Clin Rheumatol (2005) 24: 266–271
DOI 10.1007/s10067-004-1003-7

ORIGINAL ARTICLE

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Quantifying pain threshold and quality of life of fibromyalgia patients

Received: 7 May 2004 / Accepted: 15 September 2004 / Published online: 23 December 2004

Abstract The most typical symptom of fibromyalgia (FM) is diffuse pain, and pain at specific points—tender points—is crucial for its diagnosis. By comparing healthy individuals and FM patients, this study was aimed at assessing pain and quality of life of Brazilian females with FM, while seeking for a correlation between pain threshold and quality of life. A total of 178 women were evaluated: 124 were FM patients and 54 were healthy women. Pain threshold at tender points was quantified by dolorimetry, and diffuse pain by means of the visual analogue scale (VAS); the Fibromyalgia Impact Questionnaire (FIQ) was used to evaluate quality of life. Statistical treatment of the data allowed for proposing two indexes: a pain threshold index (PT) and a quality of life one (QOL). PT is the lowest value among all pain thresholds measured at the 18 tender points; QOL is the mean of responses to the FIQ and VAS. Both indexes were tested and showed significant differences between the test and control groups. By pairing pain threshold values of each tender point in the test and control groups, it was found that the most sensitive points matched between the two groups, that is, the most sensitive anatomic spots in a healthy individual are also likely to be the most sensitive points in a person with FM. This suggests that a stimulus that provokes slight discomfort to a healthy person may produce more pain in FM patients—which may bear implications for FM clinical treatment. In this sample of Brazilian women, FM patients had both lower pain threshold and worse quality of life than healthy women.

Keywords Fibromyalgia · Indexes · Pain threshold · Quality of life · Tender points

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Introduction

Fibromyalgia (FM) is a rheumatic syndrome characterized by diffuse muscle pain, low pain threshold in at least 11 tender points (of 18 over the body), and a series of associated symptoms such as fatigue, sleep disturbance, anxiety, morning stiffness [1, 2], and dyspnea in some cases [3–5]. This syndrome affects mostly women of reproductive age, interfering in their quality of life [6, 7].

The main complaint of patients with FM is diffuse pain; the most striking feature is the increase in pain sensitivity at tender points (TP). These are anatomically specific, located at tendons or in the ventral part of muscles, as determined by a study of the American College of Rheumatology (ACR) that became the criteria for FM classification [8].

For health providers, pain is difficult to measure, partly because of the individual judgment of stimuli intensity [9]. Several methods are used to evaluate intensity of pain as reported by the patient such as the visual analogue scale (VAS) [10], body maps [11], and the McGill Pain Questionnaire [12].

Some methods have been proposed to quantify pain sensitivity at tender points in patients with FM. According to Russel [13], there are three kinds of evaluation: (1) numerical counting of sensitive tender points, (2) pressing TP using the digit pressure technique, and (3) assessing the mean pain threshold through pain

measurement [14]. Tunks et al. [15] have evaluated the intra- and interobserver reliability in the examination of tender points of patients with FM. A high reliability level was set between digit pressure and pain measurement. According to Jacobs et al. [16], pain threshold evaluation by digit pressure is as acceptable and trustworthy as dolorimetry. The latter has been often used in research, as it is less examiner dependent [6] and provides an objective measure of the pain threshold at an exact point, obtained through the algometer. This device measures the pain threshold by assessing the pressure (in kg/cm^2) at the moment the patient begins to feel pain following a stimulus. This form of evaluation was chosen for the present study for, besides being widely used, it is highly reliable, as established by Russel [13], Tunks et al. [15], and Wolfe et al. [6].

Pain is the most frequent cause of suffering and disablement that seriously affects the quality of life of millions of human beings [17]. Thus, it is relevant to assess the impact of FM in patients' quality of life. As shown by Burckhardt et al. [18], a good instrument to measure this impact is the Fibromyalgia Impact Questionnaire (FIQ).

No studies in Brazil have compared healthy individuals and FM patients concerning the pain threshold at tender points. This study intended to assess pain and quality of life of Brazilian females with FM by making such a comparison and, in order to do so, it also aimed to assess the correlation between pain threshold and quality of life.

