

Relationship Between Cardio-Respiratory Parameters and Women With Fibromyalgia

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Objective: To determine groups in women with fibromyalgia syndrome (FM) based on symptoms and determine their cardiovascular parameters during treadmill exercise to prescribe them physical activity.

Patients and method: Women (n=32; age, 53.3 [6.6] years) were assigned into 2 different groups according to their functional capacity and symptoms. During incremental treadmill exercise test, exercise intensity was increased until participants achieved volitional exhaustion. Expired respiratory gases, ventilator parameters, and heart rate (HR) were measured continuously during exercise and rating of perceived exertion (RPE) was assessed each minute during the test.

Results: Peak VO_2 values for the group 1 were significantly different than for group 2 (24.9 [3.2] mL/kg/min [group 1] and 21.5 [2.1] mL/kg/min [group 2]) similar ones to the found in other studies with women with FM, although lower than in other populations without this pathology. On the other hand, if we take into account the $\text{VO}_{2\text{VT}}$, we found no significant differences between groups in both trials. We found also differences in all the evaluated parameters.

Conclusions: Depending on the level of affectation and the symptoms of the FM patients, their aerobic capacities were different; therefore, we are not be able to prescribe physical activity with the same intensity for both groups. According to those results, professionals could prescribe physical activity with a high security and control.

Key words: Women. Cardiovascular capacities. Level groups. Physical activity. Fibromyalgia.

Relación entre capacidad cardiorrespiratoria y fibromialgia en mujeres

Objetivo: Determinar los principales parámetros cardiorrespiratorios de las mujeres con fibromialgia y su clasificación en función del grado de afectación para una posterior prescripción de actividad física.

Pacientes y método: Se clasificó a una muestra de 32 mujeres (media de edad \pm desviación estándar [53,3 \pm 6,6] años) en 2 grupos experimentales en función de su grado de afectación y sintomatología. Ambos grupos se sometieron a 2 pruebas de esfuerzo en cinta sinfín, una al inicio y la otra, una semana después. La intensidad del ejercicio se incrementó hasta que las participantes alcanzasen su máxima capacidad. Los gases espirados, parámetros ventilatorios y frecuencia cardíaca se midieron continuamente durante el ejercicio y la valoración subjetiva del esfuerzo, controlada cada minuto en la prueba.

Resultados: Los valores medios de máximo consumo de oxígeno alcanzados por ambos grupos fueron 24,9 \pm 3,2 ml/kg/min (grupo 1) frente a 21,5 \pm 2,1 ml/kg/min (grupo 2), similares a otros estudios en mujeres con fibromialgia, aunque inferiores a los de otras poblaciones de referencia. En los demás parámetros ventilatorios, aun siendo inferiores en el grupo con mayor grado de afectación, no hay diferencias significativas.

Conclusiones: Hemos comprobado que, en función del grado de afectación y los síntomas de las pacientes con fibromialgia, sus capacidades cardiorrespiratorias son distintas; por tanto, no podremos prescribir un ejercicio con la misma intensidad a mujeres de uno y otro grupo. Según estos resultados los profesionales podrán prescribir actividad física con más seguridad y control.

Palabras clave: Mujeres. Grupos de nivel. Capacidad cardiovascular. Actividad física. Fibromialgia.

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Introduction

Fibromyalgia is a chronic disease that causes generalized pain and is associated to other symptoms, among them

unsound sleep, rigidity, anxiety, and others.¹⁻³ However, in spite of the reduction in physical capacity,⁴ physical exercise has been defined as a useful tool to improve quality of life, strength, and the physical condition of patients with fibromyalgia, and constitutes one of the most effective non-pharmacologic treatments for patients with this illness.⁵⁻⁹

Heterogeneity in the manifestations of fibromyalgia and the imprecision in the knowledge of its pathogenic mechanisms are linked to the lack of a treatment plan. Because there are no established protocol or procedures, it is difficult to compare the different patterns on which clinical trials have been carried out, mainly due to differences in sampling, follow-up periods, pain measuring procedures, associated symptoms, the use of different evaluation indexes, etc.

Even though the progression of the disease is chronic, many authors establish a relatively good prognosis, with symptomatic improvement of the patients in relation to the practice of regular physical exercise.^{3,8-12} Exercise is evermore employed for the rehabilitation of patients; however, for this to be effective it is necessary to be cautious in its prescription and control. Its intensity must be sufficient to induce effect on the training but not so high as to be detrimental or lead to an increase in symptoms.

