Aquatic Training and Detraining on Fitness and Quality of Life in Fibromyalgia

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ABSTRACT

TOMAS-CARUS, P., A. HÄKKINEN, N. GUSI, A. LEAL, K. HÄKKINEN, and A. ORTEGA-ALONSO. Aquatic Training and Detraining on Fitness and Quality of Life in Fibromyalgia. *Med. Sci. Sports Exerc.*, Vol. 39, No. 7, pp. 1044–1050, 2007. **Purpose:** To evaluate the effects of a 12-wk period of aquatic training and subsequent detraining on health-related quality of life (HRQOL) and physical fitness in females with fibromyalgia. **Methods:** Thirty-four females with fibromyalgia were randomly assigned into two groups: an exercise group, who exercised for 60 min in warm water, three times a week ($N = 17$); and a control group, who continued their habitual leisure-time activities ($N = 17$). HRQOL was assessed using the Short Form 36 questionnaire and the Fibromyalgia Impact Questionnaire. Physical fitness was measured using the following tests: Canadian Aerobic Fitness, hand grip dynamometry, 10-m walking, 10-step stair climbing, and blind one-leg stance. Outcomes were measured at baseline, after treatment, and after 3 months of detraining. **Results:** After 12 wk of aquatic exercise, significant positive effects of aquatic training were found in physical function, body pain, general health perception, vitality, social function, role emotional problems and mental health, balance, and stair climbing. After the detraining period, only the improvements in body pain and role emotional problems were maintained. **Conclusion:** The present water exercise protocol improved some components of HRQOL, balance, and stair climbing in females with fibromyalgia, but regular exercise and higher intensities may be required to preserve most of these gains. **Key Words:** EXERCISE, POOL, HEALTH, PAIN, BALANCE, WOMEN

Patients with fibromyalgia (FM) present with muscle pain, weakness, and fatigue (22,34) that may eventually lead to reduced physical activity and decreased quality of life (7). Some of the experimental physical therapies for FM have addressed the effects of exercising in warm water, trying to combine the revitalizing and strengthening effects of the physical exercise with the muscle-relaxation properties of bathing in warm water. These therapies have been shown to be effective for reducing symptoms and improving health-related quality of life (HRQOL), which normally has been evaluated with the Fibromyalgia Impact Questionnaire (FIQ) or the Short Form 36 (SF-36) (3,8,16,20).

Most of these previous studies describe the effects of warm-water exercise on aerobic capacity and muscle strength (16,20), although to the best of our knowledge, data are scant or even missing regarding the effects of the warm-water exercise on other major abilities, such as walking speed, balance, or flexibility in patients with FM. Few of the previous trials have also evaluated a follow-up period in women with FM. All of these studies offered treatment or encouraged patients to continue exercising regularly during the follow-up period (8,12,16,19). However, to know more precisely how long the adaptations caused by the therapy last, and to know of any possible need for continuous treatment, it is necessary to address the detraining effects after a certain period of physical treatment. This relevant topic has been analyzed by the present research group in the framework of a multidisciplinary controlled trial (ISRCTN83162243). A first study analyzing the effects of aquatic exercise and its subsequent detraining on muscular strength (as measured by an isokinetic dynamometer) and the time tradeoff utilities of HRQOL has been recently published (14). The current article presents the second study, which focuses on functional and physical fitness and on the generic and FM-specific attributes of HRQOL as main outcomes. Thus, the outcomes of the current article are addressed in relation to more pragmatic clinical issues related to sports medicine and exercise science.

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This study tested the hypothesis that waist-high-water training would increase the physical fitness of the lower limbs and HRQOL, but that these short-term gains would be lost after a short detraining period. The verification of this hypothesis would reinforce the need for continuous therapy in FM. The aim of the present study was first to evaluate the immediate effects of a 12-wk period of mixed-exercise therapy (aerobic and strength training), in a waist-high pool of warm water, on HRQOL and physical fitness related to daily activities in women with FM, and then to evaluate the stability of these effects after a similar period without physical exercise training.

