

Aspects of flexibility of women with fibromyalgia syndrome

Aspectos da flexibilidade de mulheres com síndrome de fibromialgia

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Abstract – Regular physical exercise tends to benefit people with fibromyalgia syndrome (FMS). The effects have been observed regarding aerobic power and strength; however, results concerning flexibility have been controversial. In general, studies have evaluated specific joints or tests involving only a single body movement. The aim of this study was to compare the flexibility profile of FMS and asymptomatic women using a more comprehensive test protocol regarding the number of movements and joints involved. The sample consisted of 30 women divided into two groups: asymptomatic ($n = 15$; mean age: 50.2 ± 8.2 years; mean weight: 63.0 ± 9.6 kg; mean height: 157 ± 6 cm) and fibromyalgia ($n = 15$; mean age: 47.3 ± 9.4 years; mean weight: 61.9 ± 12.2 kg; mean height: 159 ± 7 cm). Flexibility was measured using the Flexitest, which was evaluated by the global index of flexibility (Flexindex), and the five indices of variability of joint mobility: intermovement (IVIM), interjoint (IVIA), flexion-extension (IVFE), between segment (IVES) and distal-proximal (IVDP). All of the indices were calculated based on the results of the 20 movements of the Flexitest. There was no difference between groups (44.4 ± 3.7 vs. 45.7 ± 4.1 points, for asymptomatic and fibromyalgia, respectively; $p = 0.379$; 95% confidence interval (CI): -4.2 to 1.6). Most of the sample (83%) showed an average level of flexibility based on reference values for gender and age. Only IVIM showed a significant difference between the groups. Asymptomatic and fibromyalgic women have similar overall levels of flexibility but with different profiles.

Key words: Chronic pain; Joints; Range of motion.

Resumo – Exercícios físicos em mulheres com síndrome de fibromialgia (SFM) têm apresentado efeitos na força e potência aeróbica, contudo, os resultados acerca da flexibilidade têm sido controversos. Além disso, os estudos têm avaliado articulações específicas ou testes que envolvam apenas um único movimento corporal. Objetivou-se comparar o perfil de flexibilidade global de mulheres acometidas pela SFM e assintomáticas a partir de um protocolo de teste mais abrangente quanto ao número de movimentos e articulações envolvidas. Participaram da pesquisa 30 mulheres divididas em dois grupos: assintomáticas ($n = 15$; $50,2 \pm 8,2$ anos; $63,0 \pm 9,6$ kg; 157 ± 6 cm) e fibromiálgicas ($n = 15$; $47,3 \pm 9,4$ anos; $61,9 \pm 12,2$ kg; 159 ± 7 cm). A flexibilidade medida pelo Flexiteste foi avaliada pelo índice global de flexibilidade (flexíndice) e pelos cinco índices de variabilidade da mobilidade articular: intermovimentos (IVIM), intra-articulação (IVIA), flexão-extensão (IVFE), entre segmentos (IVES) e distal-proximal (IVDP). Todos os índices foram calculados com base nos resultados dos 20 movimentos do flexiteste. Não houve diferença no flexíndice entre os grupos ($44,4 \pm 3,7$ vs $45,7 \pm 4,1$ pontos, para assintomáticas e fibromiálgicas respectivamente; $p=0,379$; $IC_{95\%} = -4,2$ a $1,6$). A maioria da amostra (83%) apresentou nível de flexibilidade considerado na média da população para o gênero feminino e para cada faixa etária específica. Entre os índices de variabilidade da mobilidade articular apenas o IVIM apresentou diferença significativa. Mulheres assintomáticas e fibromiálgicas apresentam níveis globais de flexibilidade similares, mas com perfis diferentes.

Palavras-chave: Amplitude de movimento; Articulações; Dor crônica.