The problem lies, therefore, in how to start a program of physical activity for women with fibromyalgia and, moreover, how to maintain and supervise it once it has started. For that we need tools that allow us not only to safely prescribe the intensity of the effort, but also to control the evolution of our patients without the need to dedicate a lot of time and allow, little by little, this process to be adopted automatically by each of the subjects.

Prescribing an adequate exercise stimulus in order to improve cardiovascular capacity requires an adequate adjustment in the frequency, duration and intensity, and of these, the last one is the most difficult to control.¹³ A meta-analysis carried out by Busch et al⁸ (2005) chose articles with high methodological quality that prescribed physical activity to patients with fibromyalgia and, concretely, aimed to improve cardio-respiratory resistance, based on the recommendations of the ACSM (1998).¹⁴ We found, however, a serious problem in the prescription of physical activity when relating to fibromyalgia. Two women with fibromyalgia, with the same age, would theoretically have the same maximum heart rate (HR_{max}) following the traditional formula $220 - \text{age}$ that is proposed by numerous authors,^{10,15-17} so that these women would be prescribed the same type and equal intensity of exercise; however, if we assume that one of the subjects has a severe degree of affection and the second subject a lesser degree, would we prescribe the same intensity when one of the patients can barely move and the other one leads a relatively active life?

Women with fibromyalgia had different initial levels in their physical capacities; some of them can exercise at a mild to moderate intensity,⁴ while for others, this intensity can increase pain.¹⁷ Numerous investigations have shown that the intensity, in patients with chronic pain, is not constant, mainly in those with fibromyalgia whose symptoms vary considerably throughout the day.¹⁸ Nonetheless, there are currently very few studies that have measured the capacity of the patients directly or through spirometry, or determined thresholds; with these being the most adequate cardio-respiratory measures, as has been pointed out by several authors.^{4,19-20}

Several studies point to a low cardio-respiratory capacity as a great predictor of mortality.²¹ Through the analysis of oxygen consumption (VO_2), heart rate (HR), and other respiratory parameters, an objective evaluation of the functional capacity of the patient can be done,²² something that acquires great importance for the prognostic evaluation and for therapeutic decision making.

The objective of the present study will therefore be to understand the changes in the physiological parameters and the cardio-respiratory capacities during exercise of women with fibromyalgia with severe affection and the degree in which these differ from subjects with a lesser degree of affection or are sedentary, allowing afterwards to design a training and follow-up program which is adjusted to the individual capacities of these patients.

Material and Method

Participants

Two natural groups: group 1 (n=16) and group 2 (n=16); women of 44-68 years of age (group 1, 52.7 [6]; group 2, 55.4 [7.2] years of age) of the Seville Aljarafe participated voluntarily in the study. During January and February of 2006 the physiological parameters were determined in both groups, who were previously classified in relation to their degree of affection, as indicated by the Assistance Process for Fibromyalgia (Consejería de Salud, 2005),²³ through a symptomatic index, the number of tender points (TP) and the Fibromyalgia Impact Questionnaire (FIQ). Each participant previously signed an informed consent in order to comply to the ethics norms of the Declaration of Helsinki of 1975. Previous characteristics of both groups are reflected in Table 1.

Measurement Protocol

To assign patients to one of the 2 experimental groups we determined, on the same day of the test, the levels of FIQ in Spanish,²⁴ according to 4 visual-analog scales,

TABLE 1. Characteristics of the Subjects With Relation to the Experimental Group^a

	Group 1	Group 2
Age, mean (SD), y	54.12 (5.94)	55.38 (7.37)
Weight, ^b mean (SD), kg	68.95 (10.7)	74.06 (14.4)
Height, mean (SD), m	1.56 (0.05)	1.59 (0.04)
BMI	28.29 (4.49)	29.04 (4.98)
PA level ^b	2.81 (0.02)	2.03 (0.13)
Symptom level ^b	19.35 (5.47)	27.38 (4.76)
FIQ ^b	51.56 (12.46)	70.21 (5.75)
TP ^b	11.71 (4.61)	14.88 (3.36)

^aPA indicates physical activity; FIQ, fibromyalgia impact questionnaire; BMI, body mass index; TP, tender points.

^bSignificant differences between both groups, $P < .05$.

