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Sedentary time, physical activity, and sleep quality in fibromyalgia: The al-Ándalus project

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Abstract

Purpose: To get insight into the potential significance of objectively measured sedentary time (ST), and physical activity (PA) intensity levels on sleep quality (SQ) in women with fibromyalgia; and to assess whether those who meet moderate-to-vigorous PA (MVPA) recommendations have better SQ than their counterparts.

Methods: Four-hundred and nine women with fibromyalgia (age range 30-65 years old) from Andalusia (southern Spain) were included in this cross-sectional study. Sedentary time, PA intensity levels (light, moderate, and MVPA), and total PA were assessed with accelerometers during seven consecutive days. Sleep quality was measured with the Pittsburgh Sleep Quality Index self-report questionnaire.

Results: Higher ST was associated with worse subjective SQ, sleep duration, sleep disturbances, daytime dysfunction, and SQ global score (all, $P < 0.05$). All PA levels were associated with better subjective SQ and sleep latency and with less sleep medication and daytime dysfunction (all, $P < 0.05$). In addition, light and total PA were associated with better sleep efficiency, SQ global score, and less sleep disturbances (all, $P < 0.05$). Finally, women meeting bouted PA recommendations displayed better SQ than patients not meeting the recommendations (bouted or non-bouted).

Conclusion: Lower ST and greater PA levels are associated with better SQ in women with fibromyalgia. This result demonstrates that those patients with fibromyalgia who reduce periods of inactivity and perform PA could be better sleepers, which might contribute to a lower severity of the disease. It is noteworthy that meeting bouted PA recommendations is associated with better SQ.

KEYWORDS
accelerometry, objectively measure, sleep disturbance, sleep duration

1 | INTRODUCTION

Fibromyalgia is a heterogeneous and poorly understood disease,[1] which is characterized by chronic widespread pain regulation[2] and the presence of many other symptoms.[3] The American College of Rheumatology recognizes sleep disturbances as a core symptom of fibromyalgia with its inclusion in the updated diagnosis criteria.[4] In fact, patients with fibromyalgia report poorer sleep quality (SQ) ,[5] fewer hours of sleep, greater night-time awakenings, and higher non-restorative sleep compared with healthy people and other clinical populations.[6] Moreover, difficulty staying asleep and non-refreshing sleep are distressing symptoms that may impact physical functioning, well-being, and fibromyalgia symptomatology.[7]

Sedentary behavior is defined as the waking time spent sitting or leaning back.[8] Adults usually engage in sedentary behaviors during more than half of their waking time.[9] The negative impact of sedentary time (ST) on health in the general population has been widely established.[10] However, studies focused on the relationship of ST with SQ are scarce and have concluded contradictory results. Some studies developed in adolescents and children suggest that greater ST might be associated with lower sleep duration ,[11,12] while others with clinical or adult populations found no association between ST and SQ or their components.[9,13,14] Patients with fibromyalgia present greater levels of ST than controls ,[15,16] and it is unknown whether this sedentary behavior is associated with SQ in this specific population.

The amount of ST is inversely associated with PA levels. Patients with fibromyalgia present lower levels of PA than their counterparts.[15,16] Studies in chronic pain and elderly population showed a direct association between accelerometer-assessed PA and SQ.[13,17-19] To the best of our knowledge, there is only one previous study assessing the association of PA and SQ in women with fibromyalgia ,[5] reporting that self-reported PA levels were associated with SQ. Notwithstanding, in fibromyalgia, there is discordance between self-reported assessments and objective measurements of PA.[20] Indeed, PA questionnaires provide misleading information in this specific population.[21] Consequently and due to its validity, reliability, and feasibility, the use of objective measures of PA, such as accelerometry, is preferred for these patients.[22]

Sedentary time, PA, and SQ appear to be interconnected and all of them are related to the quality of life.[23] Lower ST or higher PA levels are associated with reduced general symptomatology in patients with fibromyalgia.[24] However, little is known about the contribution of ST and PA intensity levels on SQ in women with fibromyalgia. Therefore, the aims of the present study were (a) to examine the association of objectively measured ST and PA intensity levels with SQ in women with fibromyalgia and (b) to assess whether those who meet moderate-to-vigorous physical activity (MVPA) recommendations have better SQ than their counterparts.