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INTRODUCTION

Fibromyalgia syndrome (FMS) can be defined as a chronic, non-inflammatory musculoskeletal pain syndrome of unknown etiopathogenesis, characterized by diffuse pain across the body and a heightened sensitivity to the palpation of specific *tender points*, associated with chronic fatigue and sleep and mood disorders, among other problems¹. Some studies have shown that FMS affects 0.5~6% of the overall population in different countries, and its prevalence in Brazil is estimated to be 2.5%. The symptoms of FMS could appear at any age and is most common among women aged 35 to 60 years¹.

Kelley and Kelley³ performed a judicious meta-analysis to establish the effect size of exercise on the wellbeing of individuals with FMS and found that regular exercises tends to improve the overall wellbeing of those individuals. Those findings are similar to the ones reported by Kaleth et al.⁴, who assessed the effects of a moderate to vigorous training program and found that sustained physical activity was not associated with worsening of discomfort (pain). Nevertheless, most individuals with FMS report difficulties in the performance of everyday tasks, such as climbing stairs, running and carrying objects^{5,6}.

Mannerkorpi et al.⁷ detected reduced aerobic power and a lower rate of muscle strength production in women with FMS compared with asymptomatic women; however, the results regarding the active shoulder range of motion were conflicting between the two test protocols used. Additionally, Góes et al.⁸ found a reduction of functional capacity, particularly in strength production, but not in flexibility. By contrast, Pedro-Angel et al.⁹ found a significant reduction in flexibility among women with mild or severe FMS compared with asymptomatic women. While Jones et al.¹⁰ did not detect limitations in shoulder external and internal rotation range of motion, the study by Hughes¹¹ found that the degree of flexibility in the sit-and-reach test ranged between the 8th and 30th percentile for age and gender in women with FMS.

The flexibility tests used in all of the aforementioned studies consisted of one single movement or a limited number of joints, a condition that does not allow for a thorough analysis of the joint mobility in individuals with FMS. That there is not one single flexibility pattern for all of the joints in the human body makes that problem even more critical¹². In addition, flexibility has been undervalued in the studies on and interventions in FMS¹³.

Another relevant issue is that pain has been described as the main limiting factor in physical performance tests^{8,14} as well as in motor tasks as a whole, particularly when performing new exercises or unusual movements¹¹. Thus, the application of active joint mobility tests might be a relevant factor in the physical and functional assessment of individuals with FMS. This assumption is based on the age range with the highest prevalence of FMS corresponding to the stage in life when musculoarticular stiffness is most patent¹⁵. Given the relevance of flexibility in the quality of life of those individuals, the aim of the present study was to compare the overall flexibility

profile between women with or without FMS based on a more comprehensive test protocol that includes the number of movements and joints assessed.

METHODOLOGICAL PROCEDURES

Sample

To recruit participants, women performing supervised physical activity at a private physical therapy clinic were directly invited to participate; asymptomatic peers were used as the control group. All of the women were regular participants in a training program including muscle strengthening and aerobic exercise for at least 1 year, with similar regimens regarding the weekly frequency and intensity because the clinic has a standard exercise prescription routine. The exercise routine did not include stretching or flexibility exercises. The sample was composed of 30 women, 15 with a previous diagnosis of FMS based on the criteria formulated by the American College of Rheumatology¹⁶ and 15 without FMS (table 1). All of the participants read and signed an informed consent form that described all of the procedures included in the study and stressed the voluntary nature of the participation. The study was approved by the ethics committee of Federal University of Sergipe, Certificado de Apresentação para Apreciação Ética/Certificate of Presentation for Ethical Appraisal (CAAE) protocol no. 13503213.3.0000.5546.

Table 1. Demographic characteristics of the subjects. Data are expressed as the mean \pm standard deviation (minimum - maximum)

	All (n = 30)	Asymptomatic (n = 15)	Fibromyalgia (n = 15)	p*
Age (years)	48.8 \pm 8.8 (30 - 63)	50.2 \pm 8.2 (32 - 61)	47.3 \pm 9.4 (30 - 63)	0.380
Body Weight (kg)	62.4 \pm 10.8 (36 - 93)	63 \pm 9.6 (46 - 77.4)	61.9 \pm 12.2 (36 - 93)	0.790
Height (cm)	158 \pm 6 (147 - 174)	157 \pm 6 (147 - 165)	159 \pm 7 (149 - 174)	0.390

*Student's t-test for independent samples between the asymptomatic and fibromyalgia groups.

