



# Effects of physical conditioning over patients with fibromyalgia

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## ABSTRACT

**Introduction:** Fibromyalgia is a chronic syndrome characterized by widespread musculoskeletal pain. Possible symptom attenuation with physical exercise has opened new perspective for treatment. **Objective:** This study aimed to assess the effects of a program of physical exercises (SPPE) on the functional ability, perceived pain and life quality of patients with fibromyalgia. **Methods:** A cohort of eighteen female fibromyalgia patients, mean age 46,4 ± 5,8 years, having the syndrome for 10,6 ± 5,7 years, were studied along one year of supervised program of predominantly aerobic physical exercises. Patients underwent baseline and quarterly exercise stress tests (EST) to evaluate work capacity; clinical examinations to determine pain intensity through visual analogue scale; tender points count and pain threshold assessment by pressure algometer; as well as interviews using the "Medical Outcomes Study 36-Item Short-Form Health Survey" (SF-36) questionnaire. **Results:** Work capacity improved from the third month ( $p < 0,05$ ); pain threshold increased from the sixth month ( $p < 0,05$ ); post-exertion pain improved ( $p < 0,05$ ) and number of tender points decreased ( $p < 0,05$ ) in the ninth month. Pain intensity decreased in the twelfth month ( $p < 0,05$ ). Except for the "general health perceptions" domain ( $p > 0,05$ ), all the remaining issues of the SF-36 improved at different periods of the study ( $p < 0,05$ ). **Conclusion:** Work capacity, pain and life quality of female fibromyalgia patients improved over a 12-month program of supervised physical exercise.

## INTRODUCTION

Fibromyalgia (FM) is a chronic syndrome of non-elucidated etiopathogenic nature which is characterized by generalized musculo skeletal pain and presence of at least 11 out of the 18 sensitive points specific to touching (tender points)<sup>(1)</sup>. It constitutes a clinical challenge due to the lack of an efficient therapeutic strategy, being recommended a multidisciplinary treatment program consisted of pharmacotherapy, physical activity and psychosocial therapy. In order to institute such broad program it is essential to know the effects of each component to be included. Aerobic fitness training is considered beneficial to individuals with FM; yet, with undefined impact about the clinical profile of the syndrome<sup>(2-5)</sup>.

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The reduction of symptoms of FM was observed in physical training programs of variable durations<sup>(6-7)</sup>, usually short; however, the reproduction of some of these interventions becomes difficult due to methodological problems, such as: training programs poorly described<sup>(6)</sup>; inconsistent determination of the exercises intensity outlined by the patient's tolerance<sup>(8-10)</sup>; and protocols involving non-supervised physical fitness training<sup>(11-12)</sup>.

**Objective:** To verify the effects of a supervised physical fitness program (SPF) over the functional capacity, pain and life quality of patients with fibromyalgia.

## METHODS

### Studied population

In the period from June, 1999 to June, 2000, forty-five patients with FM were selected in the Division of Rehabilitation Medicine of the Clinics Hospital of the Medicine School of the São Paulo University (HC-FMUSP). The patients looked for the pain emergency ward of the Neurology Clinics and of the Orthopedics and Traumatology Institute of the HC-FMUSP (IOT). The inclusion criteria for the study were: female sex; age between 25 and 65 years; with primary fibromyalgia diagnosed for longer than five years; sedentarism for longer than one year and no use of medication or any other kind of therapeutic treatment. All patients signed a free and clarified consent form about the research protocol. The study was approved by the Ethics Committee for Research Projects Analysis of HC-FMUSP and was according to the Helsinki Declaration.

During the study 14 women (31.1%) were excluded from the study for different reasons: not following the exercises prescription; missing the training and the cardiopulmonary exertion test. Eleven volunteers returned for evaluation and mentioned having used different medication dosage, types and associations.

