Assessment of quality of life, muscle strength and functional capacity in women with fibromyalgia

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ABSTRACT

Objective: To assess the quality of life, muscle strength and functional capacity in women with fibromyalgia (FM). **Patients and Methods:** Cross-sectional study carried out with 31 female volunteers (age range, 35 to 60 years), paired in two groups (16 with FM, and 15 in the control group). Both groups underwent the following assessments: one-repetition maximum (1RM) of knee flexors and extensors; quality of life (application of the SF-36 questionnaire); 6-minute walk test (6MWT); pinch strengths (tripod, pulp-to-pulp, and key) and handgrip strength. **Results:** A significant difference between the groups was observed in the following variables: handgrip strength; pulp-to-pulp and tripod pinch strength of both hands; and the 1RM test of knee flexors and extensors in both limbs ($P < 0.05$). Only the key pinch showed no statistical difference between groups for both limbs ($P > 0.05$). The 6MWT also showed a statistical difference between the groups ($P < 0.01$). The SF-36 showed that women with FM have reduced functional capacity, increased bodily pain, and worsened general health status ($P < 0.05$). **Conclusion:** The results revealed, in women with FM, a reduction in the following: muscle strength in the upper and lower limbs; the distance walked in the 6MWT; and quality of life.

Keywords: fibromyalgia; quality of life; muscle strength.

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INTRODUCTION

Fibromyalgia (FM) is characterized by generalized chronic pain of still unknown cause. The pain does not have an inflammatory origin, manifests in the musculoskeletal system, and can have symptoms in other systems.[1] Fibromyalgia is considered the second most common rheumatologic disorder in the United States, affecting approximately four to six million North-Americans.[2-4] That population is mainly composed of women between 30 and 60 years, and the women:men ratio is 10:1.

In 1990, the American College of Rheumatology (ACR) defined the criteria to classify FM,[5] which were validated for the Brazilian population in 1999 by Atallah-Haun *et al*.[6] Those criteria are as follows: generalized pain in at least three of the four body quadrants in the last three months; and localized pain upon palpation in at least 11 of the 18 pre-established tender points.

The pathophysiology of FM includes alterations in the autonomic nervous function and endocrine system, genetic influence, and exposure to stressors. Fibromyalgia may share these causal factors with other pain conditions, such as major depressive disorder, irritable bowel syndrome, and temporomandibular disorders. Alterations in the central processing of sensory input and deficiencies in the endogenous inhibition of pain may contribute to worsen pain sensitivity and to maintain diffuse pain in patients with FM.[7]

Muscle strength is an important component of health-related physical fitness, in addition to playing a significant role in physical development in several daily-life/sports activities.[8] It is known that patients with FM have a considerable reduction in muscle strength and performance when compared with individuals without FM. Mannerkorpi *et al*.[9] have found, in one third of the women diagnosed with FM, lack of muscle strength or flexibility in their upper limbs to perform simple

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daily activities, such as reaching for high shelves or washing their own hair.

The maximum capacity of a muscle or muscle group to generate tension against resistance is defined as the maximum strength, which is frequently measured by use of the one-repetition maximum (1RM) test, a practical and low-cost operational method. It is defined as the maximum amount of weight one can move, correctly and with no muscle compensation, for a specific range of motion at a single time.[10] That test is important to determine an individual's strength, such as when verifying the impact of a training program, or even to assess the capacity for generating strength in a specific population.

According to the American Thoracic Guidelines, the six-minute walk test (6MWT) is safe, easy to apply, inexpensive, well tolerated and reflects the daily-life activities,[11] being, thus, used to the following: to assess the patient's physical capacity in general and sports activities; to assess the functional status of the cardiovascular and/or respiratory system of healthy individuals and of individuals in pathological conditions; to assess the effects of prevention and rehabilitation programs;[12] and to identify morbidity and mortality in cardiac transplantations.[13]

Unfit muscle has been shown to be more susceptible to lesion during activity,[14,15] and such muscle lesion can result in more pain, making those individuals more sedentary and unfit.

