Does the volume of physical exercise influence sleep quality in patients with fibromyalgia?

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Summary

Objective. To investigate the association between the volume of exercise and the quality of sleep in patients with fibromyalgia.

Methods. This is a cross-sectional study carried out from 2010 to 2019 in patients over 18 years old from the research project at a university in Brazil. Instruments related to sociodemographic and clinical characteristics, physical exercise, and the Pittsburgh Sleep Quality Index (PSQI) were applied. Participants were classified as inactive, insufficiently active, or active. In the statistical analysis, the Kruskal-Wallis and Mann-Whitney U tests were used. Binary logistic and multinomial regression were also performed.

Results. The majority of participants were physically inactive and had poor sleep quality; 68.3% with poor sleep quality were inactive. In the analysis of the difference between the three groups, sleep latency (time it takes to fall asleep) (p=0.00) and total PSQI (p=0.04) were significantly different. When the analysis was performed between active and inactive individuals, significant differences were found in sleep latency (p=0.02), daytime dysfunction (difficulties in performing daytime tasks due to poor sleep quality) (p=0.02), and the total PSQI (p=0.02). Binary logistic regression with crude analysis showed that inactive participants are 4.3 times more likely to have poor sleep quality when compared to active participants (odds ratio = 4.3; 95% confidence interval 1.3-13.9; p=0.014). Multinomial regression analysis showed that being physically active can be a protective factor.

Conclusions. There is a high prevalence of sleep disorders and insufficient practice of physical exercise among patients with fibromyalgia. It is suggested that regular physical exercise may be related to sleep quality, and more active participants have fewer sleep disorders, with exercise being a protective factor.

Introduction

Fibromyalgia syndrome (FM) is a rheumatic disease characterized by chronic and widespread pain, with a prevalence of between 0.2% and 6.4% depending on the country analyzed (1). It is a syndrome of unknown etiology; however, some hypotheses about its emergence and development are being investigated (2, 3). The diagnosis is performed using the criteria proposed by the American College of Rheumatology (4).

Patients with FM have high medical expenses, directly through consultations and medications, and indirectly, through absences from work (5-7). This is due to the impact caused by the disease, which is characterized by psychological and physical symptoms (2, 8-10). The most common symptoms, in addition to pain, include a decrease in functional capacity, depression, anxiety, mood alterations, fatigue, and sleep disturbances (2, 4, 11).

Sleep disorders are present in more than 90% of patients with FM (2, 12, 13). When compared to healthy people, individuals with FM present alterations in the "architecture" of sleep (2, 13-15), with a decrease in the deep sleep stage in non-REM sleep, which is considered the stage of sleep responsible for tissue restoration. Sleep quality can be associated with other FM symptoms since there is a correlation between worsening sleep quality and other symptoms shown by the patient (2, 16, 17). In healthy people, sleep deprivation can cause symptoms similar to those present in FM, such as a decrease in the pain threshold and depression (14, 18). Thus, aspects related to sleep quality should be considered for the management and treatment of patients with the syndrome (2, 14). The management of FM symptoms includes the practice of physical exercises (8, 10, 19, 20); some studies have shown that this is associated with lower rates of depression (21) and improvement in quality of life (6, 22), in addition to reducing pain and sleep disturbances (17, 23). However, despite this, patients with FM still present sedentary behavior and do not follow the recommendations for exercise, which can worsen their symptoms (24). Currently, evidence from systematic reviews indicates that there are benefits of physical exercise interventions on the quality of sleep in this population (25); however, for the long-term management of symptoms, since there is no cure, it is necessary to understand how behavior related to exercise can influence sleep. On the other hand, despite the positive results of exercise on FM symptoms, its effects on sleep quality still show conflicting results (8, 24, 26, 27), requiring further studies with different designs.

In this way, it is necessary to better understand the relationship between the practice of exercise and the quality of sleep in patients with FM. Thus, the objective of this study was to investigate the association between the volume of exercise and the quality of sleep in patients with FM.

