 \pm 10.1	56.4	22.6 \pm 10.0
	AEP	25	39.9	20.5 \pm 12.3	33.5	9.9 \pm 6.2
	AAEP	25	32.1	15.7 \pm 9.0	24.1	6.1 \pm 7.8
FIQ**	ISSEP	25	39.6	59.1 \pm 16.5	56.8	62.9 \pm 16.1
	AEP	25	35.3	58.3 \pm 13.4	29.6	36.6 \pm 15.7
	AAEP	25	39.1	60.1 \pm 12.1	27.6	34.9 \pm 17.1
6MWT/m**	ISSEP	25	34.1	541.5 \pm 53.3	19.7	540.4 \pm 53.8
	AEP	25	46.7	569.5 \pm 48.3	49.9	628.8 \pm 55.5
	AAEP	25	33.2	543.4 \pm 56.4	44.4	619.4 \pm 61.8
MCS*	ISSEP	25	33.4	31.6 \pm 9.0	19.2	32.02 \pm 9.4
	AEP	25	36.8	32.5 \pm 9.7	42.7	45.2 \pm 7.0
	AAEP	25	43.7	35.2 \pm 7.9	52.2	49.4 \pm 8.3
PCS**	ISSEP	25	34.5	37.3 \pm 7.6	18.0	36.8 \pm 8.4
	AEP	25	46.4	41.8 \pm 8.4	51.2	53.6 \pm 5.4
	AAEP	25	33.1	36.4 \pm 8.5	44.8	50.3 \pm 7.4

*significant at 0.05 level, **significant at 0.01 level, SD: standard deviation

ISSEP: home-based isometric strength and stretching exercise program AEP: gym-based aerobic exercise program, AAEP: pool-based aquatic aerobic exercise program VAS: Visual Analog Scale, BDI: Beck Depression Inventory, FIQ: Fibromyalgia Impact Questionnaire, 6MWT: Six-Minute Walk Test, MCS: Mental Component Scores, PCS: Physical Component Scores

strength-stretching exercise (ISSEP) group. In addition, no statistically significant difference was found between the AAEP group and the AEP exercise group. When the intra-group results were compared, only the ISSEP group showed an increase in the mean value of VAS, whereas both the AAEP and AEP exercise programs improved the pain threshold with only slight differences between them. Similarly, in the study of Assis et al., no significant difference in VAS was found when AEP and AAEP groups were compared³⁸). In the 48-week study conducted by Ramsey et al., one group performed aerobic exercises, while the other group participated in a home-based stretch-strength exercise program, and no improvement in the values of VAS was found between the two groups. Besides, no statistically significant difference between the groups was found¹⁶). Contrary to several previous studies reporting similar treatment effect of ISSEP and AEP, our present study found no difference in VAS between AEP and AAEP¹⁶). In addition, Bircan et al. reported that aerobic exercise and strength exercise were similarly effective at improving symptoms, tender point count, fitness depression, and quality of life in FMS³⁹).

When BDI was compared among the three groups, no significant difference before the exercise program was observed. However, a significant decrease was found after the exercises in the mean values of the AAEP and AEP groups. The AEP group showed more significant improvement than the AAEP group in the level of depression. Conversely, Assis et al. found no significant improvement in BDI after the exercise program³⁸). In our study both the AAEP and AEP

exercise programs had a significant effect on depression levels, but AEP was more effective than AAEP at decreasing the depression level. Similar to our results, Sanudo et al.⁴⁰) reported BDI scores decreased by 8.5 ± 8 ($p<0.001$) and 6.4 ± 4 points ($p<0.001$) in a supervised aerobic exercise group and a combined program of supervised aerobic, muscle strengthening, and flexibility exercises, respectively. Similarly, Santiago and Lacomba reported that aquatic and combined exercise, and alternative activities seemed to be better for the treatment of depression⁴¹).

