# The effects of 20 weeks of physical fitness training in female patients with fibromyalgia

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**ABSTRACT.** *During a period of 20 weeks 18 female patients with fibromyalgia participated in a 60-minute exercise program twice a week. A control group, comprising 17 patients, was told not to change their physical activity level. Eleven patients in the training group and fourteen in the control group completed the study. The results at entry were compared to those after 20 weeks, as well as being compared to the results of the control group. No statistically significant changes or differences in general pain, pain coping and fatigue were seen after 20 weeks. Improved dynamic endurance work performance for the upper extremity was found, however, in the training group, measured as the strength of the first ($p$ = 0.01) and the last repetition ($p$ = 0.003). These results differed from the results of the control group ($p$ = 0.02 and $p$ = 0.003). It is concluded that fibromyalgia patients may undergo low-intensity dynamic endurance training without experiencing exacerbation of their general pain and fatigue symptoms.*

R cf *Key words:* fibromyalgia, physiotherapy, exercise, physical fitness, ~~physical~~ endurance, fatigue, pain.

## Introduction

Fibromyalgia is a form of non-articular rheumatism characterized by chronic pain and tenderpoints in multiple areas of the musculoskeletal system (1-3). Patients often complain of increased feelings of fatigue and pain following physical activity (4). Pathological changes in the muscles and the nervous system have been found (5-10). Chronic pain and fatigue may lead to a reduced physical activity level (11), while inactivity might influence a patient's coping with pain (12). Studies indicate that fibromyalgia patients may have a reduced physical capacity (13-15).

After exercising according to a cardiovascular training program, a group of fibromyalgia patients improved their aerobic capacity and showed some pain reduction (16). Physical activity, especially endurance work, has been shown to induce pain (15). In order to improve endurance capacity in our patients, we developed a modified low-impact aerobic dance program. The aim of the study was to evaluate the effects of twenty weeks of endurance training on the variables of pain, fatigue, physical fitness and pain coping.

## Material and methods

*Patient groups.* Thirty-five female patients with fibromyalgia according to the 1990 ACR criteria (17) were included in the study. Laboratory tests, including ESR, haemoglobin, liver enzymes, serum creatinine, ANA, Waaler, Latex and thyroxine were required to be normal. The patients were recruited from previous hospitalizations or from members of the Patient Organization in Oslo. Prior to the study all patients reported that they had participated weekly in some kind of physical leisure activities. The characteristics of the patients are presented in Table I.

*Study design.* The study had an experimental, parallel, matched group test design with age as a randomization block factor. The

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**Table I.** Characteristics of the female fibromyalgia patients included in the study.

| | Training pts. (n = 18) | | Controls (n = 17) | |
|---|---|---|---|---|
| | Median | (range) | Median | (range) |
| Age (yrs.) | 33.5 | (21 - 42) | 34 | (25 - 38) |
| Dur. of symptoms (yrs) | 8.5 | (3 - 20) | 8 | (3 - 23) |
| Number of children | 1 | (0 - 3) | 0 | (0 - 4) |
| Pain during last week* | 61 | (4 - 82) | 60 | (33 - 85) |
| Fatigue during last week* | 69.5 | (32 - 100) | 69 | (33 - 93) |
| Sleep during last week* | 55.5 | (2 - 92) | 53 | (0 - 100) |
| Number of tenderpoints | 16 | (11 - 18) | 16 | (11 - 18) |
| Head and neck pain | 94% | | 100% | |
| Shoulder pain | 78% | | 76% | |
| Elbow and hand pain | 78% | | 94% | |
| Thoracic pain | 61% | | 65% | |
| Lumbar pain | 67% | | 65% | |
| Hip pain | 94% | | 53% | |
| Knee pain | 78% | | 94% | |
| Leg and foot pain | 56% | | 71% | |

* measured on a 100 mm visual analogue scale.

subjects were assigned at random to a control (n = 17) or a training group (n = 18). The control group was instructed not to change their habits regarding physical activities during the period. The training group followed an exercise program twice a week for twenty weeks. The exercising sessions were supposed to be performed three times a week. A pilot study, however, showed that it was difficult to motivate the patients to meet that frequently.