Materials and Methods

Participants

This cross-sectional study was conducted in the city of Florianópolis (south of Brazil). Patients over 18 years of age with a medical diagnosis of FM (4, 28) participated in the study. The sample was recruited from the project "Psychology of Sport and Exercise Applied to Health" from the State University of Santa Catarina and by means of referral from the hospitals in the region. Data were collected from 2010 to 2019. Participants gave informed written consent. This research was approved by the Research Ethics Committee Involving Human Beings of the State University of Santa Catarina, number 24584213.0.0000.0118.

Procedures

The researchers contacted patients with FM by telephone to explain the objectives of the study and invite them to participate. Data collection was performed at the State University of Santa Catarina. The patients were informed about the objectives and relevance of the study and how the data collection would be performed. Participants gave informed written consent and were invited to respond to instruments regarding sociodemographic and clinical characteristics, physical exercise practices, and sleep quality measurements.

Pittsburgh Sleep Quality Index

Sleep quality was assessed using the Pittsburgh Sleep Quality Index (PSQI) (29), a questionnaire validated for the Brazilian population (30). PSQI is a questionnaire widely used in patients with FM; it consists of 18 questions that address different aspects of sleep, such as sleep routine and daytime symptoms. The result is interpreted by the total score, which varies from 0 to 21 points, with 0-5 being considered good sleep quality and 6-21 poor sleep quality. The results can also be interpreted through the grouping of questions, which constitute seven domains: latency, duration, subjective quality, efficiency, disorders, use of sleeping medication, and daytime dysfunction; each domain has a maximum score of 3 points (30, 31).

Self-reported physical exercise

The practice of exercises was evaluated through a self-reported questionnaire, previously used by Andrade *et al.* (21) and Sieczkowska *et al*. (6), where the patient provides information on whether they perform physical exercise, with which modality, and its weekly frequency. Exercise intensity was not considered. From the results, the participants were classified into three categories: inactive (does not perform any physical exercise regularly), insufficiently active (performs up to three times a week), or active (performs more than three times a week).

Sociodemographic characterization of patients

Sociodemographic and clinical information was obtained through a previously used questionnaire (21), which includes questions about age, marital status, socioeconomic status, work situation, educational level, and use of medication.

Statistical analyses

All analyses were conducted with Statistical Package for the Social Sciences (IBM, Armonk, NY, USA) for Windows (Version 20.0) using descriptive and inferential analyses. Pearson's chi-square test was used to verify the association between sociodemographic and clinical characteristics and the level of exercise. Data distribution was determined using the Kolmogorov-Smirnov test. The Kruskal-Wallis test was used to verify significant differences in domains and total PSQI between the three groups. The Mann-Whitney U test was used to verify significant differences in domains and total PSQI between the inactive and active groups. A binary logistic regression was performed to verify whether the practice of exercise influences the quality of sleep through the classification of PSQI. A multinomial regression was performed to find associations between levels of exercise per week and good or bad PSQI sleep classification. P-values less than 0.05 were considered significant. Data were adjusted for age and disease duration. Models adjusting for medication use were not significant.

Results

Participant characteristics

A total of 308 participants were selected and met the inclusion criteria, of whom 296 (96.1%) were women. The mean age of the sample was 52.1±10.3; most were considered physically inactive (65.9%), followed by insufficiently active (24.4%), and physically active (9.7%). The relative majority were employed (29.5%) and used antidepressant drugs (50.6%), muscle relaxants (53.6%), and analgesics (54.2%). Sociodemographic characteristics are described in detail in Table 1.

Sleep characteristics and the relationship with exercise

The study shows that 284 patients (92.2%) reported poor sleep quality. In addition, a significant association was observed between the level of exercise and sleep quality of patients with FM, demonstrated by Pearson's chi-square test, as shown in Table 1. Regarding physical exercise, 45.5% of the participants reported performing walks, 34.5% combined exercises (more than one modality, *e.g.*, walking and resistance training), 7% resistance training, 4% pilates, and 9% other modalities. When analyzing patients with poor sleep quality, 68.3% were inactive, and inactive patients with good sleep quality represented only 37.5%. Figure 1 demonstrates the distribution of exercise levels according to sleep quality classification. Regarding the sleep domains analyzed using the PSQI and shown in Table 2, significant differences were found