Women with FM have been shown to be physically unfit and have reduced muscle strength in the upper limbs, but we have little information on the muscle strength of the lower limbs and on the functional capacity assessed by use of the 6MWT.

The lack of physical fitness of those patients has been well established in the literature. The 6MWT can be a valuable instrument for detecting alterations in the functional capacity, and, in addition, it can be correlated with muscle strength and quality of life.

Thus, the present study aimed at assessing muscle strength, muscle functional capacity, and the quality of life of women with FM and healthy women, in addition to correlating the variables studied.

PATIENTS AND METHODS

This is a cross-sectional study, approved by the Committee on Ethics in Research of the Federal University of São Paulo (nº 2092/08). The study selected women diagnosed with FM,[16] according to the ACR criteria, aged between 35 and 60 years, from the UNIFESP-EPM outpatient clinics, in the city of São Paulo. The control group comprised age-matched healthy women from the city of Santos, in the São Paulo state. The exclusion criteria for both groups were as follows: presence of any type of inflammatory joint disease or symptomatic degenerative joint disease; regular practice of physical activity (at least three times a week); and diagnosis of depression, symptomatic lung and heart diseases, according to previous medical assessment.

Data were collected by two researchers, one of whom assessed the strength of one maximum repetition of knee flexion and extension, and applied the Medical Outcomes Study 36-Item Short-Form Health Survey (SF-36). The other researcher applied the 6MWT and assessed the pinch strengths (tripod, pulp-to-pulp, and key) and handgrip strength by use of the following dynamometers: Preston Pinch Gauge® (B&L Engineering Co, California) and Jamar® (Asimow Engineering Co, Los Angeles), respectively.

To calculate the 1RM, patients were placed on a seated flexion/extension machine, seating straight, with their vertebral column supported, their knees flexed at 90º and their popliteal fossa touching the edge of the seat. The patients were instructed to perform a complete extension of their knees up to 0º, with no postural compensations. During all repetitions, verbal stimuli were provided.[17] For assessing the 1RM of knee flexion, the previously cited procedures were used, with the difference that the joint began extension from the 0º position and performed a 90º flexion. Weights were added up between the three attempts to identify the maximum weight at which the patients could flex and extend their knees.

When assessing the quality of life, the SF-36 comprised the following domains: physical functioning; general health perceptions; mental health; role limitations due to physical health; vitality; role limitations due to emotional problems; social functioning; and bodily pain. One more question comparing the patient's current and one-year-before health conditions was included. Each domain ranges from 0 to 100, 100 being the best score and 0 the worst.[18]

The 6MWT was performed along a long, flat, straight corridor with a hard surface, length marks every meter, and turnaround points marked with a cone. The test was always applied by the same properly trained examiner. The volunteers tested were advised to wear comfortable clothes and shoes suitable for walking. During the 10-minute rest preceding the test and at the end of the test, the dyspnea and fatigue levels of the lower limbs were measured and recorded. After the 10-minute rest, the patients were instructed to do their best, walking a distance of 20 meters as fast as possible, without running, back and forth the hallway for six minutes. The test was performed according to the recommendations of the American Thoracic Society.[11] The test was performed twice at intervals of at least 30 minutes to minimize the learning effect, and only the second attempt was considered.