During the protocol thirteen patients gave up (28.9%): five in the first trimester (they started using medication); six in the second trimester (due to diseases not related to physical activity) and two in the third trimester (one due to accidental ulnar fracture in the streets and another due to family's disease). The patients were called but did not return for re-evaluation.

Thus, the experimental group was composed of 18 women with FM who had training presence above 80%; followed correctly the exercises prescription; were present at the evaluation and were without medication or any other kind of treatment.

## Methods

### Fibromyalgia diagnosis

The FM diagnosis followed the criteria from the American College of Rheumatology<sup>(1)</sup>: generalized musculo skeletal pain for at least 3 months and presence of pain with digital pressure of 4 kg in at least 11 out of the 18 points sensitive to touching (tender points).

### Evaluation of the functional capacity

The cardiopulmonary exertion test (CPET) was applied for the determination of the oxygen consumption ( $\dot{V}O_{2max}$ ) which is the best functional capacity index. The CPETs were performed on an Inbramed electrical treadmill (Inbramed, Porto Alegre, Brazil), following the Bruce protocol. The metabolic results were obtained at each 20 seconds through the Aerosport TEEM 100 Metabolic Analyses System (Aerosport, Ann Arbor, USA), connected to the Micromed ergometry system (Micromed Biotechnology Ltd., Distrito Federal, Brazil). The interruption criterion of the CPETs was exertion limiting symptom.

### Pain evaluation

#### ▪ Evaluation of pain intensity

The visual analogue scale was applied (visual analogue scale – VAS): a 100 millimeters long non-graded ruler with descriptors at the ends: to the left 'no pain' and to the right 'unbearable pain'. The distance between the point corresponding to the painful intensity, signaled by the patient, and the left end of the scale determined the VAS value in millimeters. Higher scores showed high degrees of pain intensity.

#### ▪ Evaluation of pain intensity and number of tender points

The point was considered painful when pain occurred with the Fischer algometric pressure (Pain Diagnostics & Thermography, USA) lower than 4 kg/cm<sup>2</sup>. The pain threshold was defined by the minimum pressure needed in order to induce pain in each point. The scores of the several tender points of each individual were summed in order to quantify the pain total individual intensity in kg/cm<sup>2</sup>.

### Evaluation of life quality

The evaluation instrument of life quality, 'The Medical Outcomes Study 36-Item Short Form Health Survey' (SF-36), was applied as an interview. It was translated and adapted for the Brazilian population<sup>(13)</sup> and consists of eight domains, each one ranging from 0 – the worst to 100 – the best health status.

### Supervised physical fitness program

The supervised physical fitness program (SPF) followed the recommendations of the American College of Sports Medicine<sup>(14)</sup> and consisted of 60 minute-training sessions predominantly aerobic, three times a week, for a year. The exercises intensity was delimited by the heart rate (HR) of the anaerobic threshold (AT) and the HR of the respiratory compensation point (RCP) obtained in the initial CPET and updated at each trimester evaluation.

During the CPET the AT was determined by the point in which there was break in the aligning of the O<sub>2</sub> ventilation equivalent (lowest index of VE/ $\dot{V}O_2$ ) and lowest fraction of O<sub>2</sub> expired<sup>(15)</sup>. The RCP was established by the moment in which there was break of aligning of the CO<sub>2</sub> ventilation equivalent (lowest index of VE/ $\dot{V}CO_2$ ) and highest fraction of CO<sub>2</sub> expired, preceding its dramatic decrease<sup>(16)</sup>.

At each 15 minutes of session of SPF, the number of heartbeats in 15 seconds was checked by the radial pulse touch.

The SPF sessions on Mondays and Fridays consisted of: 10 minutes (min.) of stretching; 30 min. of aerobic activity – walking and/or running (to reach the HR established for the training) and 20 min. of activity in acclimatized swimming pool (32-34°C) (five min. of walking and/or trotting; 10 min. of swimming basics and five min. of stretching). On Wednesdays: five min. of stretching; five min. of warming-up; 30 min. of aerobic exercises – walking and/or running; 10 min. of local muscular activity and 10 min. of relaxing.