Subjects and methods

A total of 124 patients, aged 35–60 years, who met the 1990 ACR [8] criteria for the classification of FM were examined and compared with 54 healthy, age-matched female subjects. All of the subjects were interviewed and examined by a physician for spinal deformities and other diseases that might account for pain, which were exclusion criteria.

All test group patients were volunteers, invited from among patients with FM referred to the Outpatient Clinic of Rheumatology at the Hospital das Clinicas of the Medical School of the University of São Paulo (HC-FMUSP), and selected consecutively. This public, central university hospital typically receives patients referred from all over the State of São Paulo. Participation was proposed to 124 consecutive outpatients with FM.

The control group consisted of healthy volunteers chosen from the hospital personnel and from people accompanying patients. The reduced number of control group subjects is due to the exclusion criteria adopted: as mentioned, the presence of spinal deformities and other diseases that might account for chronic pain had determined the size of the control sample, as in the 35–60 age group dysfunctions that lead to chronic pain, such as low back pain, are frequent. Furthermore, all subjects were screened for FM symptoms.

The study was approved by the Ethics Committee of the HC-FMUSP. All participants gave written consent after receiving detailed information on the study. Subjects underwent both pain measurement and quality of life assessment during one and the same session.

Pain evaluation

The VAS and the algometer were the two measurement methods used for pain evaluation. The first measurement was taken using the VAS [9, 10], a self-evaluation of pain intensity consisting in a drawn 10-cm long straight line with no marks or numbers on it; on the left an indication reads "absence of pain" (corresponding to 0 cm) and on the right, "unbearable pain" (corresponding to 10 cm). Each participant was instructed to draw a mark along the line that corresponded to her own evaluation of the intensity of her pain. The larger the distance (score) from the 0 cm mark, the bigger the pain intensity.

The second measurement was dolorimetry of the 18 tender points [8]. This reflects the lowest intensity of stimulus (pressure, in this case) at which the individual perceives pain. A Fischer dolorimeter (Pain Diagnostics and Thermography, Great Neck, N.Y., USA) was used; pressure on the skin is applied through a 1-cm diameter rubber extremity. Prior to its use, each patient's 18 tender points were marked with a demographic pencil. TPs at the occiput, low cervical, trapezius, supraspinatus, second rib, lateral epicondyle, gluteal, greater trochanter, and knees were measured with the subject seated on a bench with her hands lying on her thighs and feet soles fully touching the floor. The gluteal and the trochanter TPs were marked and evaluated with the subject standing in an orthostatic position with the feet slightly apart. For pain assessment, a perpendicular pressure was applied on the surface of the skin at the TP, increased at a rate of approximately 1 kg/s. The participant was asked to tell the exact moment when she felt the pressure turning into pain.

Quality of life

Quality of life was assessed by means of the FIQ [18], a self-evaluation questionnaire on quality of life made specifically for FM patients. This questionnaire presents items related to physical functioning, professional difficulties, general well-being, pain, fatigue, morning stiffness, sleep disturbance, anxiety, and depression. The higher the score the bigger the impact of FM on the quality of life.

For this study the FIQ was translated into Portuguese and answers were obtained for all items. For data analysis, however, the items related to professional work were not considered, since most subjects reported not working outside of the home. Thus, seven of the ten FIQ items were analyzed: physical function, pain, fatigue,

morning stiffness, sleep disturbance, anxiety, and depression. As with the VAS, this evaluation is subjective and the use of its results is based on the belief that it reflects the patient's judgment on her own symptoms.

Statistical analysis

A total of 25 measures were obtained from each patient (18 pain thresholds, 7 FIQ scores, and 1 VAS score). Since they include subjective answers, these measurements may generate inadequate or inaccurate statistical analyses. To reduce dimensions yet not impair results, one measurement was singled out: the lowest pain threshold value for each patient, since it corresponds to the most sensitive point. So, the lowest pain threshold (PT) among the 18 tender points was considered the first evaluation parameter that best measured the participant's sensitivity. The seven remaining variables were the self-evaluation ones (FIQ and VAS scores), and their mean may be taken as an indicator of quality of life. Thus, two indexes were defined: PT indicating sensitivity to pain and QOL as an indicator of quality of life.

Data obtained from the same patient were compared with Student's *t*-test for paired data; and to compare data between the test and control groups, the *t*-test for independent samples was used. Multiple comparisons were not performed since there were too many ties.