All patients were tested at entry (week 0) and after twenty weeks (week 20). The testing was undertaken by a physical therapist who was blinded to the patients' classification. At the time of the re-test neither the patients nor the physiotherapist had access to the results of the baseline tests.

*Drop-outs.* Drop-out cases included those who had illnesses other than fibromyalgia during the twenty week period, and persons who did not meet for the training sessions twice a week or for re-testing. These patients were withdrawn from the study. Premature withdrawals comprised those who followed the research protocol for some time, but who did not complete the twenty week period. The results from these patients were used in the calculations according to the principle of the intention to treat (projected efficacy). The study was approved by the Regional Ethical Committee for Medical Research. All patients gave their informed consent before participating.

*The exercise program*

1. A modified low-impact aerobic dance program was undertaken in groups twice a week for twenty weeks.
2. Each exercise session lasted for 60 minutes with continuous exercises aimed at the lower extremities. Exercises for the upper extremities were performed at intervals between periods of rest.
3. Training intensity was kept at a heart rate level of 120 - 150 beats per min., controlled periodically by a pulse watch recorder.
4. To prevent muscular fatigue, frequent changes in the activation of different muscle groups was undertaken.
5. In order to prevent neck and low back pain, exercises involving jumping and extensive motion of the shoulders and hips were omitted.
6. The speed of the movements was adjusted in order to avoid static muscle work.

*Physical fitness*

*Aerobic fitness.* Aerobic fitness was tested according to Aastrand's method (18). The resistance level of the cycle ergometer was individually fitted according to the patient's exercise tolerance. During the re-tests the individual resistance levels remained unchanged. This method has previously been recommended by Klug *et al.* (19). The heart rates were monitored by a pulse watch recorder (Sport Tester PE 3000, Finland). The heart rates at a steady state level were noted, as well as the heart rates after rest in a sitting position at two and four minutes.

*Dynamic endurance work of the upper extremities.* The dominant hand was tested by a hand-held manometer (20, 21) for grip strength (Martin Vigorimeter, Gebruder Martin, Tuttlingen, Germany). Keeping the arm in a precisely defined position (15, 22), twenty repetitions of maximal grip strength were performed during a period of 30 seconds. The grip strength of the first and the 20th repetition were noted (15).

*Static endurance work of the upper extremities.* The non-dominant upper extremity was tested according to a method developed by Hagberg *et al.* (23). The period during which the upper extremity was kept in a fixed position of 30 degrees of flexion in the shoulder and 90 degrees of flexion in the elbow was measured and recorded in seconds as the static endurance time (15).

*Dynamic endurance work of the lower extremities.* The lower extremities were tested by having the patients climb up and down a 20 cm high step. The test was performed in such a manner that the right lower extremity was doing concentric muscle work (muscle contraction while the muscle is shortening), while the left lower extremity performed eccentric muscle work (muscle contraction while the muscle is elongated). The climbing speed was maintained at a rate of 100 steps per minute, controlled by a metronome. The climbing period was measured and given in seconds as the dynamic endurance time.

*Symptoms*

*Pain.* General pain intensity during the last seven days of the study was measured on a 100 millimeter long visual analogue scale (24). The endpoints of the line were defined as "no pain" and "unbearable pain" (25). Exercise-induced pain was recorded on the visual analogue scale immediately before and after performing the different muscle tests. The difference between the two recorded pain intensities was defined as the exercise-induced pain. The results are given in millimeters.

*Fatigue.* General fatigue and the amount of sleep during the last seven days was recorded on a 100 millimeter long visual analogue scale. Fatigue during the cycle ergometer test was monitored using Borg's rating scale for perceived exertion (26).

*Pain coping.* The Vanderbilt Pain Management Inventory (VPMI) was used; this records the use of active and passive pain coping mechanisms (27). The questionnaire has already been translated and used in the Norwegian language.