### Study's dynamics

All patients were submitted to an initial clinical appointment in order to evaluate the pain intensity by the VAS; determination of

the number of painful points and the pain threshold to pressure by pain measurement; questioning on life quality and CPET followed by evaluation of the post-exertion pain by the VAS. Once the SPF program was initiated, these evaluations were repeated every three months during one year for determination of the behavior of the variables throughout the time.

### Statistical analysis

In order to study the patients who completed the SPF program, the variance analysis with repeated measurements (ANOVA) was applied. They were complemented either by the multiple comparisons test by Bonferroni or by the 'Least Significant Difference' method. ANOVA, Kruskal Wallis and the Fisher's exact test were applied for the comparison of the trained group, the excluded patients group and the group of patients who have given up the study. The statistical significance level adopted was ( $p \leq 0.05$ ).

## RESULTS

### Characteristics of the studied patients

At the time of the research's inclusion, the mean (m)  $\pm$  standard deviation (SD) of the weight and the body mass index of the patients were respectively 65.6  $\pm$  11 kg and 25.5  $\pm$  3.6 kg/m<sup>2</sup>. There was not significant alteration in the subsequent evaluations ( $p > 0.05$ ).

### Intensity of the physical fitness

Table 1 shows the means  $\pm$  SD in real values (% of  $\dot{V}O_2$  peak) of the minimal and maximal thresholds of the aerobic training.

**TABLE 1**  
Minimal and maximal thresholds of the initial training intensity and of the four trimester evaluations expressed in means  $\pm$  SD of the real values (%  $\dot{V}O_2$  peak)

Evaluations	Training – Intensity	
	Minimal threshold (% $\dot{V}O_2$ peak)	Maximal threshold (% $\dot{V}O_2$ peak)
Initial	61.3 $\pm$ 13.4	82.9 $\pm$ 12.3
3 <sup>rd</sup> month	61.3 $\pm$ 13.4	82.3 $\pm$ 12.3
6 <sup>th</sup> month	54.8 $\pm$ 13.4	79.7 $\pm$ 9.9
9 <sup>th</sup> month	48.7 $\pm$ 10	78.4 $\pm$ 13.7
12 <sup>th</sup> month	50.9 $\pm$ 11.7	79.3 $\pm$ 14.2

### Functional capacity

The means  $\pm$  SD of the initial and trimester values of  $\dot{V}O_{2 peak}$  obtained in the CPET were 21.2  $\pm$  4.8; 23.6  $\pm$  4.6; 25.8  $\pm$  4.9; 24.6  $\pm$  4.6 and 24.9  $\pm$  4.5 mL.kg<sup>-1</sup>.min<sup>-1</sup>. Significant differences of the first evaluation were found in the 3<sup>rd</sup> ( $p = 0.047$ ), 6<sup>th</sup> ( $p = 0.007$ ) and 12<sup>th</sup> months of SPF ( $p = 0.014$ ).

### Pain evaluation

#### Evaluation by VAS

The means  $\pm$  SD of the pain intensity values were 60.7  $\pm$  37.6; 75.9  $\pm$  18.4; 64.6  $\pm$  25.9; 61.3  $\pm$  25.8 and 47.7  $\pm$  31.4 mm. Not significant increase in the 3<sup>rd</sup> month ( $p = 0.997$ ) and gradual reduction in the subsequent evaluations with statistically significant improvement of the 3<sup>rd</sup> for the 12<sup>th</sup> month was observed ( $p = 0.007$ ).

The means  $\pm$  SD of the post-exertion pain intensity values (80.5  $\pm$  19; 82.8  $\pm$  18.5; 78  $\pm$  23.8; 68.2  $\pm$  29.7 and 58.2  $\pm$  34.3 mm) showed similar behavior, with decrease in the 3<sup>rd</sup> month (without statistical significance,  $p = 1.0$ ) and statistical improvement from the 3<sup>rd</sup> to the 9<sup>th</sup> month ( $p < 0.05$ ).