Strength was measured with instruments that had higher coefficient of validity and reliability, such as the Jamar® dynamometer

(Asimow Engineering Co., Los Angeles, USA) and the Preston Pinch Gauge® dynamometer (B&L Engineering Co. California, USA) to measure handgrip strength and pinch strengths, respectively. The patients were seated with their shoulders adduced at a neutral rotation and the elbow bent at a right angle.[19] The forearm was maintained at a neutral rotation and the wrist also in a neutral position, a mild extension (maximum of 30º) being allowed to the latter.[19-21] The thumb was positioned with a mild flexion of the interphalangeal joint, and the other fingers not involved in the pinch were also maintained semiflexed.[19] The mean of three successive measurements was used.[22-26]

The pulp-to-pulp pinch was performed between the thumb and index finger pulps. The tripod pinch (palmar pinch) involved the thumb, index and middle finger pulps. The lateral pinch (key pinch) involved the thumb pulp and the lateral/radial side of the second phalanx of the index finger.[27]

Statistical analysis

The SPSS 13.0 software (SPSS, Chicago, IL, USA) was used for the statistical analysis. The variables were tested regarding their normality by use of the Kolmogorov-Smirnov test. Regarding the samples considered normal, the groups were assessed by use of the Student *t* test for non-paired variables.

RESULTS

The study sample comprised 31 women, 15 healthy and 16 with FM. The Kolmogorov-Smirnov test showed that the FM group (FMG) and the control group (CG) were homogeneous regarding weight, height, and BMI ($p > 0.05$).

In the FMG, the mean age was 53.5 ± 7.5 years (age range, 35 to 60 years), and the mean weight was 70.6 ± 14.6 kg. The

Table 1
Age, weight, height, and body mass index (BMI) in FM and healthy women

Variables	FMG (n = 16) (mean ± standard deviation)	CG (n = 15) (mean ± standard deviation)	P
Age (years)	53.5 ± 7.5	54.1 ± 4.4	0.776
Weight (kg)	70.6 ± 14.6	70.6 ± 13.7	0.999
Height (m)	1.58 ± 0.05	1.60 ± 0.09	0.555
BMI (kg/cm²)	28.0 ± 4.9	27.5 ± 4.5	0.767

FMG: FM group; CG: control group.

Table 2
Measures of muscle strength and 6MWT in the women studied

Variables	FMG (n = 16) (mean ± standard deviation)	CG (n = 15) (mean ± standard deviation)	P
L. handgrip (kg/F)	20.9 ± 7.1	27.0 ± 5.4	0.011*
R. handgrip (kg/F)	22.7 ± 5.3	26.8 ± 4.5	0.028*
L. pulp-to-pulp p. (kg/F)	3.2 ± 0.8	4.2 ± 0.8	0.002*
R pulp-to-pulp p. (kg/F)	3.6 ± 0.7	4.2 ± 0.6	0.028*
L. tripod p. (kg/F)	4.2 ± 0.9	5.4 ± 1.3	0.007*
R. tripod p. (kg/F)	4.4 ± 0.7	5.4 ± 1.1	0.005*
L. key p. (kg/F)	4.5 ± 1.2	5.3 ± 0.8	0.66
R. key p. (kg/F)	5.1 ± 1.1	5.4 ± 0.9	0.454
6MWT (m)	446.7 ± 126.0	522.1 ± 47.6	0.009*
L. RM flx (kg)	10.9 ± 6.4	20.8 ± 4.6	0.000*
L. RM ext (kg)	12.3 ± 7.2	28.1 ± 6.3	0.000*
R. RM flx (kg)	14.5 ± 11.9	21.1 ± 4.1	0.049*
R. RM ext (kg)	19.1 ± 23.0	27.6 ± 6.1	0.000*

FMG: FM group; CG: control group; L: left; R: right; P: pinch; RM: repetition maximum; flx: knee flexion; ext: knee extension; 6MWT: 6-minute walk test;
*statistically significant difference ($P < 0.05$).

CG had a similar profile, with a mean age of 54.1 ± 4.4 years (age range, 44 to 60 years), and a mean weight of 70.6 ± 13.7 kg. The mean BMI values were 28.0 ± 4.9 kg/cm² in the FMG and 27.5 ± 4.5 kg/cm² in the CG (Table 1).