*Statistics.* The Statistical Analysis Program (SAS) was utilised. The distribution of the continuous variables are given as the median and range. Changes in the variables within groups from week 0 to week 20 were analyzed by the Wilcoxon sign rank test (28). Differences between groups were analyzed by the Wilcoxon sum rank test (28). Two-tailed tests were applied. Differences and changes were considered to be statistically significant when the p values were ≤ 5%.

## Results

Seven patients in the training group and three in the control group were drop-outs according to the research protocol. The reasons given were bronchitis, fracture, surgery, changes in work schedule or home responsibilities. Statistical analysis indicated that there were no differences in general pain, pain duration, general fatigue, number of tenderpoints or physical fitness between the subjects who completed the study and those who did not. Two patients in the training group and one in the control group followed the research protocol for about 10 weeks. They were retested after 10 weeks, and the results were analyzed according to the principle of projected efficacy. The results are thus given for 11 patients in the training group and 14 patients in the control group. During the study period one more patient from each group received sick leave pension. After twenty weeks there was no statistically significant change in drug consumption in either of the groups.

*Physical fitness.* The results for aerobic fitness, and dynamic and static endurance work are shown in Table II. In the training group, improved dynamic endurance work for the upper extremities was seen at week 20 compared to the results at week 0 in terms of grip strength at the first repetition ($p = 0.01$) and at the 20th repetition ($p = 0.003$). The results differed from those in the control group at the first repetition ($p = 0.02$) and at the 20th repetition ($p = 0.003$).

*Symptoms.* After twenty weeks of exercise every patient in the training group felt that exercising had increased their feelings of general well-being. Nine patients said that exercising had reduced the feelings of muscular tension (missing data for one). The results from the general pain, exercise-induced pain, pain coping and fatigue recordings are shown in Table III.

## Discussion

The present study shows that female fibromyalgia patients can perform a modified low-impact aerobic dance program without increasing their general pain and fatigue symptoms. Increased feelings of well-being were reported by the training group, as well as reduced feelings of muscular tension. Improved dynamic endurance work performance, as well as some reduction in exercise-induced pain when performing dynamic and static endurance work in the upper extremities were noted.

Our exercise program consisted of low-intensity dynamic endurance work. The lower extremities were moved continuously. The upper extremities were exercised with

**Table II.** The physical fitness of female fibromyalgia patients at study entry and after twenty weeks.

| | Training group (n = 11) | | Control group (n = 14) | |
|---|---|---|---|---|
| Physical tests | Week 0 median (range) | Week 20 median (range) | Week 0 median (range) | Week 20 median (range) |
| Aerobic fitness (heart rate at steady state) | 165 (132 - 187) | 142* (110 - 173) | 155 (120 - 177) | 147* (122 - 168) |
| Heart rate after 2 minutes rest | 111 (85 - 143) | 103* (62 - 120) | 104 (71 - 136) | 99 (64 - 120) |
| Heart rate after 4 minutes rest | 100 (70 - 130) | 93* (55 - 108) | 91 (53 - 127) | 91 (62 - 102) |
| Dynamic endurance work - upper extremity | | | | |
| Strength at the 1st repetition (in kPa) | 60 (28 - 84) | 66* (54 - 92) | 58 (50 - 76) | 60† (42 - 84) |
| Strength at the last repetition (in kPA) | 48 (10 - 65) | 52** (40 - 84) | 45 (32 - 60) | 46†† (34 - 62) |
| Static endurance work - upper extremity (in sec.) | 115 (37 - 409) | 104 (55 - 660) | 123 (64 - 282) | 124 (76 - 211) |
| Dynamic endurance work - lower extremities (in sec.) | 450 (59 - 600) | 144* (25 - 600) | 157 (75 - 600) | 134** (58 - 600) |

*Changes within groups; †changes between groups, $p < 0.05$. **Changes within groups; ††changes between groups, $p < 0.01$.