2 | MATERIAL AND METHODS

2.1 | Participants

We recruited a representative sample of women with fibromyalgia from Andalusia (southern Spain) as described elsewhere.[16] Briefly, a total of 617 women with fibromyalgia (age range between 30 and 65 years old) were recruited from Andalusia through fibromyalgia associations. We also recruited potential participants via e-mail and mass media. Interested participants read and signed an informed consent form before taking part in the study. The inclusion criteria were (a) having been diagnosed with fibromyalgia by a rheumatologist, (b) meeting the 1990 American College of Rheumatology fibromyalgia criteria, (c) having neither acute nor terminal illness, nor severe cognitive impairment [Mini-Mental State Examination (MMSE) score <10], and (iv) being ≤65 years old. The study protocol was reviewed and approved by the Ethics Committee of the Virgen de las Nieves Hospital in Granada (Spain).

2.2 | Procedures

The evaluation process was carried out on two non-consecutive days. On day 1, the MMSE was administered, socio-demographic data were self-reported, the diagnosis of fibromyalgia was confirmed, and anthropometry and body composition measures were taken. On day 2, the participants completed the Pittsburgh Sleep Quality Index questionnaire, and they received the accelerometer and the sleep diary, which were returned to the research team nine days later.

2.3 | Measurements

2.3.1 | Sociodemographic and clinical data

A questionnaire was used to collect the participants' self-reported sociodemographic and clinical data, such as age, fibromyalgia diagnosis, marital status, educational level, and menstruation, among others.

2.3.2 | Anthropometry and body composition

Weight (kg) and total body fat (%) were measured with a bioelectrical impedance analyzer (InBody R20, Biospace, Seoul, South Korea).

2.3.3 | Sedentary time and physical activity intensity levels

The data were collected using a triaxial accelerometer GT3X+ (Actigraph Pensacola, Florida) at a rate of 30 Hz

and stored at an epoch length of 60 seconds. The participants wore the device on the hip, near the center of gravity, underneath their clothes, and secured with an elastic belt.

The accelerometer wearing time was calculated by subtracting the sleeping time from each day (registered by the patients on a diary where they reported the time they went to bed to sleep and the time they woke up). The bouts of 90 continuous minutes of zero counts were excluded from the analyses, considered as non-wear periods. The data were recorded up to 9 days, starting from the day the patients received the accelerometers until the day they returned the devices. The first and last days were excluded from the analyses. Therefore, a total of seven continuous days with a minimum of 10 valid hours per day was the criteria for being included in the study.

As an overall measure of PA, average counts per minute (cpm) in each independent axis and the vector magnitude were calculated for each woman. Sedentary time, light, moderate, and vigorous PA intensity levels were calculated based on the recommended PA vector magnitude cut points: 0-199, 200-2689, 2690-6166, and ≥6167, respectively, and were expressed as minutes per day. Total PA was calculated as the sum of light, moderate, and vigorous PA (minutes/day). A bout of moderate-to-vigorous PA (MVPA) was defined as spending ≥10 continuous minutes in MVPA (≥2690 cpm). The total time in MVPA in bouts of ≥10 minutes was also calculated. Meeting the bouted PA recommendations required engaging in at least 150 minutes/week of MVPA accumulated in bouts ≥10 minutes; conversely, non-bouted PA recommendations did not need to accumulate MVPA in bouts ≥10 minutes. We used the manufacturer software Actilife™ v.6.11.7 desktop for data download, reduction, cleaning, and analyses purposes.

2.3.4 | Sleep quality

We assessed the sleep quality over the last month interval with the Spanish version of the *Pittsburg Quality Sleep Index*, which is reliable and valid in fibromyalgia. The Pittsburg Quality Sleep Index is composed of 19 questions addressing seven components: subjective sleep quality, sleep latency, sleep duration, sleep efficiency, sleep disturbances, sleep medication, and daytime dysfunction. Each component includes items with four-point Likert scales (0-3). The sleep quality global score is the sum of all components, and the score ranges from 0 to 21. Higher scores indicate worse sleep quality.

2.3.5 | Sleep or relaxation medication

The intake of sleep or relaxation medications was registered as a binary variable (yes/no).

2.4 | Statistical analysis

Before the principal analyses, we calculated bivariate correlations to identify potential confounders. Accordingly, age, total body fat percentage, marital status, educational level, sleep or relaxation medication, and regular menstruation were included as covariates in all analyses. Vigorous PA was excluded from the analyses due to the low participants' engagement in this intensity level (<1 min/day).

The raw (Spearman) and adjusted (partial) correlations were used to examine the individual association between ST and PA intensity levels and total PA with the Pittsburgh Sleep Quality Index components. We used the linear regression (enter method) analysis to explore the individual association of ST, light, moderate, moderate-to-vigorous (in bouts of ≥10 minutes), and total PA with the SQ global score in separate regression models. We introduced the SQ global score as the dependent variable and the above-mentioned covariates.