A significant difference between the groups was observed in the following parameters: handgrip strength; pulp-to-pulp pinch strength; and tripod pinch strength for both hands ($P < 0.05$). Only the key pinch showed no statistically significant difference between the groups for both limbs ($P > 0.05$). The 1RM test of the knee flexors and extensors in both limbs revealed significant differences in muscle strength ($P < 0.05$). The 6MWT also showed a statistically significant difference in functional capacity, which was reduced in patients with FM ($P < 0.01$). The results of the tests are shown in Table 2.

The comparison of the two groups by use of the SF-36 showed that the FMG women had reduced physical functioning, increased bodily pain, and worsened general health perceptions ($P < 0.05$). However, the other domains (role limitations due to physical health, vitality, social functioning, role limitations due to emotional problems, and mental health) showed no significant difference ($P > 0.05$). These SF-36 results are shown in Table 3.

The Pearson correlation analysis was performed between all variables studied in the FMG and the most relevant results. The following correlation coefficient values were considered: $r \geq 0.70$, strong correlation; r between 0.30 and 0.7, moderate correlation; and r between 0 and 0.3, weak correlation (Table 4).

The SF-36 physical functioning domain showed a moderate positive correlation with the Jamar handgrip strength, key pinch strength, and 6MWT, indicating that the greater the strength and the better the 6MWT, the greater the functional capacity.

The SF-36 bodily pain domain showed a moderate positive correlation with the key pinch strength.

DISCUSSION

The present study showed that women with FM, as compared with healthy individuals of their same age and BMI, have a reduced muscle strength in their upper limbs, by use of handgrip and pinch dynamometers, and a reduced muscle strength in their lower limbs, by use of 1RM measures, during knee flexion and extension, in both limbs. Those women also have function loss assessed by use of the 6MWT.

Previous studies had already shown that patients with FM had a considerable reduction in muscle strength and

Table 3
Domains of the SF-36 of the FMG and CG

Domains of the SF-36	FMG (n = 16) (mean ± standard deviation)	CG (n = 15) (mean ± standard deviation)	P
Physical functioning	43.8 (± 20.4)	82.6 (± 13.5)	0.00*
Role limitations due to physical health	42.8 (± 41.7)	81.6 (± 31.9)	0.06
Bodily pain	35.7 (± 20.4)	78.1(± 24.07)	0.00*
General health perceptions	35.7 (± 20.4)	78.1 (± 24.07)	0.02*
Vitality	50.9 (± 25.50)	63.0 (± 17.70)	0.13
Social functioning	71.8 (± 26.92)	83.1 (± 19.14)	0.18
Role limitations due to emotional problems	58.3 (± 49.4)	55.5 (± 46.5)	0.87
Mental health	65.7(± 17.40)	74.6(± 24.26)	0.25

FMG: FM group; CG: control group. *statistically significant difference ($P < 0.05$).

Table 4
Pearson correlation coefficients of SF-36 physical functioning and bodily pain with the following variables: left and right Jamar handgrip strength, left and right key pinch strength, and 6MWT

	L. Jamar	R. Jamar	L. key pinch strength	R. key pinch strength	6-MWT
	r coefficient	r coefficient	Coefficient	Coefficient	Coefficient
Physical functioning	0.623	0.591	0.603	0.706	0.505
Bodily pain	0.245	0.452	0.604	0.667	-0.084

L: left; R: right; 6MWT: 6-minute walk test.

performance as compared with healthy individuals.[9] Women with FM are below average regarding physical performance when assessed by use of clinical tests, such as handgrip strength, back flexibility, 6MWT, lower limb strength, and isometric shoulder endurance. That reduction might be partially due to chronic pain. Our study also showed a reduction in handgrip strength and lower limb muscle strength in women with FM as compared with those of healthy women.[9]

Nordeskiold *et al.*[28] have also suggested that fatigue and pain play a significant role in reducing handgrip strength in patients with FM, which can also explain the reduction in pulp-to-pulp and tripod pinch strength and in the muscle strength of knee flexors and extensors in this study.