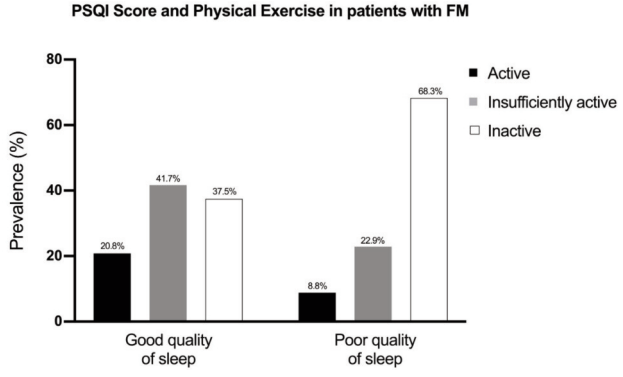

Figure 1. Distribution of exercise levels between patients with good and poor sleep quality. FM, fibromyalgia syndrome; PSQI, Pittsburgh Sleep Quality Index.

between the three groups only for sleep latency (p=0.00), where inactive patients had a higher mean. There was also a significant difference between the three groups for the total PSQI value (p=0.04), where inactive patients presented a higher total value than insufficiently active and active patients. When the analysis was performed only between active and inactive patients, significant differences were found in the domains of sleep latency (p=0.02), daytime dysfunction (p=0.02), and the total PSQI value (p=0.02). Binary logistic regression with crude analysis showed that inactive participants were 4.3 times more likely to have poor sleep quality when compared to active participants [odds ratio (OR)=4.3; 95% confidence interval (CI) 1.3-13.9; p=0.014), and in the analysis adjusted for age, inactive participants were 3.5 times more likely to have poor sleep quality than active participants (OR=3.5; 95% CI 1.039-11.8; p=0.043). The comparison with active and insufficiently active was not significant (crude analyses: OR=1.3; 95% CI 0.4-4.2; p=0.660 and adjusted for age: OR=1.1; 95% CI 0.3-3.7; p=0.922)

The multinomial regression analysis showed that participants with good sleep quality were 3.4 times more likely to be active and 3.5 times more likely to be insufficiently active than to be inactive. Data from the crude and adjusted analysis are detailed in Table 3.

Discussion

FM is a disabling syndrome that directly affects the quality of life of patients (6). In our sample, we observed that only 29% of the participants were working, a low value since the average age of the participants fell in the working age. However, patients with FM tend to have difficulties working (32). In the study conducted by Andrade *et al.* (2), 90.7% of participants with FM who did not work reported sleep disorders. Thus, treatments that help improve sleep quality are essential for this population. Among the forms of treatment, the use of exercise is important, since patients with FM tend to suffer fewer symptoms (19, 33, 34) and have fewer

Table 1. Sociodemographic and clinical characteristics of patients with fibromyalgia.

	General (n=308)	Active (n=30)	Insufficiently active (n=75)	Inactive (n=203)	Chi-square p-value
Age, mean±SD, years	52.1±10.3	55.2±9.9	52.2±9.4	51.7±9.7	
Sex, n (%)					
Female	296 (96.1)	27 (90)	73 (97.3)	196 (96.6)	[a]
Male	12 (3.9)	3 (10)	2 (2.7)	7 (3.4)	
Marital status[†], n (%)					
With partner	165 (53.9)	17 (56.7)	35 (46.7)	113 (56.2)	0.35
Without partner	141 (46.1)	13 (43.3)	40 (53.3)	88 (43.8)	
Work, n (%)					
Employed	91 (29.5)	5 (16.7)	23 (30.7)	63 (31.0)	0.44
Unemployed	68 (22.1)	11 (36.7)	13 (17.3)	44 (21.7)	
Retired	86 (27.9)	8 (26.7)	23 (30.7)	55 (27.1)	
Work leave	61 (19.8)	6 (20.0)	16 (21.3)	39 (19.2)	
Use of medicines, n (%)					
Antidepressant	156 (50.6)	12 (40)	38 (50.7)	106 (52.2)	0.52
Anti-inflammatory	101 (32.8)	7 (23.3)	25 (33.3)	69 (34.0)	0.55
Muscle relaxants	165 (53.6)	13 (43.3)	37 (49.3)	115 (56.7)	0.30
Somniferous	79 (25.6)	5 (16.7)	19 (25.3)	55 (27.1)	0.50
Analgesic	167 (54.2)	12 (40)	43 (57.3)	112 (55.2)	0.27
Sleep quality, n (%)					
Good sleep	24 (7.8)	5 (16.7)	10 (13.3)	9 (4.4)	0.008*
Poor sleep	284 (92.2)	25 (83.3)	65 (86.7)	194 (96.6)	

SD, standard deviation. The distribution of frequencies was carried out within each category of exercises, according to the column; †for the presence of missing, the total number of patients evaluated does not correspond to the total "n"; [a]with the values of male x female it was not possible to perform chi-square; *significant value, p<0.05.