To examine the differences in the SQ global score (ie, dependent variable) across groups of ST (ie, independent variable), we compared the tertiles based on the distribution of the data for total ST using the one-way analysis of covariance (ANCOVA). The analyses were adjusted by age, total body fat percentage, marital status, educational level, sleep or relaxation medication, and regular menstruation covariates. Similarly, to study the differences in the SQ global score (ie, dependent variable) across groups of light and total PA (ie, independent variables in separate models), we compared the tertiles based on the distribution of the data for light and total PA, respectively, using ANCOVA with the above-mentioned covariates. We used Bonferroni's correction for multiple comparisons when comparing the differences between tertiles. The effect size statistic was calculated in all of the analyses by means of Cohen's *d* (standardized mean difference). The effect size was interpreted as small (~0.25), medium (~0.5), or large (~0.8 or greater).

The differences in SQ across groups meeting and not meeting the current PA recommendations for adults (non-bouted and bouted MVPA) were compared using ANCOVA with age, total body fat percentage, marital status, educational level, sleep or relaxation medication, and regular menstruation. The Bonferroni's post hoc analyses for multiple comparisons assessed the differences across groups.

The statistical analysis was performed with the Statistical Package for the Social Sciences (IBM SPSS Statistics for Window, Version 20.0; IBM Corp, Armonk, New York, USA). Statistical significance was accepted at $P < 0.05$.

3 | RESULTS

Thirty-six women had not been diagnosed by a rheumatologist, 81 did not meet the 1990 American College of

Rheumatology criteria, one had severe cognitive impairment, and 11 were older than 65 years old. Forty-nine participants did not agree to wear an accelerometer. The accelerometer data were lost from 30 patients because of malfunction when downloading the data (n = 3), not meeting accelerometer criteria (n = 17), and missing data (n = 10). The final sample subject to analyses included 409 women with fibromyalgia (51.4 ± 7.6 years old). Table 1 shows sociodemographic and clinical characteristics of the study participants. Roughly, 57% of the sample had unfinished or primary education, 72.9% took sleep or relaxation medication, and 68.9% did not have a regular menstruation.

Table 2 shows the association between ST and the PA intensity levels with the SQ components of the Pittsburgh Sleep Quality Index. Several significant small correlations were observed. More ST was associated with worse subjective SQ, sleep duration, sleep disturbances, and daytime dysfunction (all, $P < 0.05$). All of the PA intensity levels were correlated with better subjective SQ, sleep latency, sleep medication, and daytime dysfunction (all, $P < 0.05$). Light PA and total PA were associated with sleep efficiency and sleep disturbances (all, $P < 0.05$). After adjusting for the corresponding covariates, all correlations remained unchanged (all, $P < 0.05$) except for the correlations of ST with sleep disturbances, light PA with sleep latency, and moderate and moderate-to-vigorous PA with sleep medication (all $P > 0.05$). The individual associations of ST and PA intensity levels with SQ global score are shown in Table 3 (all separate analyses). Sedentary time was independently associated with worse SQ global score ($B = 0.118$, $P < 0.05$), and light PA and total PA were independently associated with better SQ global score (B=−0.157, B=−0.163, respectively; all, $P < 0.01$).

The SQ global score across tertiles of ST, light PA, and total PA are plotted in Figure 1. The post hoc analyses showed that patients with fibromyalgia with the highest number of minutes in ST (3rd tertile) presented worse SQ global scores than those from the 2nd tertile (14.0 vs 12.8, $F = 3.766$, $P < 0.05$, Cohen's $d = -0.24$). Regarding light PA, the participants who spent less time in PA (1st tertile) showed worse SQ global scores than those from the 2nd and 3rd tertiles (14.1 vs 12.9 and 12.8, $F = 5.186$, all $P < 0.01$, Cohen's $d = 0.33$ and $d = 0.35$, respectively). With respect to total PA, the participants who spent less time in PA (1st tertile) showed worse SQ global scores than those from the 2nd and 3rd tertiles (14.2 vs 12.8 and 12.8, $F = 5.186$, all $P < 0.01$, Cohen's $d = 0.42$ and $d = 0.40$, respectively).

The differences in SQ global scores across groups of both patients meeting (bouted or non-bouted) and not meeting the PA recommendations are presented in Figure 2. The post hoc analyses showed that the women who met the bouted PA recommendations displayed better SQ than the patients who did not meet the recommendations (bouted or non-bouted) (mean difference = 1.49; $P < 0.05$).