SUBJECTS AND METHODS

Participants. An invitation to participate in the study was sent to all members of a local FM association. Fifty-nine individuals decided to ask for detailed information about the study. Once they were informed about the protocol, all 59 eligible persons signed a written informed consent to participate in the study. During the selection procedure, a physician checked their medical records and clinical status, including an assessment of the tender points, and confirmed the diagnosis according to American College of Rheumatology criteria (37). According to these criteria, FM was diagnosed if a history of widespread pain had been present for at least 3 months. Pain was considered widespread when it was present in both sides of the body and when it was observed above and below the waist. In addition, axial skeletal pain (cervical spine, anterior chest, thoracic spine, or low-back pain) had to be present. Low-back pain was considered lower-segment pain. In addition, pain on digital palpation (performed with an approximate force of 4 kg, assessed by a handheld algometer) had to be present in at least 11 of the 18 tender-point sites described by the American College of Rheumatology. Exclusion criteria were history of severe trauma, frequent migraines, peripheral nerve entrapment, inflammatory rheumatic diseases, and severe psychiatric illness. In addition, patients with other diseases that might prevent physical loading and pregnancy were also omitted. Finally, those women with FM who attended another psychological or physical therapy were excluded, to avoid possible interactions with the present trial, which included a detraining period. Those with a history of partaking in more than one intensive exercise session of 30 $min \cdot wk^{-1}$ during a 2-wk period in the last 5 yr would have been excluded from the final analysis, but none of the eligible women did any regular exercise other than easy walking and work. Fifteen individuals were excluded according to the criteria: these patients had psychological therapy (N = 9), inflammatory rheumatic disease (N = 4), severe disorder of the spine (N = 1), or psychiatric illness (N = 1).

A final sample of 35 female patients aged 35–73 yr were randomly assigned either to an exercise group (EG) or to a control group (CG). All participants gave their written informed consent once the study protocol and possible risks and benefits of the therapy had been explained to them. The committee on biomedical ethics of the University of Extremadura (Spain) approved the study.

Each subject performed all the tests and questionnaires in a unique session, and the order of application was the same at baseline, after 12 and 24 wk. The patients were off their medications for a 24-h period when performing each testing session. First, the diagnosis of FM was verified, then the HRQOL and spare-time questionnaires were administered, and later on, the fitness test battery was applied.

HRQOL. The Spanish version of the SF-36 (1) was used to evaluate HRQOL. The SF-36 assesses eight dimensions: physical function, role physical problems, body pain, general health perception, vitality, social function, role emotional problems, and mental health. The scale of each dimension runs from 0 = very poor to 100 = very good.

The scale total of the Spanish version of the FIQ (26) was used to evaluate the impact of FM on patients' physical and mental health. The FIQ has eight subscales that range from 0 = no impact of the disease to 10 = very affected by the disease.

Physical fitness. First, postural balance was assessed with a blind flamingo test, in which the barefoot subject stood on one leg while the other leg was flexed at knee level and held at the ankle by the hand of the same side of the body, with the eyes closed. The number of trials that the subject needed to complete 30 s of the static position (the chronometer was stopped whenever the subject did not comply with the protocol conditions) was measured. The outcome was expressed as the number of trials (equal to the number of falls + 1). In our group, the test–retest intraobserver reliability coefficient observed for this test (intraclass coefficient = 0.83) can be considered acceptable for field testing in Spanish adults (5,13,27,28). Secondly, hand grip strength was assessed in both hands with a hand dynamometer (TKK, Taiwan), and the mean of both hands was considered the outcome (24). Flexibility was assessed through the sit-and-reach test (36). Immediately afterward, to evaluate functional capacity, three physical tests were performed: a maximal-speed walking test for 10 m (intraclass coefficient = 0.88), a 10-stair climbing test (intraclass coefficient = 0.95), and a 10-stair climbing test carrying a 5-kg bag in each hand (33) (intraclass coefficient = 0.96). Outcomes in these tests were recorded in seconds, using photocell devices. Finally, the Canadian Aerobic Fitness Test (35) was applied to estimate maximal oxygen uptake according to heart rate, age, and gender of the patients.

Spare-time and labor activities questionnaire. To ensure that the subjects maintained low levels of physical activity (< 5 d of moderate-intensity activity or walking for at least 30 $min \cdot d^{-1}$), physical activity levels were assessed by the short form of the Spanish version of the iPAQ (www.ipaq.ki.se) (Spearman rho = 0.43 to

0.60) (17), and the frequency of usual activities were assessed using the Spanish version of the FIQ and on the basis of labor activities (unemployed, blue-collar worker, or white-collar worker).