#### Evaluation by pressure algometer

The means  $\pm$  SD of the number of tender points (16.1  $\pm$  2.4; 15.9  $\pm$  3.8; 13.9  $\pm$  4.0; 12.5  $\pm$  6.1, and 12.8  $\pm$  6.6) were steady until

the third month and decreased later, showing significant difference between the 3<sup>rd</sup> and 9<sup>th</sup> months' results ( $p = 0.041$ ).

In the third month of SPF, the physical exam of two patients showed lack of diagnosis criteria for FM [according to the one established by the American College of Rheumatology<sup>(1)</sup>]. The same fact occurred with one patient in the sixth and with another after the ninth month of training. In the end of the study, a total of six participants did not fulfill the diagnosis criteria for FM.

The means  $\pm$  SD of the pain total individual intensity ( $43.40 \pm 12$ ;  $46.50 \pm 17.9$ ;  $53.58 \pm 14.9$ ;  $58.52 \pm 19.8$ ; and  $55.08 \pm 22.1$  kg/cm<sup>2</sup>) showed significant improvement between the beginning, the 6<sup>th</sup> ( $p = 0.026$ ) and the 9<sup>th</sup> months ( $p = 0.005$ ); as well as from the 3<sup>rd</sup> to the 9<sup>th</sup> month of SPF ( $p = 0.035$ ).

### Evaluation of the life quality – domains

- '*General health status*': the means  $\pm$  SD did not reveal statistically relevant difference during the protocol ( $43.3 \pm 23.0$ ;  $45.8 \pm 28.5$ ;  $50.4 \pm 25.2$ ;  $50.3 \pm 25.4$  and  $57.4 \pm 24.1$ ).

- '*Functional capacity*' ( $33.1 \pm 21.1$ ;  $36.9 \pm 20.7$ ;  $41.9 \pm 19.5$ ;  $41.4 \pm 18.7$ ; and  $45.8 \pm 16.5$ ): there was significant increase in the 12<sup>th</sup> month ( $p = 0.024$ ) compared with the beginning.

- '*Physical aspects*' ( $13.9 \pm 26$ ;  $27.8 \pm 33.1$ ;  $37.5 \pm 37.6$ ;  $38.9 \pm 39.5$ ; and  $34.7 \pm 37.5$ ): significant increases concerning mean  $\pm$  SD were observed in the 3<sup>rd</sup>; 6<sup>th</sup> and 9<sup>th</sup> months ( $p < 0.05$ ).

- '*Pain*' ( $28.1 \pm 23.4$ ;  $32.3 \pm 23.5$ ;  $39.4 \pm 20.8$ ;  $41.8 \pm 20.1$ ; and  $40.9 \pm 20.8$ ): there was significant improvement concerning the beginning for the evaluations of the 9<sup>th</sup> and 12<sup>th</sup> months ( $p < 0.05$ ).

- '*Vitality*' ( $35.8 \pm 19.3$ ;  $35.8 \pm 25.7$ ;  $46.9 \pm 20.7$ ;  $45.8 \pm 22.1$ ; and  $42.8 \pm 23.7$ ): significant increases occurred from the second to the third and fourth evaluations ( $p < 0.05$ ).

- '*Mental health*' ( $38.2 \pm 24.4$ ;  $45.8 \pm 27.7$ ;  $53.1 \pm 25$ ;  $51.1 \pm 25.2$ ; and  $52.4 \pm 26.5$ ): significant increases were observed from the beginning to the 6<sup>th</sup>, 9<sup>th</sup> and 12<sup>th</sup> months ( $p < 0.05$ ).