On the other hand, the reduction in functional capacity in the 6MWT can be partially explained by the reduction in the muscle strength of lower limbs seen in this study. Other explanations would be the reduction in respiratory muscle strength[29] and aerobic capacity[30-32] of women with FM.

Bennett *et al*.[33] have reported that most women with FM have a reduction in their aerobic capacity, and, due to a decrease in their sleep, they have a reduced physical activity level, which leads to progressive lack of fitness. That can later result in pain and muscle fatigue.

Women with FM have a decrease in their anaerobic threshold, oxygen consumption, and maximum heart rate. That indicates that those women have a submaximal effort and that their ventilatory anaerobic threshold should be considered the best index to assess their physical fitness.[30] In addition, it also shows that they can benefit from a physical fitness program,[31,32] Such findings are in accordance with a worse performance in the 6MWT.

Okumus *et al*.[34] have reported that the impact of chronic muscle pain on daily activities is important and that the reduction in muscle strength can contribute to reduce work capacity. Those authors have also reported that patients with FM have a decrease in their maximal voluntary strength and that pain might be partially responsible for that.

A reduction in handgrip strength has been shown in patients with FM as compared with individuals without that disease. Nordeskiold *et al*.[28] have suggested that fatigue, pain and other central origin factors can influence the muscle strength reduction in FM. To confirm muscle strength reduction in the upper limbs, we assessed the pulp-to-pulp, key and tripod pinch strengths. The results showed a significant reduction in the pulp-to-pulp and tripod pinch strengths, and in the handgrip strength in the FMG. The key pinch strength was the only variable that showed no statistically significant difference, possibly because it is the strongest pinch among those assessed or because of the small sample size. This study showed a reduction in muscle strength and function in both upper and lower limbs in patients with FM.

Patients with moderate or severe pain are prone to reduce their physical activity, thus decreasing their muscle fitness.[35]

Jacobsen *et al*.[35] have reported that individuals with FM have lower maximal voluntary isokinetic and isometric muscle strength than healthy individuals do. The reasons for that muscle strength reduction could be lack of motivation and pain, which have a negative effect on motor unit recruitment. Abnormal biopsy findings, poor oxygen distribution, and a reduction in the muscle content of high-energy phosphates are other peripheral abnormalities observed in patients with FM.[36,37]

The pinch and grip strengths are related to the intrinsic and extrinsic muscle flexing mass of the forearm and hand, not necessarily with the individual's weight and height.[29]

We found a positive correlation between the hand muscle strength and the functional capacity of women with FM. Sahin *et al*.[29] have also reported a reduction in the hand muscle strength in women with FM.

It is worth noting that our patients belonged in the tertiary health care, and, could be individuals with a greater impairment of muscle strength, because comorbidities, disease duration, and disease impact were not assessed.

Tomas-Carus *et al*.[38] have reported a correlation between the improvement in lower limb muscle strength and the quality of life of patients with FM. Patients with FM improved their lower and upper limb muscle strength when submitted to an exercise training program.

Several studies have reported the negative impact of FM on quality of life.[39-42] Based on that, female volunteers have been assessed by use of the SF-36 quality of life questionnaire to compare functional impairment and quality of life.[44] According to Martinez *et al*.,[42] the SF-36 is also efficient for assessing the quality of life of patients with FM, and can distinguish healthy individuals from those with FM.

In addition to assessing health status and physical functioning, the questionnaires also allow the psychological assessment of patients through their subscales of anxiety and depression.[43] In another study, Brazilian women with FM were compared with a control group regarding the effects on quality of life. That study, which used the SF-36 as an assessment tool, has concluded that the disease has a negative impact on the quality of life,[44, 45] According to Rasol *et al*.,[46] the comparison between FM and healthy women showed a significant difference in the SF-36 scores in the following domains: physical functioning; general health perceptions; physical role; vitality; emotional role; and bodily pain.

In the present study, the SF-36 assessment showed that physical functioning, general health perceptions, and bodily pain were significantly different between healthy and FM individuals. The pain domain can be related to an imbalance in the central nervous system (CNS) mediators,[47] such as serotonin.