TABLE 1 Descriptive characteristics of the women with fibromyalgia study sample (n = 409)

	Values
Age (years)	51.4 (7.6)
Body mass index (kg/m^2)	28.4 (5.4)
Total body fat (%)	40.1 (7.6)
Time since fibromyalgia diagnosis, n (%)	
Less than 5 years	165 (40.3)
More than 5 years	233 (57.0)
Missing data	11 (2.7)
Marital status, n (%)	
Married	312 (76.3)
Single, separated, divorced, or widowed	97 (23.7)
Educational level, n (%)	
Unfinished or Primary education	235 (57.5)
Secondary or University education	174 (42.5)
Sleep or relaxation medication, n (%)	
No	111 (27.1)
Yes	298 (72.9)
Regular menstruation, n (%)	
No	282 (68.9)
Yes	127 (31.1)
Sleep quality (PSQI)[a]	
Subjective sleep quality (0-3)	2.1 (0.8)
Sleep latency (0-3)	2.0 (0.9)
Sleep duration (0-3)	1.8 (0.9)
Sleep efficiency (0-3)	1.6 (1.2)
Sleep disturbances (0-3)	2.1 (0.6)
Sleep medication (0-3)	2.1 (1.3)
Daytime dysfunction (0-3)	1.5 (0.8)
Sleep quality global score (0-21)	13.3 (3.9)
Sedentary time and PA intensity levels (min/day)	
Sedentary time	460.1 (104.0)
Light PA	418.4 (91.7)
Moderate PA	43.8 (29.5)
MVPA (min/week, in bouts ≥10 min)	85.5 (111.9)
Total PA	462.6 (105.6)

All values are expressed as mean (SD) unless otherwise indicated. MVPA, moderate-to-vigorous physical activity; PA, physical activity; PSQI, Pittsburgh Sleep Quality Index; SD, standard deviation.
[a]Higher values indicate worse sleep quality.

4 | DISCUSSION

The main findings of this study confirmed the associations of ST and PA with SQ in women with fibromyalgia. Furthermore, meeting PA recommendations (ie, more than

150 minutes/week of MVPA in bouts ≥10 minutes) was associated with better SQ.

The observed association between ST and daytime dysfunction differs from findings of previous studies that indicated a lack of association between ST and daytime sleepiness in healthy adults[13] as well as in overweight adults with obstructive sleep apnea.[14] The lack of findings in previous studies may be due to the time lag in the data collection protocol between sleep and accelerometry assessments ,[13] or to the small sample size (n = 62) ,[14] which prevented from finding a small correlation. However, our findings may also suggest that the association between ST and daytime dysfunction might be specific for fibromyalgia, or for women. A previous study by McClain et al[13] also observed that the frequency of daytime sleepiness was associated with reduced levels of MVPA in women from 20 to 39 and ≥60 years old. Due to the fact that our data are correlational, they may reflect a mutual influence of ST, lower PA, and disturbed sleep. These observations are in agreement with the hypothesis that women with fibromyalgia who present less pain, worries, and time in sedentary behaviors or more PA might sleep better and feel less sleepy during the day.

The patients with fibromyalgia who spent more time in ST had a shorter sleep duration. This is in disagreement with previous studies performed in healthy adults and people with the metabolic syndrome.[9,13] Saleh and Janssen [9] employed accelerometry to assess sleep duration, but the participants removed the display before going to bed. Consequently, the sleep duration was a proxy measure as non-wear time at night, which may have overestimated sleep time. Nonetheless, our results are consistent with other studies in children [11,12]and with a study with European adults, where short sleepers (<6 hours per night) spent more minutes per day sitting in front of screens (computer or tablet) than normal sleepers (6-8 hours per night).[25] Thus, our findings could support that those women with fibromyalgia that show more ST spend more time in screen behaviors (computer, tablet, or television) and, therefore, have a shorter sleep duration. Finally, regarding ST and PA intensity levels, we observed a trend showing that those women with lower ST and greater PA levels have better subjective SQ (meaning better SQ perception). This is relevant in this population due to the fact that fibromyalgia patients usually underestimate their SQ,[26] so reducing ST and increasing PA might improve SQ perception.