Procedures

All of the assessments were performed at the aforementioned clinic on dates and times defined together with the participants and were systematically conducted in the afternoon. The participants were instructed not to practice physical activity before the assessments, and warming up was not permitted because this activity could interfere with the assessment of the overall flexibility profile¹⁷. Additionally, to not affect the flexibility assessment, the participants were instructed to wear clothes that would not restrict movement.

Measurement of flexibility

The Flexitest was used to establish the overall flexibility profile.¹⁸ The Flexitest is a dimensionless test used to measure and assess the maximum passive range of motion of 20 joint movements involving the ankles, knees, hips, trunk, wrists, elbows and shoulders. Eight movements correspond

to the lower limbs, three to the trunk and nine to the upper limbs. Each movement is compared with an evaluation map that assigns scores of 0 to 4 to the corresponding range of motion.

In addition to the assessment of single movements, the Flexitest allows for the acquisition of an overall flexibility index, the Flexindex, which is the sum of the scores of the 20 single movements, as well as the pattern of homogeneity of flexibility. The study of the latter allows for the comparison of individuals with equal Flexindex absolute values but resulting from different scores in the individual components. Homogeneity is measured based on five dimensionless indices formulated by Araújo¹⁹, and the definitions of the indices are summarized in Box 1.

Box 1. Operational definition of the five indices of variability of joint mobility calculated from the results of the Flexitest

Variability Indices of Joint Mobility	Operational Definition
Intermovement (IVIM)	Standard deviation of 20 movements
Interjoint (IVIA)	Variability among seven joints evaluated by the Flexitest
Flexion-Extension (IVFE)	Comparison between flexion and extension movements
Between Segment (IVES)	Comparison between upper and lower body segments
Distal-Proximal (IVDP)	Comparison between proximal and distal joints

The measurements were performed in the order established in the original protocol to perform data collection in the shortest time possible as follows: movements on the dorsal decubitus, movements on the ventral decubitus, lateral, sitting and standing up. One single examiner trained and experienced in the application of the procedure performed all of the measurements.

Data analysis

The score of each movement was assigned based on an ordinal scale. Additionally, no quantitative relationship was established between the results corresponding to the individual joint range of motion. The score sum that composes the Flexindex was subjected to parametric statistical analysis because all of the assessed variables exhibited a normal distribution (Kolmogorov-Smirnov test; $p > 0.05$) and equal variances (Leven's test; $p > 0.05$). Thus, Student's t-test for independent samples was used to assess differences between the groups.

The participants were classified based on the Flexindex results and index of variability of joint mobility according to the reference values suggested by Araújo¹⁸ (percentiles for age and gender). Next, comparisons between the groups were performed using the non-parametric Mann-Whitney U-test. All of the analyses were performed using SPSS 20.0 statistical software at 5% significance and a 95% confidence interval (95% CI).

RESULTS

Differences were not found in the Flexindex scores between the groups

(mean scores: 44.4 ± 3.7 vs. 45.7 ± 4.1 , asymptomatic vs. FMS, respectively; $p = 0.379$; 95% CI = -4.2 to 1.6; $power = 0.139$). The flexibility level of most of the sample (83%) corresponded to the average for the female gender and corresponding age range (table 2). There was no significant difference in the classification of the groups ($p = 1.00$). The percentile distribution in the asymptomatic group fell between the 25th and 75th percentiles; however, in most of FMS group, the distribution fell between the 35th and 75th percentiles, with one participant in the 3rd percentile and another in the 10th percentile. The FMS group exhibited, on average, a 10% greater range of motion in three specific movements compared with the asymptomatic group; that difference was statistically significant regarding two of the movements: wrist flexion (scores: 2.6 ± 0.6 vs. 2.3 ± 0.5 , respectively; $p = 0.207$); elbow flexion (scores: 3.0 ± 0.0 vs. 2.7 ± 0.5 , respectively; $p=0.032$); and shoulder extension (scores: 3.1 ± 0.3 vs. 2.7 ± 0.5 , respectively; $p=0.020$). The range of motion of the remainder of the assessed movements was similar between the groups.