Correlation coefficients between PT and QOL, PT and VAS, and PT and FIQ items in both groups were calculated and their consistency verified with the *t*-test for correlation coefficients. Statistical significance was declared at the 0.05 level.

Results

In an attempt to reduce dimensions, at first a comparison was made between the same individual's pain thresholds for the tender points on the left and right sides. No significant difference was found between the sides on any point in both groups (control and test). Further checking was made by using the nonparametric sign test [19]. This allowed considering only 9, instead of 18, measurements for each participant; when pain thresholds differed between the sides, the lowest one was taken. The sample means for each tender point for both groups were then calculated and set in order, revealing an almost identical sequence between the test and control groups. However, different responses for sets of tender points were noticed. The comparison between pain threshold means for upper and lower tender points showed a highly significant difference both in the test group ($p = 2e^{-17}$) and in the control group ($p = 4e^{-10}$); pain threshold values for upper tender points were significantly lower than for those at the lower part of the body.

Table 1 presents the means of minimum threshold values between right and left sides at each tender point, arranged in sequence from lowest to highest for the test group; it is worth noticing that for the control group the sequence is very similar, with very slight differences of tender point ranking. Also shown are the mean values found for the sets of upper and lower points on the body, the former presenting significantly smaller values. The last line shows the minimum value amongst all points, that is, the sensitivity index (PT) for both groups, with a highly significant difference ($p = 7e^{-13}$) between test and control groups. Aiming to stress this difference, Fig. 1 presents a comparison amongst PT percentiles in both groups.

Table 2 shows means and standard deviations for all measurements used to calculate the QOL index. When comparing the QOL between the two groups, a highly significant difference ($p = 4e^{-36}$) was found; values were consistently higher for the test group. Again, comparison amongst QOL percentiles for both groups is highlighted (Fig. 2).

These data suggest that QOL and PT indexes are valid and useful to distinguish between healthy subjects and those with fibromyalgia, since both present statistically significant differences between test and control groups. The higher the QOL value, the poorer the quality of the individual's life; inversely, lower PT indexes point to patients' poorer conditions. Then a negative association between these two indexes would be expected: the correlation coefficient of both should confirm or should not confirm an association between them. For the test group, the correlation between PT and QOL ($r = -0.004$) did not prove significant ($p = 96.5\%$) when compared to absence of correlation. For the control group, however, the same correlation ($r = -0.45$) presented a significant difference ($p = 0.1\%$) when compared to null correlation. Figure 3 shows the association between PT and QOL for both groups, plotted on a dispersion diagram. Other correlation tests were made between PT and VAS, and between PT and each FIQ item (physical function, pain, fatigue, tiredness, stiffness, anxiety, and depression), but no correlation could be established. These results are discussed below.

Table 1 Pain threshold means for tender points in both groups

Points	Test		Control	
	Mean	SE	Mean	SE
Second rib	1.31	0.07	2.19	0.11
Low cervical	1.41	0.08	2.32	0.09
Lateral epicondyle	1.66	0.08	2.55	0.13
Occiput	1.80	0.08	2.43	0.11
Supraspinatus	1.88	0.09	3.31	0.17
Knees	1.88	0.11	3.13	0.20
Trapezius	1.90	0.09	3.06	0.14
Greater trochanter	2.15	0.09	3.73	0.22
Gluteal	2.23	0.11	3.72	0.20
Upper	1.02	0.06	1.84	0.09
Lower	1.62	0.09	2.93	0.18
PT	0.98	0. 06	1.83	0.09

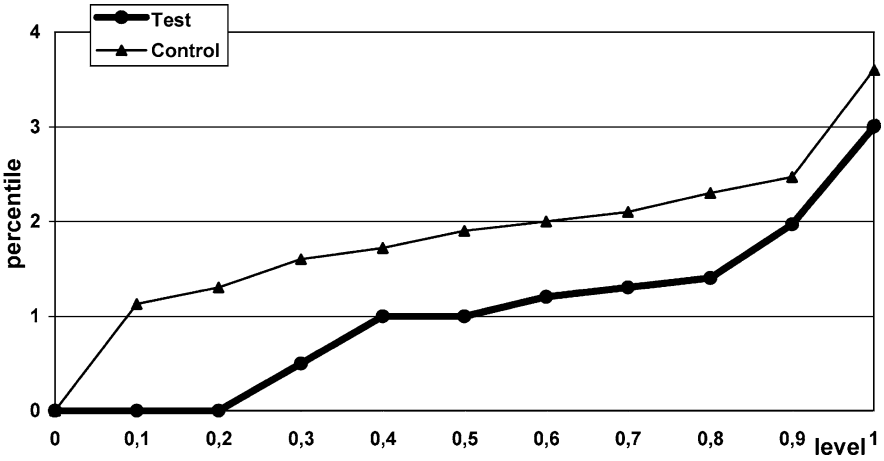

Fig. 1 Comparison of PT percentiles between test and control groups

Table 2 FIQ and VAS scores for test and control groups (mean ± SE)