Among the exercise groups, both the AAEP and AEP exercise groups showed more improvement than the ISSEP group in the mean value of FIQ. Also, no statistically significant difference was found between the AAEP and AEP exercise groups. Similarly Assis et al. reported that the level of improvement in the AAEP group was higher than that of the AEP group³⁸). In the study of Mannerkorpi et al., the effect of aquatic training on FIQ of FMS patients was investigated with a combination of six sessions education, which resulted in significant differences in the mean value of FIQ as compared to the control⁴²).

Jentoft et al. found a significant difference in FIQ between the groups in their studies¹⁷). In the present study there was a significant improvement in FIQ in both the AAEP and AEP groups, but there was no difference between the two groups. This result suggests that both of the exercise programs were equally effective at improving physical functioning, increasing quality of the life, and decreasing of pain. The results for FIQ were similar those reported by Sanudo et al., who

Table 2. The comparison of pre- post- test results of each group

Variables	Groups	n	Baseline		After 12 weeks	
			Mean Rank	Mean \pm SD	Mean Rank	Mean \pm SD
VAS/mm	ISSEP**	25	35.7	68.2 \pm 11.8	57.6	70.4 \pm 12.5
	AEP**	25	37.5	70.0 \pm 12.9	28.4	48.2 \pm 8.8
	AAEP**	25	40.7	71.5 \pm 13.1	28.1	48.0 \pm 9.3
BDI	ISSEP**	25	41.9	19.4 \pm 10.1	56.4	22.6 \pm 10.0
	AEP**	25	39.9	20.5 \pm 12.3	33.5	9.9 \pm 6.2
	AAEP**	25	32.1	15.7 \pm 9.0	24.1	6.1 \pm 7.8
FIQ	ISSEP	25	39.6	59.1 \pm 16.5	56.8	62.9 \pm 16.1
	AEP**	25	35.2	58.2 \pm 13.4	29.6	36.6 \pm 15.7
	AAEP**	25	39.1	60.9 \pm 12.1	27.6	34.9 \pm 17.1
6MWT/m	ISSEP	25	34.1	541.4 \pm 53.3	19.7	540.4 \pm 53.8
	AEP**	25	46.7	569.5 \pm 48.3	49.9	628.8 \pm 55.5
	AAEP**	25	33.2	543.3 \pm 56.4	44.4	619.4 \pm 61.8
MCS	ISSEP	25	33.4	31.6 \pm 9.0	19.2	32.0 \pm 9.4
	AEP**	25	36.8	32.5 \pm 9.7	42.7	45.3 \pm 7.0
	AAEP**	25	43.7	35.2 \pm 7.9	52.2	49.4 \pm 8.3
PCS	ISSEP	25	34.5	37.3 \pm 7.6	18.0	36.8 \pm 8.4
	AEP**	25	46.4	41.8 \pm 8.4	51.2	53.6 \pm 5.4
	AAEP**	25	33.1	36.4 \pm 8.5	44.8	50.3 \pm 7.4

*significant at 0.05 level, **significant at 0.01 level, SD: standard deviation

ISSEP: home-based isometric strength and stretching exercise program, AEP: gym-based aerobic exercise program, AAEP: pool-based aquatic aerobic exercise program VAS: Visual Analog Scale, BDI: Beck Depression Inventory, FIQ: Fibromyalgia Impact Questionnaire 6MWT: Six-Minute Walk Test, MCS: Mental Component Scores, PCS: Physical Component Scores

compared an exercise program of exclusively aerobic exercise, with another of combined exercise, and found similar improvements of around 14% in FIQ⁴⁰).

In previous studies, better results were obtained by the aquatic program, however, in the present study no significant difference was observed¹⁷. Evcik et al. showed that aquatic and home-based land exercise therapy was beneficial for pain reduction at the end of treatment, and after a long-term follow up of 3 months. Additional benefits of aquatic exercises may be related to the water itself, as well as the benefits derived from the social aspects of exercising with others outside of the home⁴³. The comparison of our three groups revealed that both the AAEP and AEP groups showed statistically significant improvements in 6MWT as compared to the ISSEP exercise group. No statistically significant difference was found between the AAEP and AEP groups, indicating that both AAEP and AEP had equally positive effects on walking ability.