Table 2. Comparison of sleep domains of active, insufficiently active, and inactive fibromyalgia patients.

Domain of PSQI	General (x±SD)	Active (x±SD)	Insufficiently active (x±SD)	Inactive (x±SD)	p-value (3 groups)[b]	p-value (2groups)[a]
Subjective quality	1.87±0.87	1.63±0.89	1.83±0.84	1.93±0.87	0.22	0.99
Latency	1.99±1.05	1.47±1.07	1.89±1.02	2.11±1.05	0.00*	0.02*
Duration	1.70±2.02	1.30±1.15	1.53±1.24	1.83±2.32	0.20	0.09
Efficiency	1.66±1.28	1.43±1.36	1.53±1.27	1.73±1.27	0.21	0.23
Sleep disturbance	1.96±0.64	1.97±0.72	1.85±0.63	2.00±0.63	0.31	0.89
Medication	1.41±1.44	1.20±1.42	131±1.39	1.48±1.46	0.36	0.26
Daytime dysfunctions	1.71±1.07	1.27±1.17	1.73±0.96	1.78±1.07	0.67	0.02*
Total sleep	12.28±4.62	10.57±4.80	11.71±4.80	12.75±4.45	0.04*	0.02*

SD, standard deviation; PSQI, Pittsburgh Sleep Quality Index. *Significant difference with p<0.05; [a]Mann-Whitney U test between active and inactive; [b]Kruskal-Wallis test between the three groups.

absences from work if they are active (6). It has also been observed that active patients make less use of medication, an important factor given the high cost associated with treatment (5). Most participants were physically inactive and had poor sleep quality. It is common for patients with FM to be inactive due to symptoms of pain, fatigue, and depression (35). The main results of this study confirm an association between exercise and sleep quality. Physically active patients reported fewer sleep disorders than inactive patients, with physical exercise being considered a protective factor. In the general population, the recommended amount of sleep for adults is 7-9 hours a day (36); however, patients with FM tend to have a lower average sleep time (15), a common fact in patients with chronic pain who have fewer hours of sleep due to both insomnia and constant sleep interruptions (15, 23, 37). The prevalence of sleep disorders in the general population varies according to the study region; in the USA, it was 56%, in Western Europe, 31%, and in Japan, 23% (38); however, in patients with FM, the prevalence reached was greater than 90% (2, 13), as verified in our study (92.2%). The relationship between sleep and FM has been investigated for some years, and the presence of α-δ sleep was found, which is the abnormal appearance of α activity in δ waves during slow-wave sleep in patients with FM (13). α intrusions are presumed to represent an arousal or awakening state that disturbs sleep (14). In recent years, many types of sleep abnormalities have been reported among FM patients, such as lower sleep efficiency (16), increased stage 1 sleep (13, 15, 16), decreased slow wave sleep (15), and an increase in the number of awakenings (16). However, there is still a need for further studies using polysomnography to understand the sleep patterns of patients with FM and the effects of exercise. In most studies evaluating sleep quality, subjective scales were used, such as the PSQI and the visual analog scale (8). Although the PSQI provides a good sleep analysis, more specific tests are needed.