Variables	Test		Control	
	Mean	SE	Mean	SE
Age	50.51	1.07	50.11	1.55
VAS	6.67	0.21	2.61	0.39
FIQ				
Physical function (PF)[a]	4.64	0.15	1.37	0.16
Pain	6.89	0.20	2.55	0.38
Fatigue	7.71	0.17	3.82	0.38
Tiredness	6.92	0.25	2.45	0.36
Stiffness	6.92	0.24	1.61	0.27
Anxiety	7.92	0.18	4.19	0.42
Depression	6.40	0.25	2.87	0.35
QOL	6.76	0.12	2.68	0.23

[a] Since PF values range from 0 to 30, unlike all the others (0–10), the scores found were divided by 3

Discussion

The expression ''quality of life'' is used in several fields of knowledge and conveys a large variety of concepts, from a state of good health to the idea of satisfaction and possession of desirable social characteristics or goods [20]. Among health scholars and providers, quality of life connotes the effect of environmental or individual, biological factors on the perception of individual well-being (APTA) [21]. Although the etiology of the FM painful condition is unknown, it may have a significant impact on patients' individual well-being. In fact, the results above show that patients with FM present greater pain intensity when compared to healthy women (Table 2).

The pain perception reported by FM patients is the main cause for concern of health care providers [22], which points to the adequacy of taking pain as a parameter in the study and treatment of FM patients.

The maximum and minimum values of pain threshold found in the test group were 2.46 and 1.46 kg/cm^2 (mean = 1.8), while in the control group, 4.02 and 2.36 kg/cm^2 (mean = 2.94). Lower mean values were found in the upper part of the body (1.01 kg/cm^2 in the test group and 1.83 kg/cm^2 in the control group) when compared to the lower part (1.62 kg/cm^2 in the test group and 2.93 kg/cm^2 in the control group). It is worth stressing that pain threshold values obtained from the present study sample of FM patients are well below those found by other studies: Croft et al. [2] found mean values of approximately 2.7 kg/cm^2 in patients with fibromyalgia, and Wolfe et al. [8] found mean values of 4.0 kg/1.54 cm^2; when considering the difference be-