Exercise therapy. The EG group exercised in a waist-high pool of warm water (33°C), three times per week for a 12-wk period. Each therapy session was 1 h long and included 10 min of warming up with slow walks and easy movements of progressive intensity, 10 min of aerobic exercise at 65–75% of maximal heart rate (HR_{max}), 20 min of overall mobility and lower-limb strength exercises using water resistance (four sets of 10 repetitions of unilateral flexion and extension of the knee at a slow pace, with the body in a vertical position), another 10-min set of aerobics at 65–75% HR_{max}, and 10 min of cooling down with low-intensity exercises. Heart rate was monitored using a pulse meter (Polar Accurex Plus; Polar Electro Oy, Kempele, Finland). At the end of the 12-wk therapy, all patients were instructed to avoid physical exercise training until the next evaluation. During the entire 24-wk period, participants in the CG continued their daily activities, which did not include any form of physical exercise similar to those in the therapy.

Statistical analysis. Normality of data was initially tested using the Kolgomorov–Smirnov test, using the correction of Lillifors. The results are expressed as means ± standard deviation or 95% confidence interval. The effects of the intervention program were tested using analyses of variance for continuous variables and chi-square test for categorical variables. Age-adjusted analyses of covariance for repeated measures assessed the between-groups differences of change between each time point for the measured variables. For all tests, the significance level was set at $P < 0.05$. The analyses were done using SPSS 13.0 (SPSS Inc. Chicago, IL).

RESULTS

HRQOL and physical fitness were assessed at baseline, at week 12, and at week 24. Attendance to the therapy was checked for every session. Only one participant from the EG dropped out, because of an accident not related to the therapy. Seventeen patients in the EG attended more than 95% of the sessions, and 17 patients in the CG fully completed the measurement protocol. Their results were included in the analysis.

The EG and CG presented similar clinical and sociodemographical statuses at baseline (Table 1).

HRQOL. Baseline values showed no differences between the groups in any of the questionnaires (Table 2). After 12 wk of water exercise, significant improvements attributable to treatment effects were found in physical function (42%), body pain (84%), general health perception (37%), vitality (34%), social function (38%), role emotional problems (79%), and mental health (39%), all in favor of EG. Of these improvements, only body pain and role emotional problems were maintained during the detraining.

TABLE 1. Characteristics of females with fibromyalgia at baseline.

	Exercise Group (N = 17)	Control Group (N = 17)	P
Age (yr)	51 ± 10	51 ± 9	0.986
Body mass index (kg·m^{-2})	27 ± 5	27 ± 4	0.597
Duration of symptoms (yr)	24 ± 9	19 ± 8	0.155
Number of tender points (1–18)	17.3 ± 1.2	17.1 ± 1.4	0.517
Presence of specific drugs (%)			
Antidepressives	58.8	70.6	0.473
Muscular relaxants	17.6	47.1	0.067
Analgesics	41.2	52.9	0.492
Employment status (%)			0.931
Blue collar	47.0	41.0	
White collar	17.8	17.8	
Unemployed	35.2	41.2	
Education level (%)			0.753
Unfinished studies	11.8	11.8	
Primary school	52.9	64.7	
Secondary school	17.6	17.6	
University degree	17.6	5.9	

Values expressed as mean ± standard deviation.

Physical fitness. At baseline values in the physical tests for the EG and the CG, no differences were seen (Table 3). The EG showed significant improvements attributable to treatment effects in balance (34%) and stair climbing with no extra weight (7%) and with the 10-kg weight (18%). After the detraining period, these improvements were lost.

DISCUSSION

The main findings in the present trial were that 1) 3 months of water-based exercise improved the HRQOL, with a major relief in pain and emotional problems, and by improving physical functional capacity and balance; 2) the improvements in fitness did not last for 12 wk after the end of the training period, whereas some of the components of the HRQOL (and, particularly, the pain relief and emotional problems) were maintained; and 3) the high adherence rate and compliance could be partially attributed to the design of physical exercises (physical activity with music, games, etc.), which promoted interaction between the patients, and the interaction with the exercise monitor.