- '*Social aspects*' ( $49.3 \pm 38.7$ ;  $57.6 \pm 40.5$ ;  $75.7 \pm 36$ ;  $62.5 \pm 35.4$ ; and  $79.2 \pm 32.9$ ): there was significant improvement from the beginning to the evaluations of the 6<sup>th</sup> and 12<sup>th</sup> months and from the 3<sup>rd</sup> to the 6<sup>th</sup> month of SPF ( $p < 0.05$ ).

- '*Emotional aspects*' ( $16.7 \pm 34.8$ ;  $27.3 \pm 34.8$ ;  $57.2 \pm 37.8$ ;  $43.3 \pm 43.4$ ; and  $44.5 \pm 41.2$ ): significant increase occurred from the 1<sup>st</sup> and 2<sup>nd</sup> evaluations to the 3<sup>rd</sup> ( $p < 0.05$ ), followed by a decrease without statistical significance ( $p > 0.05$ ).

### Comparison of the trained group; the excluded patients and the group of the patients who have given up of the study

The comparison of the trained group; the excluded patients and the patients who have given up of the study did not show statistical difference ( $p = 0.07$ ) in the age ( $46.5 \pm 5.8$ ;  $49.4 \pm 9.6$  and  $41.2 \pm 11.5$  years respectively) and weight means ( $65.7 \pm 11.0$ ;  $64.8 \pm 10.9$  and  $66.2 \pm 15.3$  kg respectively,  $p = 0.96$ ); of the body mass index ( $25.5 \pm 3.7$ ;  $25.3 \pm 3.7$  and  $25.9 \pm 5.3$  kg/m<sup>2</sup> respectively,  $p = 0.93$ ); of the time of disease ( $10.6 \pm 5.7$ ;  $9.8 \pm 9.6$  and  $10.5 \pm 9$  years;  $p = 0.55$ ); the number of tender points ( $16.1 \pm 2.5$ ;  $14.0 \pm 2.9$  and  $15.9 \pm 2.4$ ;  $p = 0.06$ ) and of the pain total individual intensity ( $43.4 \pm 12$ .  $52.7 \pm 15.1$  and  $43.5 \pm 14.5$  kg/cm<sup>2</sup> respectively,  $p = 0.13$ ).

The group of patients who completed the training program concentrated higher number of subjects with elementary education (56%) and the group with the patients who have given up the study presented higher concentration of subjects with high school education (46%).

The group which completed the study; the group of the excluded patients and the group of the patients who have given up did not present differences ( $p > 0.05$ ) concerning the functional capacity ( $21.2 \pm 4.8$ ;  $22.7 \pm 3.4$  and  $25.3 \pm 5.8$  mL.kg<sup>-1</sup>.min<sup>-1</sup> respectively); aerobic training minimal threshold ( $61.3 \pm 13.4$ ;  $55.8 \pm 13.6$ ; and  $60.1 \pm 11.9$ ) and maximal threshold ( $82.9 \pm 12.3$ ;  $77.5 \pm 13.7$ ;

$79.3 \pm 15.1$ ); expressed in real means (in % of the  $\dot{V}O_2$  peak) in the beginning of the protocol.

## DISCUSSION

### Functional capacity

The increase of the  $\dot{V}O_2$  peak in our experimental group from the third month of SPF confirmed the results of previous studies which applied different types of training<sup>(11)</sup> and several methods of evaluation<sup>(7)</sup>. Moreover, such increase can be attributed to chronic effects of the aerobic exercises over the cardiovascular and musculo skeletal systems: 1) increase of the cardiac debt<sup>(17)</sup>; 2) movement to the right of the hemoglobin dissociation curve<sup>(18)</sup>; increase of the muscular capillarity<sup>(19)</sup> and decrease of the resistance to O<sub>2</sub> diffusion of the red blood cells to the contracting muscular fibers<sup>(20)</sup>; remodeling of the exercised muscles with transformation of the type IIb fibers to IIa<sup>(17)</sup>; increase in number, size and enzymatic concentration of the mitochondria of the slow contraction muscular cells<sup>(21)</sup>.