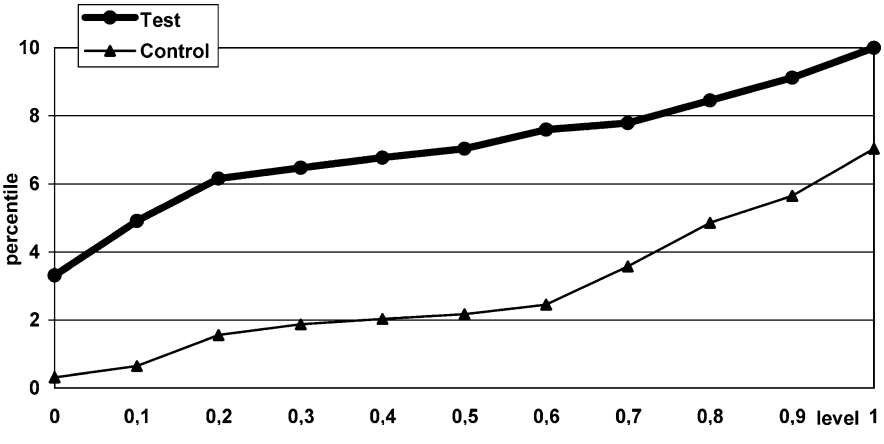

Fig. 2 Comparison of QOL percentiles between test and control groups

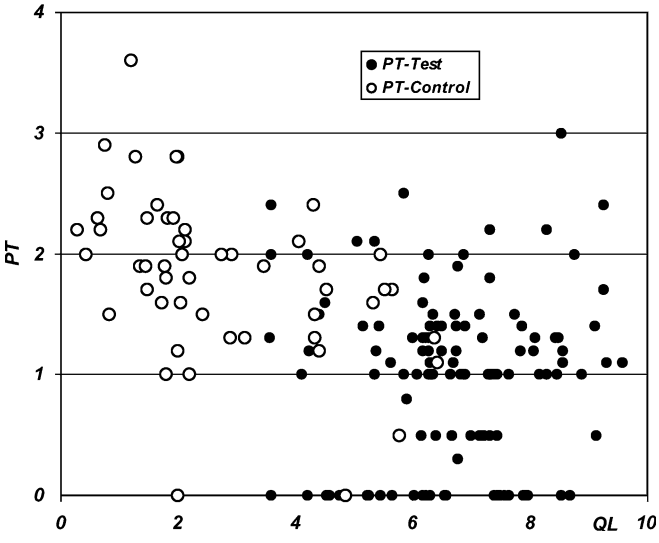

Fig. 3 Association between PT and QOL

tween the rubber tips used by them and by this study (1 cm^2), such a mean falls to 2.60 kg/cm^2, still higher than the one found here. People with FM in the population studied by Wolfe et al. [6] scored a mean value of 2.7 kg/cm^2; and the mean pain threshold values found in the population as a whole were 4.25 kg/cm^2 in women and 6.0 kg/cm^2 in men [14].

According to Skevington [23], cultural features may affect the perception of pain threshold, which was also shown by Clark et al. [24]. The results found here may be due to characteristics of the Brazilian population, since both patients and control subjects presented lower pain thresholds than those found for North Americans. There are no studies on Brazilians' pain sensitivity. A study for validating the 1990 ACR criteria was made in Brazil [25], but the authors employed digit pressure, not dolorimetry; this is also the case in several studies on FM prevalence among various populations: Forsth and Gran [26], Nishikai [27], and Prescott et al. [28].

As to neurobiological aspects of FM, this study is in accordance with literature that suggests individuals with this syndrome show an amplified response to pain [29–32]. Weigent and colleagues [32] suggested that abnormal pain thresholds found in various anatomic sites (tender points) and the diffused pain reported by patients with FM would be the final result of a combination of changes both in the neuroendocrine system and in central nervous system functions in individuals with a genetic predisposition. Brain structures with altered functioning would be those related to modulating nociceptive input (e.g., thalamus) and to processing pain discrimination between sensory (e.g., thalamus, caudate nucleus) and affective dimensions (e.g., prefrontal cortex, anterior cingulate cortex); the latter belong to the limbic system, which is influenced by the hypothalamic-pituitary–adrenal axis. As suggested by Crofford [33], neuroendocrine alterations might be influenced by infections, emotional trauma, or stressing events and be related to symptoms that are common in fibromyalgia, such as fatigue, anxiety, and depression.

The results in Table 1 show that each tender point presented a different mean of minimum values of pain threshold, indicating that some points have higher sensitivity than others. The more sensitive spots were the second rib, low cervical and lateral epicondyle ones, for the test as well as for the control group (Table 1). Such differences may be due to the proximity of these points to the bone surface, or to the presence of smaller amounts of soft tissue just under them. It is worth noticing that the most sensitive points in the test group matched the most sensitive ones in the control group, and this was also the case for the least sensitive ones. This implies that the most sensitive anatomic spots in a healthy individual are likely to be also the most sensitive tender points in a FM individual; since the pain threshold represents the lowest intensity of stimulus under which a patient perceives pain [34], a weak stimulus that does not provoke pain in a healthy individual may be painful to FM patients.

In practice, this may be quite meaningful to professionals who treat FM patients, for several studies advise the use of physical exercises during long periods to improve the impairing symptoms of FM [35–41]. Mengshoel et al. [42] examined the difference between FM patients and healthy females as regards pain induced by physical exercise, finding high levels of pain after performing exercises; but in patients with FM the pain remained for a long time, while this did not occur in healthy females. This illustrates that a stimulus—such as physical effort in this case—that may provoke some discomfort to healthy people may engender intense suffering for FM patients.

As to the quality of life, the results showed that among this sample of Brazilian women it was distinctly worse for FM patients than for healthy people (Fig. 2). These results suggest that QOL and PT indexes are valid and useful to distinguish between healthy subjects and those with fibromyalgia, since both present statistically significant differences between test and control groups. It must be reminded that PT represents the lowest value of the pain threshold and that the QOL index is obtained by averaging the FIQ and the VAS measurements.