Although the 6MWT is a simple, safe and low cost test that has gained much attention in the clinical and scientific fields^{33, 44, 45}, researchers have reported that a substantial number of women with FMS show increased pain intensity and perceived effort compared to controls⁴⁶. Mannerkorpi et al. combined six sessions of education investigated the effect of aquatic training on the 6MWT distance of FMS patients. The 6MWT distance of the aquatic training group was significantly longer than that of the controls⁴², suggesting that patients with fibromyalgia might benefit from aerobic fitness training.

The PCS of SF-36 was compared across the three groups. Both the pool-based aquatic and gym-based aerobic exercise groups showed more improvement than the home-based isometric strength-stretching exercises group. However, no statistically significant difference was found between the pool and gym groups. Assis et al. found no statistically significant difference groups in the SF-36 physical health scores of two groups³⁸. In the literature only the study conducted by Jentoft et al. reported a result similar and comparable to that of our study. They did not find statistically significant differences in the physical health scores when the groups were compared¹⁷. Both the pool and gym exercise programs provided similar increases in the quality of life.

The MCS of SF-36 was compared across the three groups. Both the pool-based and gym-based groups showed statistically significant differences, but the home-based exercise group did not. When the pool and gym groups were compared, a more significant difference was found in the pool group than in the gym group. Two studies presented similar results, reporting no significant difference in terms of MCS^{17, 38}. The results of our present study suggest that gym exercise programs lead to improvement of the MCS of FMS patients, and that, different from other studies, the aquatic program was more efficient than the other programs in this regard.

In a study conducted by Van Santen et al., 37 FMS patients were divided into two groups and one group with 19 members exercised with higher intensity while the other group with 18 members performed aerobic exercises of lower intensity¹⁸. Their showed low intensity exercises provided a medium-level improvement in the quality of life and physi-

cal health after 20 weeks, but it had no effect on the general health and psychological state of the patients; also, the high intensity exercises had no statistically significant effect on the quality of life or physical health¹⁸. In the study of Salek et al., patients were assigned to two groups, and one group of patients did exercises while the other group was given antidepressants and analgesics. When the pre-treatment and the post-treatment measurements after 16 weeks were compared, it was found that the level of sore points and pain had improved 48% in the group that exercised regularly, and 39% in the group that did not exercise. However, there was no significant difference between the groups¹⁹.

Water-based exercises are not only an important effective treatment for FMS^{7, 9, 27}, but they are also important and effective tools for improving isometric, isotonic, and isokinetic strength in young women^{47, 48}. Significant improvements in isokinetic knee extensor and flexor torques in the elderly after a water-based program were reported⁴⁹. It was also reported that isokinetic muscle contraction in the water provided excellent rate of strength gain over range of motion and with a low possibility of muscle injury compared to isometric and isotonic muscle contractions^{28, 31}.

The results of our present study show that the ISSEP group demonstrated only slight improvements between pre- and post-test in FIQ, 6MWT, MCS and PCS, while significant improvements ($p < 0.01$) in all variables were observed in the AEP and AAEP groups with respect to their baseline values. The ISSEP group showed significant improvements ($p < 0.01$) only VAS and BDI between pre- and post-test (Table 2).

The AAEP group had statistically better results than the AEP and ISSEP groups for all variables. Significant differences among the three groups were derived from the low improvements of the ISSEP group, ISSEP with the exception of 6MWT distance. Both the AAEP and AEP groups had significantly higher scores of MCS and PCS than the ISSEP group.

In conclusion, AAEP and AEP are effective methods in the treatment of FMS. AAEP also had additional effects on the SF-36 mental health score and the BDI. AAEP was also significantly more effective in the treatment of FMS than to AEP and ISSEP. The superiority of AAEP as a treatment method for FMS may originate from its lack of impact force on the joints, and the use of only concentric or isokinetic contractions during shallow and deep water exercises²⁸.

Further research is required to assess the advantages and disadvantages of ISSEP, AAEP and AEP in the treatment of FMS using experimental groups matched for health status, symptoms, body structure, physical fitness and age, and a long-term follow-up.

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