### Pain

The pain manifestation is a multidimensional experience; moreover, in the case of FM it is modeled by fatigue, emotional stress and depression. Since VAS is a one-dimensional instrument<sup>(22)</sup> for the pain evaluation, we chose to analyze together the VAS scores and the ones from pain measurement.

In the first three months of SPF, the pain threshold and the number of tender points remained the same and the pre and post-exertion VAS scores presented increase without statistical significance. This negative result confirmed the findings of other studies<sup>(2,7)</sup> and may be attributed to the great expectation of improvement of the post-exercise pain generated by exocentric force, stronger than the daily life's, imposed to the sore muscles of the fibromyalgia.

During this study a lower pain perception on the part of the patients can be explained by several mechanisms: 1) decrease of night discomfort and consequent 'waking' reducing the muscles contraction kept of the FM<sup>(23)</sup>. 2) release of endorphins by the central nervous system<sup>(24)</sup>.

The number of tender points is a clinical sign of high sensitivity and specificity in the syndrome's diagnosis<sup>(1)</sup>. The lack of diagnosis criteria for FM in six patients in the end of the protocol shows the efficiency of the proposed training program.

### Life quality

The SF-36 questionnaire despite not being validated for patients with FM was applied for being broader than the 'Fibromyalgia Impact Questionnaire'<sup>(25)</sup>, which is specific for such condition.

After the third month of the protocol, the patients reported higher easiness to do tasks and work, probably due to the increase of the functional capacity confirmed by the CPET. From the sixth month of SPF the patients perceived greater vigor; improvement of mood and depression; lower interference of emotional problems over work and social relations. These responses confirmed the psychological benefits of aerobic exercises over the FM symptoms, such as well being and reduction of anxiety and somatization<sup>(2)</sup>.

Lower interference of the pain over work from the ninth month of training was due to improvement of post-exertion pain as well as reduction of the number of tender points.

Greater aptitude to perform daily tasks diagnosed at the end of 12 months was attributed to lower pain intensity, confirmed by the VAS as well as the sum of the favorable effects of physical training during the protocol.

## FINAL CONSIDERATIONS

The 11 excluded patients who used different medication were not compared with those who completed the SPF program in order to avoid possible discrepancies.



Low adherence and presence in the proposed SPF program also observed in other investigations<sup>(8-9)</sup> was attributed to pain increase (single adverse effect observed) in the third month of SPF, since the trained, excluded and patients who have given up groups presented similar characteristics, functional capacity and training intensity. The patients who have given up had higher educational background and maybe having more information, reached for additional treatment. During the second semester of the protocol there was improvement of the FM symptoms and consequently a lower number of patients who gave up.

Conversely to the literature, we recommend exercise protocols of long duration. We suggest patients' clarification on the presumed pain intensification in the first months of the intervention, medication therapeutic support as well as pain control techniques in this period.

### Study's limitations

The reduced size of the population in our research was due to the difficulty to select individuals with fibromyalgia without concomitant diseases, which could interfere in the study's results. The exclusion criteria strictness was also a limiting factor. Training frequency lower than 80% of the total sessions; disobedience of the physical exercises prescription and lack of evaluations would compromise the evaluation of the program's effectiveness. An important obstacle was the restriction of medication use. Such fact generated lack of confidence on the part of the patients; without therapeutic support in case the pain worsened, caused low initial patients' adherence. However, were patients under medication and/or diverse therapies included, the research would have doubtful results derived from collateral effects, interactions between these treatments and their effect over the tolerance of physical exertions.

The highly selected sample and the individual variability of the spectrum as well as the symptoms intensity do not allow findings generalization.

### CONCLUSION

The effects of the supervised physical fitness training over individuals with fibromyalgia were: increase of the functional capacity and pain and life quality improvement.

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*All the authors declared there is not any potential conflict of interests regarding this article.*

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