The data did not show a significant correlation between the indexes PT and QOL for test group measurements, although they did for the control group. This may be due to the fact that the patients presented a high level of pain, a low pain threshold on the tender points, and a poor quality of life, as can be observed on the dispersion graphic (Fig. 3). It can be seen that the points representing the sample of patients with FM are concentrated in a narrow band on one side of the graphic, indicating an unlikely association between the variables. However, if the graphic is analyzed considering both groups, a negative correlation between the variables QOL and PT can be noticed. This could be due to a greater variation between the pain level and the quality of life, which strengthens the preceding argument.

This study attests that, in this sample of Brazilian women, FM patients have both lower pain threshold and worse quality of life than healthy women, though no correlation could be found between pain measures and quality of life. Furthermore, this study suggests that the Brazilian female population may show a lower pain threshold than the ones found in other countries—which requires further investigation among our population.

References

1. Wolfe F (1997) The relation between tender points and fibromyalgia symptom variables: evidence that fibromyalgia is not a discrete disorder in the clinic. Ann Rheum Dis 56:268–271
2. Croft P, Schollum J, Silman A (1994) Population study of tender point count and pain as evidence of fibromyalgia. BMJ 309:696–699
3. Caidahl K, Lurie M, Bake B, Johansson G, Wettweqvist H (1989) Dyspnea in chronic primary fibromyalgia. J Intern Med 226:265–270
4. Lurie M, Caidahl K, Johansson G, Bake B (1990) Respiratory function in chronic primary fibromyalgia. Scand J Med 22:151–155
5. Weiss DJ, Kreck T, Aalbert RK (1998) Dyspnea resulting from fibromyalgia. Chest 113:246–249
6. Wolfe F, Aarflot T, Bruusgaard D, Henriksson KG, Littlejohn G, Moldofsky H, Raspe H, Vaeroy H (1995) Fibromyalgia and disability. Scand J Rheumatol 24:112–118
7. Henriksson C, Burckhardt C (1996) Impact of fibromyalgia on everyday life: a study of women in the USA and Sweden. Disabil Rehabil 18:241–248
8. Wolfe F, Smythe HA, Yunus MB, Bennett RM, Bombardier C, Goldenberg DL, Tugwell P, Campbell SM, Abeles M, Clark P, Fam AG, Farber SJ, Fiechtner JJ, Franklin CM, Gatter RA, Hamaty D, Lessard J, Lichtbroun AS, Masi AT, McCain GA, Reynolds J, Romano TJ, Russel JI, Sheon RP (1990) The American College of Rheumatology 1990 criteria for the classification of fibromyalgia. Arthritis Rheum 33:160–172
9. Revill SI, Robinson JO, Rosen M, Hogg IJ (1976) The reliability of a linear analogue for evaluating pain. Anaesthesia 31:1191–1198
10. Huskisson EC (1974) Measurement of pain. Lancet 9:1127–1131
11. Rydén O, Lindal E, Udén A, Hansson SB (1985) Differentiation of back pain patients using a pain questionnaire. Scand J Rehab Med 17:155–161
12. Melzack R (1983) The McGill pain questionnaire. In: Melzack R (ed) Pain measurement and assessment. Raven Press, New York, pp 41–47
13. Russell IJ (1998) Advances in fibromyalgia: possible role for central neurochemicals. Am J Med Sci 315:377–384
14. Fischer AA (1987) Pressure algometry over normal muscle. Standard values, validity and reproducibility of pressure threshold. Pain 30:115–126
15. Tunks E, McCain GA, Hart LE, Teasell RW, Goldsmith CH, Rollman GB, McDermid AJ, DeShane PJ (1995) The reliability of examination for tenderness in patients with myofascial pain, chronic fibromyalgia and controls. J Rheumatol 22:944–952
16. Jacobs JWG, Geenen R, Van der Heide A, Rasker JJ, Bijlsma JWJ (1995) Are tender points assessed by manual palpation in fibromyalgia reliable? An investigation into the variance of tender point scores. Scand J Rheumatol 24:243–247