**Table III**. Symptoms and pain coping in female fibromyalgia patients at study entry and after twenty weeks.

| | Training group (n = 11) | | Control group (n = 14) | |
|---|---|---|---|---|
| | Week 0 median (range) | Week 20 median (range) | Week 0 median (range) | Week 20 median (range) |
| General pain (in mm using VAS[1]) | 51 (4 - 78) | 60 (27 - 82) | 59 (33 - 85) | 66 (11 - 88) |
| Exercise induced pain in: | | | | |
| Dynamic endurance work upper extremity (mm) | 17 (0 - 40) | 7** (0 - 25) | 24* (0 - 50) | 13 (0 - 25) |
| Static endurance work upper extremity (mm) | 36 (4 - 74) | 14* (2 - 48) | 28 (0 - 48) | 14 (0 - 56) |
| Concentric endurance work lower extremity (mm) | 13 (2 - 52) | 5 (2 - 21) | 20 (0 - 53) | 13 (2 - 57) |
| Eccentric endurance work lower extremity (mm) | 6 (0 - 54) | 8 (0 - 31) | 15 (0 - 45) | 14 (0 - 42) |
| Exertion during the last week (VAS) | 67 (32 - 93) | 64 (35 - 91) | 70 (33 - 93) | 75 (26 - 100) |
| Sleep during the last week (VAS) | 60 (2 - 90) | 46 (14 - 74) | 52 (0 - 100) | 37 (4 - 100) |
| Exertion during cycle ergometer test (RPE scale) | 17 (13 - 20) | 17 (11 - 19) | 17 (11 - 20) | 17 (11 - 18) |
| Vanderbilt Pain Management Inventory Questionnaire | | | | |
| Active pain coping | 21 (14 - 27) | 23 (17 - 25) | 20 (0 - 25) | 21 (12 - 28) |
| Passive pain coping | 29 (15 - 33) | 27 (22 - 30) | 28 (16 - 35) | 25 (18 - 36) |

* Changes within the groups, $p < 0.05$; ** changes within the groups, $p < 0.01$; no difference between the groups, $p > 0.05$.
[1]measured using a 100 mm long visual analogue scale.

intervals of rest. A higher exercising intensity (counted in number of repetitions) was thus aimed at the lower extremities than at the upper extremities. The different exercising intensities might explain the improved dynamic endurance work performance in the upper extremity and the reduced dynamic endurance work performance in the lower extremities seen in the training group. During the exercise sessions there might have been aerobic metabolism locally in the muscles of the upper extremities and periods of anaerobic metabolism in the muscles of the lower extremities.

The improved dynamic endurance work performance in the upper extremities might partly be explained by the physiological effect of exercise on the muscles. The two major fuels used by the muscles for endurance work are carbohydrates and free fatty acids (29). The glycogen content of the working muscle is one determinant for the capacity to perform long-term exercises (30). As endurance-trained persons utilize more free fatty acids as substrates and fewer carbohydrates, the reserves of this glycogen will then last longer and thereby improve endurance (31). Fatty acids arrive in the muscles after having been released from adipose tissues (32). This explanation is supported by the fact that the patients in the training group in the present study experienced a significant reduction in their body fat mass after the training period as compared to the control group (Haugen, unpublished data 1991). This reduced body fat mass as a result of aerobic dance exercise is in accordance with the results demonstrated in healthy subjects (33).

The present study did not demonstrate a statistically significant reduction of general pain. This observation is in accordance with the result of the study by McCain *et al.* (16). Hypoxia and the accumulation of metabolites are probably the determinants of exercise-induced muscle pain (34). Increased capillar density in the skeletal muscles is one of the first changes to occur during endurance training (29). Improved local circulation might thus explain the reduced exercise-induced pain seen when endurance work in the upper extremities was performed.

There were a high number of drop-outs during the study. They all dropped out during the first 10 weeks of the study. Those patients consenting to participate in an exercise program for a long period of time may be assumed to have positive attitudes towards physical activity. The fact that many of the patients participated regularly in some kind of physical activity prior to the study could reflect this. The patients in the study might therefore represent a selected group. Because of the low patient number completing the study and the possibility that group selection occurred, broad conclusions cannot be drawn. We can say, however, that fibromyalgia patients may perform low-intensity dynamic endurance exercises and thereby increase their physical activity level without experiencing exacerbation of their general pain and fatigue symptoms.

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