Table 2. Classification of the flexibility level by gender and age, according to the Flexindex. Data are presented as n (%)

Classification	All	Asymptomatic	Fibromyalgia
Very Low	2 (7)	0	2 (13)
Low	3 (10)	3 (20)	0
Medium	25 (83)	12 (80)	13 (87)

Comparison of the joint mobility variability indices showed that only IVIM exhibited a significant difference between the FMS and asymptomatic groups (table 3). In the distribution of the classification of the joint variability mobility indices, only IVIM exhibited a differentiated pattern as a function of the investigated clinical condition. Approximately 60% of the women in the asymptomatic group exhibited a more homogeneous profile among the 20 assessed movements, with a predominance of an atypical pattern below the normal range. In turn, most of the women in the FMS group (60%) were classified as being within the normal range, and the profile was quite homogeneous in 13%. The remainder of the variability indices was similar between the groups (figure 1).

Table 3. Comparison of the variability indices of joint mobility determined by the Flexitest among asymptomatic and fibromyalgia women. The results are expressed as the mean \pm standard deviation (minimum - maximum).

	All	Asymptomatic	Fibromyalgia	p (95% CI)	Power
IVIM	0.59 ± 0.09 (0.48 - 0.83)	0.55 ± 0.06 (0.48 - 0.66)	$0.62 \pm 0.11^*$ (0.50 - 0.83)	0.023 (-0.014 - -0.01)	0.638
IVIA	0.31 ± 0.08 (0.19 - 0.52)	0.30 ± 0.09 (0.19 - 0.48)	0.32 ± 0.08 (0.21 - 0.52)	0.470 (-0.09 - 0.04)	0.109
IVFE	1.29 ± 0.14 (1.00 - 1.60)	1.26 ± 0.13 (1.00 - 1.50)	1.32 ± 0.15 (1.07 - 1.60)	0.242 (-0.17 - 0.04)	0.211
IVES	1.09 ± 1.10 (0.96 - 1.25)	1.09 ± 0.09 (0.99 - 1.25)	1.08 ± 1.10 (0.96 - 1.25)	0.795 (-0.06 - 0.08)	0.057
IVDP	1.11 ± 0.17 (0.81 - 1.64)	1.09 ± 0.14 (0.91 - 1.43)	1.13 ± 0.20 (0.81 - 1.64)	0.495 (-0.17 - 0.09)	0.103

*Significant difference compared with the asymptomatic group; IVIA: interjoint variability index; IVIM: intermovement variability index; IVFE: flexion-extension movement variability index; IVES: between segment variability index; IVDP: proximal-distal movement variability index.