17. Bonica JJ (1990) History and pain concepts and therapies. In: Bonica JJ (ed) The management of pain. Lea & Febiger, Philadelphia, pp 2–17
18. Burckhardt CS, Clark SR, Bennett RM (1991) The fibromyalgia impact questionnaire: development and validation. J Rheumatol 18:728–733
19. Gottfried N (1991) Introduction to statistics: the nonparametric way. Springer, Berlin Heidelberg New York
20. Djikers M (1999) Measuring quality of life. Am J Phys Med Rehabil 78:286–300
21. American Physical Therapy Association (2001) Guide to physical therapist practice. Phys Ther 81:27–33
22. Wolfe F, Anderson J, Harkness D, Bennett RM, Caro XJ, Goldenberg DL, Russell IJ, Yunus MB (1997) A prospective, longitudinal, multicenter study of service utilization and costs in fibromyalgia. Arthritis Rheum 40:1560–1570
23. Skevington SM (1995) Psychology of pain. Wiley, Chichester
24. Clark WC, Clark SB (1980) Pain responses in Nepalese porters. Science 209:410–412
25. Haun MVA, Ferraz MB, Pollak DF (1999) Validação dos critérios do Colégio Americano de Reumatologia (1990) para classificação da fibromialgia, em uma população brasileira. Rev Bras Reumatol 39:221–230
26. Forseth KØ, Gran JT (1992) The prevalence of fibromyalgia among women aged 20–49 years in Arenal, Norway. Scand J Rheumatol 21:74–78
27. Nishikai M (1992) Fibromyalgia in Japanese. J Rheumatol 19:110–114
28. Prescott E, Kjøller M, Jacobsen PM, Danneskiold-Samsøe B, Kamper-Jørgensen F (1993) Fibromyalgia in the adult Danish population: I. A prevalence study. Scand J Rheumatol 22:233–235
29. Gracely RH, Petzke F, Wolf JM, Clauw DJ (2002) Functional magnetic resonance imaging evidence of augmented pain processing in fibromyalgia. Arthritis Rheum 46:1333–1343
30. Russel IJ (1998) Advances in fibromyalgia: possible role for central neurochemicals. Am J Med Sci 315:377–384
31. Mountz JM, Bradley LA, Alarcón GS (1998) Abnormal functional activity of the central nervous system in fibromyalgia syndrome. Am J Med Sci 315:385–396
32. Weigent DA, Bradley LA, Blalock E, Alarcón GS (1998) Current concepts in the pathophysiology of abnormal pain perception in fibromyalgia. Am J Med Sci 315:405–412
33. Crofford LJ (1998) Neuroendocrine abnormalities in fibromyalgia and related disorders. Am J Med Sci 315:359–366
34. Bonica JJ (1990) Definitions and taxonomy of pain. In: Bonica JJ (ed) The management of pain. Lea & Febiger, Philadelphia, pp 18–22
35. Clark SR, Jones KD, Burckhardt CS, Bennett R (2001) Exercise for patients with fibromyalgia: risks versus benefits. Curr Rheumatol 3:135–140
36. Jentoft ES, Kvalvik AG, Mengshoel AM (2001) Effects of pool-based and land-based aerobic exercise on women with fibromyalgia/chronic widespread muscle pain. Arthritis Care Res 45:42–47
37. Ramsay C, Moreland J, Ho M, Joyce S, Walker S, Pullar T (2000) An observer-blinded comparison of supervised and unsupervised aerobic exercise regimens in fibromyalgia. Rheumatology 39:501–505
38. Meiworm L, Jakob E, Walker UA, Peter HH, Keul J (2000) Patients with fibromyalgia benefit from aerobic endurance exercise. Clin Rheumatol 19:253–257
39. Offenbacher M, Stucki G (2000) Physical therapy in the treatment of fibromyalgia. Scand J Rheumatol 29:78–85
40. Nichols DS, Glenn TM (1994) Effects of aerobic exercise on pain perception, affect, and level of disability in individuals with fibromyalgia. Phys Ther 74:327–332
41. Mengshoel AM, Komnaes HB, Forre O (1992) The effects of 20 weeks of physical fitness training in female patients with fibromyalgia. Clin Exp Rheumatol 10:345–349
42. Mengshoel AM, Vollestad NK, Forre O (1995) Pain and fatigue induced by exercise in fibromyalgia patients and sedentary healthy subjects. Clin Exp Rheumatol 13:477–482