As previously cited, FM can be mistaken for other diseases. This is due to the fact that the drop in serotonin is also caused by major depression. White *et al*.[48] have reported that FM negatively influences the quality of life of patients at productive ages. That study justifies the SF-36 findings, because the women with FM assessed showed a decrease in the general health status. Another important finding was the decrease in the functional capacity reported by those women, because, in addition to pain, the symptoms of fatigue and subjective weakness cause function loss, leading to incapacity to work, and, consequently, a drop in family income, which reflects in the quality of life of those individuals.[48] A possible explanation for the lack of statistical differences in the other domains can be the sample size. If we had a larger number of individuals, the differences found could be reinforced and other differences not found could be evidenced.

CONCLUSION

This study shows a reduction in muscle strength in the upper and lower limbs of patients with FM as compared with that of healthy individuals of the same sex. The 6MWT confirmed that patients with FM walk a shorter distance than healthy individuals. In addition, some quality of life aspects are worse in patients with FM.

REFERENCES

REFERÊNCIAS

1. Provenza JR, Pollak DF, Martinez JE, Paiva ES, Helfenstein M, Heymann R *et al*. Diretrizes da fibromialgia - Sociedade Brasileira de Reumatologia, 2004. Disponível em: http://www.projetodiretrizes.org.br/projeto_diretrizes/052.pdf.
2. Geel SE, Robergs RA. The effect of graded resistance exercise on fibromyalgia symptoms and muscle bioenergetics: a pilot study. Arthritis Rheum 2002; 47(1):82-6.
3. Gowans SE, Dehueck A, Voss S, Silaj A, Abbey SE, Reynolds WJ. Effect of a randomized, controlled trial of exercise on mood and physical function in individuals with fibromyalgia. Arthritis Rheum 2001; 45(6):519-29.
4. Wolfe F, Hawley DJ, Goldenberg DL, Russell IJ, Buskila D, Neumann L. The assessment of functional scales and the development of the FM Health Assessment Questionnaire. J Rheumatol 2000; 27(8):1989-99.
5. Wolfe F, Smythe HA, Yunus MB, Bennett RM, Bombardier C, Goldenberg DL *et al*. American College of Rheumatology 1990: Criteria for classification of fibromyalgia. Arthritis Rheum 1990; 33(2):160-72.
6. Atallah-haun MV, Ferraz MB, Pollak DF. Validação dos critérios do Colégio Americano de Reumatologia (1990) para classificação da fibromialgia, em uma população brasileira. Rev Bras Reumatol 1999; 39:221-30.
7. Bradley LA. Pathophysiology of fibromyalgia. Am J Med 2009; 122(12 Suppl):S22-30.
8. Weigent DA, Bradley LA, Blalock JE, Alarcon GA. Current Concepts in the pathophysiology of abnormal pain perception in fibromyalgia. Am J Med Sci 1998; 315(6):405-12.
9. Dias RMR, Cyrino ES, Salvador EP, Caldeira LFS, Nakamura FY, Papst RR *et al*. Influência do processo de familiarização para avaliação da força muscular em testes de 1-RM. Rev Bras Med Esporte 2005; 11(1):34-8.
10. Mannerkorpi K, Burckhardt CS, Bjelle A. Physical performance characteristics of women with fibromyalgia. Arthritis Care Res 1994; 7(3):123-29.
11. Pereira MIR, Gomes PSC. Testes de força e resistência muscular: confiabilidade e predição de uma repetição máxima - Revisão e novas evidências. Rev Bras Med Esporte 2003; 9(5):304-14.