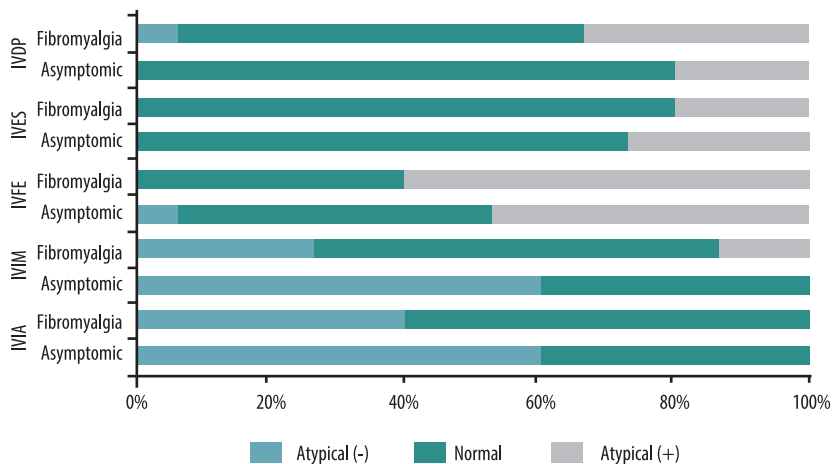


Figure 1. The percent frequency distribution of the classification of fibromyalgia and asymptomatic women at each variability index of joint mobility. IVIA: interjoint variability index; IVIM: intermovement variability index; IVFE: flexion-extension movement variability index; IVES: between segment variability index; IVDP: proximal-distal movement variability index; *indicates $p < 0.05$.

DISCUSSION

In FMS, chronic pain tends to limit the performance of everyday movements, a finding that was emphasized by Aparício et al.²⁰ upon reporting that women with the most severe pain exhibited greater limitation of movements compared with those with less pain. Nevertheless, it was not known whether such an effect was caused by a particular pattern of joint mobility. Thus, the aim of the present study was to compare not only the overall flexibility level but also the flexibility profile between women with FMS and asymptomatic women. The main result of the present study was that although flexibility was similar between both groups, there were relevant variations between the investigated joint movements.

That finding was made possible by the application of the Flexitest to the measurement of the joint range of motion because this assessment includes a larger number of movements compared with other procedures. One might imagine that some Flexitest measurement positions were impaired by the matching of the point of contact of the examiner's hand, when moving the body segments, with the participants' *tender points*. However, only two such points (trapezius and supraspinatus) are close to the sites used as support for the examiner's hands when assessing movements X and XI (trunk extension and trunk lateral flexion). Nevertheless, no differences were detected for those movements between the groups. Thus, the use of the Flexitest was valuable in the present study because the previous studies merely recorded a rather narrow range of joint movements^{7,8,15,20} that does not systematically reflect the actual level of flexibility of individuals or allow the determination of a more complete profile of body movements.

Mannerkorpi et al.⁷ assessed only two active shoulder adduction movements and found that in the FMS group, the range of motion was smaller on the *hand-to-neck* test but not on the *hand-to-scapula* test. Using a procedure similar to the latter, Aparício et al.²⁰ did not find a significant

difference in the active shoulder adduction range of motion (*back scratch test*). Dierick et al.¹⁵ assessed passive musculoarticular stiffness in ankle flexion and extension using an electromechanical device and found that this stiffness was greater in the FMS group.

Trunk flexion is quite widely used to characterize the overall flexibility of individuals. Although that movement depends on a complex set of joints and vertebrae, Araújo¹⁸ suggests considering this movement as involving one single joint for simplicity reasons. In this regard, a significant difference was not found in the flexibility of women with or without FMS by studies that applied the conventional sit-and-reach test or trunk flexion in the standing position²¹. By contrast, in other studies, the FMS group exhibited poorer performance on the conventional sit-and-reach test regardless of the severity of pain⁹ and on the modified sit-and-reach test (unilateral and sitting on a chair) compared with the control group²⁰.

The conflicting results of the aforementioned studies suggest that flexibility should be assessed not only more comprehensively but also passively to attain the maximum range of motion, considering that most protocols used in studies measure flexibility actively. Furthermore, the neuromuscular performance of women with FMS being poorer²² explains why active flexibility tests might underestimate the actual range of motion and impair the determination of their flexibility level.

In the present study, the overall flexibility level of the women with FMS was similar to that of the control group, as assessed by the Flexindex and percentile reference values for age²³. Most of the women in the sample were classified within the population average, independent of FMS, a result that disagrees with evidence indicating that FMS is associated with joint hypermobility²⁴⁻²⁶.