Physical exercise is a protective factor for sleep quality in patients with fibromyalgia

In the general population, exercise is recommended for people who want to improve their sleep quality (39, 40). This recommendation extends to patients with FM. Despite these recommendations, the relationship between exercise and sleep quality is still not fully understood, as some studies find significant changes while others do not (8). In the current study, we verified an association between sleep quality and the practice of exercise. A significant difference was observed in sleep latency and the total PSQI score, and when only active and inactive patients were compared, a difference in daytime dysfunction was also observed. The effect of exercise can explain these improvements in only a few domains. Practicing exercise may not improve all aspects of sleep, however, improving some domains may result in an improvement in the overall quality of sleep. However, more studies with different designs are needed to confirm this. Some studies have investigated the effect of exercise on the sleep quality of patients with FM (17, 41-43). Bircan *et al*. (42) compared aerobic exercise with resistance training and found no significant differences between the two interventions. At the end of 8 weeks, both groups presented significant improvements in sleep. In our study, most participants who exercised opted for walks; however, both aerobic and resistance exercises were shown to improve sleep quality (8, 25, 26). On the other hand, some studies did not find significant differences, requiring further investigations on the intensity and volume of exercise (27, 44). In recently published reviews, body-mind exercises and combined exercises showed better results in improving sleep quality (27, 43). As in our study 34.5% performed combined exercises, the improvement observed is in line with these recent studies. In the current one, exercise proved to be a protective factor, with inactive participants being 4.3 times more likely to have poor sleep quality when compared to active patients. In the analysis adjusted for age, inactive participants were 3.5 times more likely to have poor sleep quality than active participants. Another advantage of exercising is that it improves more than one symptom (8, 10, 45, 46). Sleep quality is a variable that is related to pain (17), fatigue (41), and depression (18, 47). In one of the first studies investigating the topic, Moldofsky and Scarisbrick (48) exposed healthy volunteers to an experiment where participants were impeded to sleep properly and found increased fatigue and muscle stiffness. Good sleep is essential for the recovery of the body because regulatory processes occur during sleep (49): its absence represents a risk factor for several diseases (50) and explains the relationship between sleep disorders, pain, and depression. Thus, regular practice of exercise is recommended to improve sleep quality and other symptoms in patients with FM, mainly mind-body exercises and combined exercises.

Limitations and future studies

Despite the good results found related to the practice of exercise and the quality of sleep, some limitations must be considered. Firstly, the cross□sectional design does not allow the establishment of a causal relationship. Although valid and reliable, the PSQI questionnaire is not an objective measure of sleep and cannot, for instance, measure how much time people are in the deep restorative sleep phases. Future studies should be conducted to analyze data from this population over time, applying the most direct measures, such as polysomnography. In addition, clinical studies with high methodological quality are also recommended, which control variables and results between groups.

Study strengths, innovations, and applications

The strengths and innovations of our study include the data

Table 3. Multinomial regression analysis to identify the association between the classification of physical activity level and the classification of sleep quality of patients with fibromyalgia.

	Active				Insufficiently active			
	Crude OR (CI)	p	Ajusted OR (CI)	p	Crude OR	p	Ajusted OR (CI)	p
Good sleep	4.311 (1.338-13.888)	0.014*	3.437 (1,012-11.673)	0.048*	3,316 (1.291-8.518)	0,013*	3,535 (1.265-9.877)	0.016*
Poor sleep	1		1		1		1	
Age	1.034 (0.996-1.074)	0.083	1.030 (0.989-1.072)	0.157	1.005 (0.980-1.032)	0.694	1.005 (0.977-1.034)	0.731
Duration of disease	1.001 (0.997-1.005)	0.711	0.999 (0.995-1.004)	0.753	0.996 (0.992-1)	0.038*	0.995 (0.991-0.999)	0.016*

OR, odds ratio; CI, confidence interval. Exercise level reference category: inactive. *Significant difference with p<0.05; in relation to the duration of the disease, despite showing significance in the Wald test, the CI results are close to 1, showing an insignificant association.

obtained over 10 years of investigation and care for patients with FM following the practice of exercise and the symptoms of the syndrome, including the quality of sleep. Our results significantly contribute to the evidence for understanding the relationship between exercise and sleep quality in patients with FM.

The study presents possible applications of its findings, strengthening the recommendation to adhere to an active lifestyle normally associated with other healthy habits. Another important aspect, considering the exercise recommendation for health and our findings, is the possibility of including exercise in public policies and projects for the treatment of FM.

Conclusions

Patients with FM have a high prevalence of sleep disorders and are insufficiently active. Regular physical exercise may be related to sleep quality, and more active participants have fewer sleep disorders. Exercise is a protective factor, strengthening recommendations to adhere to an active lifestyle.

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