Exercisers registered moderate to very high improvements in most of the SF-36 dimensions, whereas the changes in the CG were minor and statistically not significant. As an example, the present trial revealed a major relief in pain attributable to the treatment effects of 84% in the SF-36 scale immediately after the therapy period, and this improvement was maintained at a similar level during the subsequent detraining period. This relief in pain status, although higher in magnitude, is in agreement with previous findings. Earlier studies about the effect of water exercise have also shown relief in pain status by 30–40% in the SF-36 scale, or by 15–29% when assessed by a visual analog scale (14,20,25). Possible explanations for the magnitude of change in the present trial may be the

TABLE 2. Health-related quality of life at baseline, after 12 wk of training in warm water, and after 12 wk of subsequent detraining (exercise group, $N = 17$; control group, $N = 17$).

	Baseline		Week 12				Week 24			
	Exercise M ± SD	Control M ± SD	Exercise M ± SD	Control M ± SD	Training Effect M (95% CI)	P†	Exercise M ± SD	Control M ± SD	Detraining Effect M (95% CI)	P†
FIQ total score (0–100)	63 ± 20	59 ± 16	52 ± 19	60 ± 17	−12 (−19 to −4)	0.197	57 ± 16	60 ± 17	−6 (−15 to 2)	0.614
SF-36 (0–100)										
Physical function	36 ± 23	33 ± 19	55 ± 30	37 ± 17	15 (1 to 28)	0.029	48 ± 21	37 ± 17	8 (−4 to 21)	0.088
Role physical problems	35 ± 36	25 ± 25	34 ± 37	25 ± 28	−1 (−32 to 29)	0.442	29 ± 41	22 ± 26	−3 (−26 to 21)	0.536
Body pain	21 ± 19	23 ± 19	44 ± 23	28 ± 20	18 (1 to 35)	0.030	43 ± 19	28 ± 20	17 (5 to 29)	0.024
General health perception	32 ± 24	29 ± 15	40 ± 24	27 ± 15	12 (−2 to 25)	0.048	33 ± 27	27 ± 15	4 (−10 to 17)	0.437
Vitality	30 ± 15	20 ± 14	47 ± 21	25 ± 15	10 (−4 to 25)	0.002	35.6 ± 25	25 ± 15	−1 (−17 to 15)	0.161
Social function	54 ± 34	52 ± 26	79 ± 25	57 ± 24	21 (3 to 38)	0.013	60 ± 33	57 ± 24	1 (−25 to 27)	0.767
Role emotional problems	37 ± 45	33 ± 41	65 ± 46	31 ± 34	29 (1 to 58)	0.023	75 ± 36	31 ± 34	39 (5 to 73)	0.001
Mental health	48 ± 20	51 ± 24	66 ± 22	50 ± 20	19 (10 to 27)	0.034	62 ± 27	50 ± 20	15 (3 to 27)	0.152

Values expressed as mean (M) ± SD and 95% CI.
FIQ, Fibromyalgia Impact Questionnaire; SF-36, Short Form 36 Health Survey.
† *P* values of analysis of variance for repeated measures from baseline to week 12 and week 24.

exacerbated pain status of the participants before the treatment, or the specificity of the test used. Studies combining SF-36 and a visual analog scale have normally revealed, after treatment, higher pain relief when measured with SF-36 than with the visual analog scale. Therefore, it seems that the sensitivity and specificity of the test used may affect the perception and interpretation of the change in pain status.

On the other hand, maintenance for a 3-month period of the pain relief achieved after treatment is, to our knowledge, a novel finding; our study showed a maintenance between follow-ups with no physical exercise (patients had completely sedentary habits), whereas the previous studies did not show this (14,19,25). At the present time, the physiological mechanisms involved in this process of pain reduction and maintenance are still poorly understood. They may be related to the reduced gravity conditions in water and to the increased hydrostatic pressure and resistance to movement, causing a reduced mechanical impact on muscle mass, joints, and tendons, and thus decreasing muscle stiffness (18).