12. American Thoracic Society. ATS Statement. Guideline for the six-minute walk test. ATS Committe on Proficiency Standards for Clinical Pulmonary function Laboratories. J Respir Crit Care Med 2002; 166(1):111-17.
13. Enright PL. The six minute walk test. Respir Care 2003; 48(8):783-5.
14. Pires SR, Oliveira AC, Parreira VF, Britto RR. Six-minute test at different ages and body mass indexes. Rev Bras Fisioter 2007; 11(2):147-51.
15. Bengtsson A, Henriksson KG, Larsson J. Reduced high-energy phosphate levels in the painful muscles of patients with primary fibromyalgia. Arthritis Rheum 1986; 29(7):817-21.
16. Heymann RE, Paiva ES, Helfenstein M Jr, Pollak DF, Martinez JE, Provenza JR *et al*. Brazilian consensus on the treatment of fibromyalgia. Rev Bras Reumatol 2010; 50:56-66.
17. Hénriksson KG, Bengtsson A, Larson J, Lindström F, Thornell LE. Muscle biopsy findings of possible diagnostic importance in primary fibromyalgia (fibrositis, myofacial syndrome). Lancet 1982; 2(8312):1395.
18. Kraemer WJ, Adams K, Cafarelli E, Dudley GA, Dooly C, Feigenbaum MS *et al*. Progression models in resistance training for healthy adults. American College of Sports Medicine. Med Sci Sports Exerc 2002; 34(2):364-80.
19. Ciconelli RM, Ferraz MB, Santos W, Meinão I, Quaresma MR. Tradução para a língua portuguesa e validação do questionário genérico de avaliação de qualidade de vida SF-36 (Brasil SF-36). Rev Bras Reumatol 1999; 39(3):143-50.
20. Kraft GH, Detels PE. Position of function of the wrist. Arch Phys Med Rehabil 1972; 53(6):27275.
21. Pryce JC. The wrist position between neutral and ulnar deviation that facilitates the maximum power grip strength. J Biomech 1980; 13(6):505-11.
22. Hook WE, Stanley JK. Assessment of the thumb to index pulp to pulp pinch grip strength. J Hand Surg Br 1986; 11(1):91-2.
23. Caporrino FA, Faloppa F, Santos JBG, Santos JBG, Réssio C, Soares FHC *et al*. Estudo populacional da força de preensão palmar com dinamômetro de Jamar. Rev Bras Ortop 1998; 33(2):150-4.
24. Fess EE, Moran CA. Clinical assessment recommendation. American Society of Hand Therapists, 1981.
25. Kellor M, Frost J, Silberberg N, Iversen I, Cummings R. Hand strength and dexterity. Am J Occup Ther 1971; 25(2):77-83.
26. Mathiowetz V, Weber K, Volland G, Rashman N. Reliability and validity of grip and pinch strength evaluations. J Hand Surg Am 1984; 9(2):222-6.
27. Mathiowetz V, Rennells C, Donahoe L. Effect of elbow position on grip and key pinch strength. J Hand Surg Am 1985; 10(5):694-7.
28. Nordenskiold UM, Grimby G. Grip force in patients with rheumatoid arthritis and fibromyalgia and in healthy subjects: A study with the Grippit instrument. Scand J Rheumatol 1993; 22(14):14-9.
29. Sahin G, Ulubas B, Callkoglu M, Erdogan C. Handgrip strength, pulmonary function tests, and pulmonary muscle strength in fibromyalgia syndrome: is there any relationship? Southn Med J 2004; 97(1):25-9.
30. Valim V, Oliveira LM, Suda AL, Silva LE, Faro M, Neto TL *et al*. Peak oxygen uptake and ventilatory anaerobic threshold in fibromyalgia. J Rheumatol 2002; 29(2):353-7.
31. Valim V, Oliveira L, Suda A, Silva L, de Assis M, Barros Neto T *et al*. Aerobic fitness effects in fibromyalgia. J Rheumatol 2003; 30(5):1060-9.