Group 1, with moderate degree of affection and group 2, with severe degree of affection. Data are presented as mean (standard deviation).

corresponding to the dimensions of the quality of life aspects (physical, psychological, and social), that constitute the fundamental core of the affection in fibromyalgia. The number of specific TP in this pathology and an evaluation of the symptomatic level based on 4 analog scales of 0-10 points (How much pain do you have?, How much sadness or depression do you feel?, How much anxiety or nervousness do you perceive?, How difficult is it for you to perform your tasks or job?). According to the arithmetic sum of all of the scales (FIQ, number of TP, and symptomatic evaluation) were defined by 2 levels of affection:

- Medium level of affection (group 1): those with a total score in the 3 tests <60 points
- Severe level of affection (group 2): those with a total score >60 points

According to this system of classification, we can evaluate not only the dimensions of the patients functional capacity, the frequency of performance of activities of daily living, and the difficulty to perform these activities,²⁵ with this procedure we can also describe the differences regarding tender points (which define this disease) and another 2 symptoms present in the majority of women with fibromyalgia, such as anxiety and depression and that, as several studies have reflected, could be altered by the differences related to the degree of affection of the patients.¹²

Once classified, the subjects performed 2 maximal treadmill tests, one at the beginning and the following one, a week later. The Bruce protocol as modified by Kaminsky (1993) was employed.²⁶ During the tests, testing of exhaled gases during ventilation was performed (VE), as we determined

both the respiratory rate (RR) and the respiratory quotient (RQ) every 5 s, using MetaMax 3B (Cortex Biophysik GMBH, Germany) with breath by breath technology. HR was telemetrically obtained through a pulse meter (Polar; Seattle, United States).

Each subject warmed up for 5 minutes before the test. Three minute steps were determined and a subjective effort evaluation was solicited (RPE) every minute and the rest of the parameters, VE, RQ, FC, and oxygen consumption, every 5 s. Maximum oxygen consumption criteria (VO_{2max}) were at least 2 of the following: a) $RQ=1$; b) 95% HR_{max} of the maximum estimated for the patients age; and c) stability of the VO_2 curve (2 mL/kg/min) for the last minute of the stage.

Statistical Analysis

Analysis was done using the SPSS 12.0 software package for Windows (SPSS Inc, Chicago, United States). A descriptive analysis of the mean values found was performed for each variable and the validity of this data was estimated through the Pearson (r_{xy}) test between both tests and the HR, oxygen consumption ($\%VO_{2max}$), RR, VE, and RQ as dependent variables.

Results

Thirty-two women fulfilled the inclusion criteria of the ACR (1990) and, once classified according to their degree of affection, means of 11.7 (4.6) TP for a moderate degree of affection, versus 14.9 (3.4) TP found in women with severe affection, which allowed for significantly superior scores. When evaluating the FIQ and symptomatic level scores, we also found significant differences between both groups (70.9 in group 1 vs 97.6 in group 2).

The mean values of the response to exercise variables of the patients in both groups are summarized in Table 2. Sixty-three per cent of the subjects in group 1 and only 40% of those in group 2 reached VO_{2max} according to our criteria; nonetheless, all of the subjects reached the anaerobic threshold (VO_{2VT}).

For VO_{2max} of the patients with a lesser degree of affection, we found significant differences ($P < .01$) with respect to the values of group 2 in both tests (26.2 [3.6] mL/kg/min [group 1] vs 22.1 [2.5] mL/kg/min [group 2]); these values were slightly inferior, though equally significant ($P < .01$), in the second test (23.6 [2.8] mL/kg/min [group 1] vs 20.9 [1.6] mL/kg/min [group 2]).

Another important finding was that the HR_{max} , VE, and RQ values were all less in the group with the worse symptoms when compared to the group with lesser affection. With respect to RPE, we did not find important differences between the groups and approximately varied by 1 point (13.6 [0.9] vs 14.2 [1.2] in group 2).

TABLE 2. Physiological Parameters and Perception of Effort of the Subjects in Both Tests^a

Variable	Test 1			Test 2		
	Group 1 (n=16)	Group 2 (n=16)	Total (n=32)	Group 1 (n=15)	Group 2 (n=13)	Total (n=28)
Respiratory rate	27.95 (5.50)	26.68 (6.75)	27.32 (6.13)	25.32 (5.16)	26.16 (8.21)	25.74 (6.69)
Ventilation	36.58 (5.55)	35.61 (5.15)	36.10 (5.35)	34.29 (5.93)	32.22 (7.07)	33.26 (6.50)
VO ₂ , L/min	1.31 (0.19)	1.28 (0.2)	1.30 (0.20)	1.27 (0.02)	1.23 (0.27)	1.25 (0.15)
VO _{2max}	26.17 (3.62) ^b	22.13 (2.50) ^b	24.15 (0.79)	23.59 (2.83) ^b	20.89 (1.62) ^b	22.24 (0.86)
VO _{2VT}	20.28 (2.70) ^b	19.21 (2.22) ^b	19.75 (0.33)	20.29 (3.04) ^b	18.55 (1.67) ^b	19.42 (0.97)
RQ	0.91 (0.01)	0.91 (0.01)	0.91 (0.01)	0.89 (0.1)	0.89 (0.05)	0.89 (0.08)
HR _{max}	158.17 (12.37)	144.00 (21.33)	151.08 (6.34)	153.88 (10.76)	145.11 (19.92)	149.50 (6.48)
HR _{VT}	140.33 (16.62)	131.64 (22.76)	135.99 (4.34)	138.35 (11.84)	133.11 (16.39)	135.73 (3.21)
RPE	13.60 (0.87)	14.22 (1.20)	13.91 (1.04)	13.42 (0.63)	14.31 (0.71)	13.86 (0.67)