Total FIQ score improved in previous water therapies (3,4,16) and therapies using a mixture of land-based and water-based exercise (12,20). In the present trial, no significant improvements were found in the total FIQ score as a result of the treatment effects. Differing from some of the earlier studies, the present trial did not include health education that was specific for the FM patients; this could have contributed to the patients' understanding of the disease, thus decreasing its impact on patients' physical and mental health (20).

The participants in the present trial reported that they followed their daily life activities during the training and detraining periods and that they did not participate in any other kind of regular physical exercise or therapy, except for in the present intervention. To our knowledge, this is the first study that examines the stability of the effects of exercise therapy on HRQOL after a detraining period. Previously, when a follow-up study was performed after a land-based or water-based exercise trial, patients received guidelines on how to exercise by themselves. As a result, in most of those studies, the patients' physical condition and HRQOL remained at similar levels during the follow-up compared with immediately after therapy (3,8,16,19). In the present study, because of a detraining effect, most of the gains in the patients' physical fitness and HRQOL were lost. Nonetheless, the gains in the SF-36 dimensions of body pain and emotional problems were still present 3 months later. In contrast, the first article of the current trial has reported that participants lost the pain gains measured by a visual analog scale after detraining (14). This finding reflects the specificity of each instrument of measurement

TABLE 3. Physical fitness outcomes at baseline, after 12 wk of physical training in warm water, and after 12 wk of subsequent detraining (exercise group, $N = 17$; control group, $N = 17$).

	Baseline		Change to 12 Weeks				Change to 24 Weeks			
	Exercise M ± SD	Control M ± SD	Exercise M ± SD	Control M ± SD	Training Effect M (95% CI)	P†	Exercise M ± SD	Control M ± SD	Detraining Effect M (95% CI)	P†
Maximal oxygen uptake ($mL \cdot kg^{-1} \cdot min^{-1}$)	24 ± 4	3 ± 4	24 ± 4	24 ± 4	0 (−1 to 1)	0.788	25 ± 4	24 ± 4	0 (−2 to 2)	0.593
Hand grip strength (kg)	38 ± 13	38 ± 16	37 ± 13	38 ± 11	−1 (−12 to 9)	0.834	34 ± 13	35 ± 11	−1 (−10 to 8)	0.911
10-stair climbing, weightless (s)	4.3 ± 0.7	4.7 ± 0.9	4.2 ± 0.8	5.2 ± 1.3	0 (−1 to 0)	0.004	4.8 ± 1.0	5.3 ± 1.2	0 (0 to 1)	0.168
10-stair climbing with 10 kg (s)	5.0 ± 1.8	6.0 ± 2.4	4.6 ± 1.6	6.7 ± 2.5	−1 (−2 to 0)	0.002	5.5 ± 1.1	6.7 ± 2.5	0 (−1 to 1)	0.052
10-m walking speed ($m \cdot s^{-1}$)	1.6 ± 0.2	1.6 ± 0.3	1.7 ± 0.3	1.7 ± 0.3	0 (0 to 0)	0.711	1.6 ± 0.2	1.6 ± 0.3	0 (0 to 0)	0.988
Flexibility: sit and reach (cm)	17 ± 8	17 ± 7	18 ± 9	18 ± 7	0 (−4 to 4)	0.889	19 ± 10	15 ± 7	4 (−2 to 10)	0.165
Balance (trials to 30 s)	24 ± 8	23 ± 8	16 ± 6	23 ± 7	−8 (−14 to −3)	0.007	20 ± 10	23 ± 6	−5 (−11 to 2)	0.112

Values expressed as mean (M) ± SD and the training effect 95% CI.
† *P* values of analysis of variance comparing differences between groups at week 12 and week 24.

when results of different studies are compared. The SF-36 scales are calculated by several items and weighted to general population scores, but visual analog scores mainly reflect individual, subjective perceptions of pain.

Another major finding in the present trial was the improvements in patients' balance and in stair-climbing tests that required leg strength. Improvements in balance have previously been described in water exercise trials, including in healthy women and women with lower-extremity arthritis (31), but as far as we know, there is no previous evidence about the possible changes in balance in female FM patients who have undergone exercise training. A previous study has shown a reduced balance capacity in FM patients compared with healthy adults (32). The participants in the present study also showed a reduced balance capacity compared with the normative values for a healthy adult population of the same age range. After the training period, balance capacity improved, although the values were still 0.5–1.5 SD lower than the mean of Spanish healthy women (mean 11.5 trials, SD 3).