As described when presenting the protocol, in the Flexitest, each assessed movement is scored from 0 (lowest range of motion) to 4 (largest range of motion). Upon assessing some movements more thoroughly, the shoulder extension range of motion was larger in the FMS group. However, interestingly, all 15 participants scored 3 for the latter measurement corresponding to a range of motion above the average, without characterizing joint hypermobility. Flexitest movements XVI (shoulder posterior adduction at 180° of abduction) and IX (trunk flexion) are similar to the procedures applied in other studies (shoulder^{7,20} and trunk^{8,9,20,21}), allowing for a more robust methodological comparison between those studies and ours. Our results did not indicate a significant difference in those movements between the groups. Finally, the difference found in the elbow flexion favorable to the FMS group might be related to differences in the biceps muscle volume, which was not measured in the present study.

Acasuso-Diaz and Collantes-Estevez²⁶ used a modified version of the Beighton et al.²⁷ protocol and found a higher prevalence of hypermobility among women with FMS compared with other rheumatic conditions. Sendur et al.²⁵ and Ofluoglu et al.²⁴ found hypermobility rates of 47% vs. 29% and 64% vs. 22%, respectively, in women with FMS compared with asymptomatic women according to Beighton et al.'s²⁷ original criteria. Our

results rather resemble those by Karaaslan et al.²⁸, who did not find discrepancies between the prevalence rates found in the FMS and asymptomatic control groups (8% vs. 6%). Representative cases of joint hypermobility were not found in our sample. Although we applied methods different from the ones used in the aforementioned studies, the Flexitest was previously used to determine joint hypermobility²⁹; therefore, its use does not represent a methodological limitation of the present study.

Another relevant issue of our study was the identification of the pattern of distribution of joint mobility across the 20 movements that were assessed. That aspect is relevant because two individuals might seem equally flexible based on the Flexindex score (total sum of the score of each individual movement), while the range of the various movements might exhibit considerable variation. For example, a Flexindex score of 40 might result from a score of 2 on all 20 movements or from a score of 0 on five, a score of 1 on five, a score of 3 on five and a score of 4 on five. Thus, the variability indices allow the assessment of the homogeneity among the measurements of flexibility of one individual.

Similar to the Flexindex, most of the variability indices did not differ between the groups, except IVIM, which is the most typical marker of variability because it is calculated based on the standard deviation of all 20 movements. The FMS group exhibited greater heterogeneity in the ranges of motion compared with that in the control group; more than 50% of the asymptomatic women exhibited greater homogeneity among the 20 movements than expected (figure 1). It is worth noting that the other four variability indices represent the existence of a characteristic flexibility pattern, by identifying the potential differences between joints (IVIA), the predominance of flexion over extension (IVFE), the predominance of the distal over the proximal joints (IVDP) and the predominance of the upper over the lower part of the body (IVES). Those data indicate that although the overall flexibility was similar between the groups, it was patently composed of different elements, and no typical pattern was found, allowing the discrimination between the women with FMS and asymptomatic women.

To the best of our knowledge, the present study is the first to compare the flexibility profile of women with or without FMS in a more comprehensive and detailed manner, allowing the assessment of joint mobility features of interest for the prescription of stretching and flexibility exercises for individuals with FMS. Given that flexibility is movement- and joint specific, as shown above, knowledge of those results allows for a more conscious indication of training programs based on the understanding that this component of physical training ought to be individualized similar to that for aerobic and muscle strengthening exercises. Thus, it is evident that although the overall flexibility was similar, the specific needs for joint mobilization differed between the investigated groups.

The present study had some limitations that should be stressed. Recruitment was performed by convenience sampling among individuals who attended a private outpatient clinic, in which treatment included exercise.

Although the study universe was, thus, rather restricted, it allowed for closer comparison with the control group given the similar characteristics among the individuals. Another relevant aspect was that the level of chronic pain was not measured. Although we expected that pain would behave as a limiting factor for flexibility, the results did not support that hypothesis; thus, we believe that such an aspect did not interfere with our results.

CONCLUSION

No significant difference was found in the overall flexibility levels between the asymptomatic women and women with fibromyalgia. The women with fibromyalgia exhibited greater heterogeneity in the ranges of motion.

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