32. Assis MR, Silva LE, Alves AM, Pessanha AP, Valim V, Feldman D *et al*. A randomized controlled trial of deep water running: clinical effectiveness of aquatic exercise to treat fi bromyalgia. Arthritis Rheum 2006; 55(1):57-65.
33. Bennett RM, Clark SR, Goldberg L, Nelson D, Bonafede RP, Porter J *et al*. Aerobic fitness in patients with fibrositis: A controlled study of respiratory gas exchange and 133 xenon clearance from exercising muscle. Arthritis Rheum 1989; 32(4):454-60.
34. Okumus M, Gokoglu F, Kocaoglu S, Ceceli E, Yorgancioglu ZR. Muscle performance in patients with fibromyalgia. Singapore Med J 2006; 47(9):752-6.
35. Jacobsen S, Wildschiodtz G, Danneskiold-Samsoe B. Isokinetic and isometric strength combined with transcutaneous electrical muscle stimulation in primary fibromyalgia syndrome. J Rheumatol 1991; 18(9):1390-3.
36. Lund N, Bengtsson A, Thorborg P. Muscle tissue oxygen pressure in primary fibromyalgia. Scand J Rheumatol 1986; 15(2):165-73.
37. Bengtsson A, Henriksson KG, Larsson J. Reduced high-energy phosphate levels in the painful muscles of patients with primary fibromyalgia. Arthritis Rheum 1986; 29(7):817-21.
38. Tomas-Carus P, Gusi N, Hakkinen A, Hakkinen K,Raimundo A, Ortega-Alonso A. Improvements of muscle strength predicted benefits in HRQOL and postural balance in women with fibromyalgia: an 8-month randomized controlled trial. Rheumatology (Oxford) 2009; 48(9):1147-51.
39. Sañudo B, Galiano D, Carrasco L, Blagojevic M, Hoyo M, Saxton J. Aerobic Exercise Versus Combined Exercise Therapy in Women With Fibromyalgia Syndrome: A Randomized Controlled Trial. Arch Phys Med Rehabil 2010; 91(12):1838-43.
40. Goldenberg DL, Mossey CJ, Schmid CH. A model to assess severity and impact of fibromyalgia. J Rheumatol 1995; 22(12):2313-8.
41. Martinez JE, Ferraz MB, Sato EI, Atra E. Fibromyalgia versus rheumatoid arthritis: a longitudinal comparison of the quality of life. J Rheumatol 1995; 22(2):270-4.
42. Martinez JE, Barauna IS, Kubokawa KM, Cevasco G, Pedreira IS, Machado LAM. Avaliação da qualidade de vida de pacientes com fibromialgia através do "Medical Outcome Survey 36 Item Short-Form Study". Rev Bras Reumatol 1999; 39:312-6.
43. Buskila D, Neumann L, Alhoashle A, Abu-Shakra M. Fibromyalgia syndrome in men. Semin Arthritis Rheum 2000; 30(1):47-51.
44. Martinez JE, Barauna IS, Kubokawa Km, Pedreira IS, Machado LA, Cevasco G. Evaluation of the quality of life in Brazilian women with fibromyalgia, through the medical outcome survey 36 item short-form study. Disabil Rehabil 2001; 23(2):64-8.
45. Martinez JE, Fujisawa RM, Carvalho TC, Gianini RJ. Correlação entre a contagem dos pontos dolorosos na fibromialgia com a intensidade dos sintomas e seu impacto na qualidade de vida. Rev Bras Reumatol 2009; 49:32-8.
46. Rasol R, Seyed SS, Tavoli A, Zynab Q, Ashtiani AF. Quality of life in women with fibromyalgia. Arch Med Sci 2009; 5(2):267-70.
47. Weigent DA, Bradley LA, Blalock JE, Alarcon GA. Current Concepts in the pathophysiology of abnormal pain perception in fibromyalgia. Am. J Med Sci 1998; 315(6):405-12.
48. White KP, Speenchley M, Harth M, Ostbye T. Comparing self reported function and work disability in 100 comunity cases of fibromyalgia syndrome versus controls in London, Ontario. Arthritis Rheum 1999; 42(1):76-83.