Previous trials have reported that reduced leg-muscle strength was associated with lower outcomes in functional tests related to daily living (sitting up and sitting down on a chair, walking) in individuals with FM (21) and with increased disability in females with rheumatoid arthritis (15). In the present trial, whereas the women in the CG reduced their stair-climbing performance, the patients who exercised achieved slightly better performances in some of the functional capacity tests: the 10-step stair climbing, either weightless or carrying two bags. Therefore, the water-based program seemed to prevent the deterioration measured by these functional tests, but the clinical relevance of the magnitude of the measured changes in the current trial requires further specifically designed studies. These short-term effects of exercise training might be related to improved leg-strength status in the patients, as stated in a previous report (14). As far as the capacity of maintaining the muscular strength gains are directly related to the intensity of the exercise program (10), the low to moderate intensity of the current study could lead to the fast loss of these muscular strength gains.

The present exercise protocol did not achieve changes in the aerobic capacity, grip strength, or flexibility of females with FM. Although the findings for grip strength or flexibility were not surprising (they were not emphasized in the exercise protocol), changes in aerobic capacity could have been expected. One reason for this limitation would be the exercise intensity. In a previous study, the exercise intensity was set to a moderate to high level, and subjects achieved 11–38% improvements in maximal oxygen uptake (4,16). But in the present trial, exercise intensity was low to moderate (up to 65–75% of HR_{max}), and the mean maximal oxygen uptake of the EG remained unchanged. Bilberg et al. (6) implemented similar moderate intensities in a warm-water exercise program in patients with rheumatoid arthritis. They found strength ameliorations, but the aerobic gains were small. These authors attribute the observed lack of aerobic improvement to the intensity of exercise. This exercise intensity for these protocols was chosen to protect the patients from muscle damage and pain attributable to muscle stiffness (23). Although the therapy clearly succeeded in pain protection, achieving an increase in maximal oxygen uptake would require a higher physical load. Another reason for the lack of significant changes in aerobic condition might be related to the sensitivity of the indirect stair test that was used for aerobic performance in relation to the specificity of the walk-based physical loads that were applied in the training. In addition, the fatigue of the long evaluation session could influence performance in the last test: the Canadian Aerobic Fitness Test.

Literature did not show evidence either in favor of or against exercise in warm-water compared with other types of land-based physical activities or strengthening programs in women with FM (16) or lower-limb osteoarthritis (9,11), except for pain management. In fact, balneotherapy in warm-water baths has been shown to be effective in managing muscle pain in FM (3) and ankylosing spondilitis (2). In this sense, in the current study, which was characterized by three warm-water sessions a week, one might have expected a higher effect on the pain sensitivity (pain threshold, bodily pain, etc.) than that obtained in land-based programs, but the improvements of the current study were similar to those of previous studies. This unexpected finding could be partially related to the low intensity of aerobic exercise. Chronic aerobic exercise stimulates the release of endogenous opioid peptides and increases nociceptive threshold, and these changes are positively correlated with exercise output and are rapidly lost with detraining in female rats (30). This possible limitation of the magnitude of biological improvement in pain management could also partially explain the maintenance of the gains in pain perception.

The present study also included some limitations that need to be pointed out. Although our results are consistent with the literature, the conclusions here must be drawn with caution when considering patients with other age, gender, previous physical activity level, or symptom background. In addition, because of the reduced size of the sample, the statistical power to detect changes in some variables could also have been limited. Although the program showed positive effects in most dimensions of the SF-36, the power to detect changes in the physical fitness tests and FIQ was more limited.

To conclude, the present trial assessed FM patients who had undergone a 12-wk period of exercise in a waist-high pool of warm water, and improvements were shown in HRQOL (especially pain and emotional problems) and in physical functional capacity and balance. The long-term effects after a consecutive 12-wk period of physical inactivity were maintained only in pain and

emotional problems. Thus, continuity and intensity of exercise training may be the key for preserving relevant changes in other dimensions of HRQOL, and also in physical fitness, for a longer period.

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