^aVO₂ indicates oxygen consumption; VO_{2max}, maximum consumption of oxygen achieved during the test; VO_{2VT}, oxygen consumption in the anaerobic threshold; RQ, respiratory exchange quotient; HR_{max}, maximum heart rate; HR_{VT}, heart rate in the anaerobic threshold; RPE, subjective effort evaluation (Borg 6-20RPE).

^bSignificant differences between groups, $P \leq 0.01$. Data is presented as mean (standard deviation).

Discussion

As can be seen in the study by Thieme et al²⁷ (2005), many of the studies fail by not considering groups according to the level of fibromyalgia, leading on occasions to an inadequate treatment. In our study we have proven that subjects in group 2 (with a greater degree of affection) all have a lesser degree of oxygen consumption and heart rate than their counterparts in group 1 (with a moderate degree of affection). Only 3 studies have previously tried to evaluate the cardio-respiratory capacities of the subjects with fibromyalgia compared to control subjects, though none established level of affection groups.^{19-20,28} Valim et al²⁰ (2002) confirmed the low cardio-respiratory level of patients with fibromyalgia when compared to sedentary controls. In several studies, on the contrary, the conclusion reached established that the aerobic capacity of these patients seems to normal when compared to that of a similar population, though the perception of the effort at a relative intensity is higher in patients with fibromyalgia.¹⁹ With respect to mean RPE, the results do not differ greatly between groups; however, when analyzing these differences through the means of each step of the test, we find differences that are close to 2 points in the scale between the 2 groups.

Numerous authors considered the aerobic capacity as one of the determining factors in the pathogenesis of fibromyalgia and there is evidence that with exercise we may be able to modulate the pain in these patients.^{20,29} Though Bennett et al²⁹ (1989) found that 80% of patients presented poor physical condition, Sietsema et al²⁸ (1993) did not find differences between patients with fibromyalgia and control subjects, using VO_{2max} and VO_{2VT} to that end.

In our study we found significant differences between individuals with a different degree of affection according to their VO_{2max}.

The values obtained in this study are somewhat inferior to those reflected by Meiworm et al³⁰ (2000), though similar to the mean values reported by other authors.^{4,28-29} However, all of this data is in direct contrast with the ones present in group 2 of our study, with a more severe degree of affection (22.1 [2.5] mL/kg/min).

When comparing this data with the standard values of sedentary population, attention is drawn to the fact that the values in both groups are below the mean according to the criteria proposed by ACSM (1998) for sedentary women between 40 and 59 years of age,¹⁴ comparable to those obtained by women who are older than 70 years of age³¹ or to those of women with some type of affection.³² With respect to our group 2, the results show the low aerobic capacity of these patients.

Numerous authors have pointed out that the subjects with fibromyalgia must exercise in order to improve their aerobic capacity with a low to moderate intensity^{3-4,8}; nonetheless, without any subgroups in their prescription, the variability between their subjects is ample. In our study, by establishing level of affection groups we have a greater security in the prescription, mainly because our groups are more homogeneous and their physical capacities are very similar; however, new studies are necessary that allow us to understand the mechanisms by which exercise improves the symptoms of women with fibromyalgia and which intensity is more adequate so that such a treatment is more effective.

In conclusion, this is the first study that analyzes the cardio-respiratory parameters of women with fibromyalgia

classified according to their symptoms and degree of affection.

The results show that the consumption of oxygen is significantly lower in patients with a higher degree of affection and these are therefore significantly inferior to populations of the same age without the disease. The fact that affection levels were established in the prescription of aerobic physical exercise in women with fibromyalgia allows us to reduce individual differences regarding their capacities, therefore insuring a larger amount of control over the intensity of the session.

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