Therefore, we suggest that ST and SQ seem to be related in this population. In agreement with our results, Kakinami et al[27] observed that more time spent in sedentary activities was associated with poorer SQ in young adults. Regarding MVPA, a study in a small sample of healthy adults ≥65 years old (n = 60) showed that MVPA was associated with better SQ.[18] Slightly in contrast, we observed (in our larger sample) no direct association between MVPA (in bouts of ≥10 minutes) and the SQ global score. Nevertheless, when

TABLE 2 Raw (Spearman) and adjusted (partial) correlations between sedentary time and physical activity (PA) intensity levels with sleep quality components in women with fibromyalgia (n = 409)

	Subjective sleep quality		Sleep latency		Sleep duration		Sleep efficiency		Sleep disturbances		Sleep medication		Daytime dysfunction	
	Raw	Adjusted	Raw	Adjusted	Raw	Adjusted	Raw	Adjusted	Raw	Adjusted	Raw	Adjusted	Raw	Adjusted
Sedentary time, *r*	0.133**	0.111*	0.086	0.087	0.150**	0.167***	−0.004	−0.002	0.098*	0.058	0.093	0.044	0.179***	0.135**
Light PA, *r*	−0.133**	−0.115**	−0.113*	−0.085	−0.026	−0.021	−0.139***	−0.142**	-0.147**	−0.101*	−0.203***	−0.133**	−0.161**	−0.160**
Moderate PA, *r*	−0.136**	−0.102*	−0.110*	−0.104*	−0.042	−0.024	−0.062	−0.046	−0.064	−0.022	−0.107*	−0.006	−0.136**	−0.121*
MVPA[a], *r*	−0.137**	−0.107*	−0.112*	−0.105*	−0.041	0.002	−0.062	−0.022	−0.064	−0.018	−0.109*	−0.011	−0.136**	−0.123**
Total PA, *r*	−0.148**	−0.130**	−0.126*	−0.105*	−0.022	−0.025	−0.133**	−0.138**	−0.138**	−0.096*	−0.185***	−0.120**	−0.159**	−0.176***

Raw, Spearman correlation; adjusted, partial correlation controlled for age, total body fat percentage, marital status, educational level, sleep or relaxation medication, and regular menstruation. MVPA, moderate-to-vigorous physical activity.

[a]MVPA in bouts ≥10 min.

*$P < 0.05$.

**$P < 0.01$.

***$P < 0.001$.

TABLE 3 Associations of sedentary time and physical activity (PA) intensity levels with sleep quality global score in women with fibromyalgia (n = 409)

	β	*B*	95% CI		*P*
Sedentary time	0.118	0.004	0.001	0.008	0.014
Light PA	−0.157	−0.007	−0.011	−0.003	0.001
Moderate PA	−0.081	−0.011	−0.023	0.001	0.085
MVPA[a]	−0.078	−0.003	−0.006	0.000	0.098
Total PA	−0.163	−0.006	−0.009	−0.003	0.001

Results of separate regression (enter method) analyses controlled for age, total body fat percentage, marital status, educational level, sleep or relaxation medication, and regular menstruation.

β, standardized regression coefficient; *B*, non-standardized regression coefficient; CI, confidence interval; PA, physical activity; MVPA, moderate-to-vigorous physical activity

[a]MVPA in bouts ≥10 min

we compared women who did and did not meet the PA recommendations (ie, 150 minutes/week of MVPA in bouts ≥10 minutes), we observed that those who did, presented a better SQ global score. For the remaining PA intensity levels, in contrast with our findings, a study performed in rheumatoid arthritis patients[28] and others in young adults Kakinami et al[27] did not find an association between PA and sleep. To note is that both studies assessed PA levels by questionnaires, whereas we have employed objectively measured PA. Andrews et al[17] observed that, in patients with chronic pain, high-intensity activities and high fluctuations in PA were associated with poorer sleep at night. Thus, they suggested that PA could be a key treatment for sleep complaints (ie, awakes or SQ). With the categorization of groups by tertiles, we observed that women with fibromyalgia with the highest ST and the lowest light and total PA presented a greater SQ global score, meaning poorer SQ, than the other groups. Moreover, exercise intervention studies have observed a positive effect of exercising on SQ in patients with fibromyalgia.[29] Furthermore, exercise appears to be a useful non-pharmacological treatment to improve fibromyalgia symptomatology.[30]

Among the mediators that might explain the associations of ST and PA levels with SQ are hormonal changes, structural and functional neurological changes, and modifications in the autonomic nervous system functioning. During PA, the sympathetic autonomic nervous system is stimulated.[31] However, after PA there is a physiological response that includes a decrease in this sympathetic tone and a shift toward parasympathetic activity, which promotes muscular and nervous relaxation.[32,33] Partially as a consequence of this parasympathetic activity, PA is shown to decrease the heart rate and to have antihypertensive effects which also facilitate sleep.[34] Moreover, PA induces body and mental relaxation and has a clear anxiolytic effect ,[35] thus decreasing stress levels,[35] which may all together promote a better SQ.[36] It is also plausible that those women with high levels of ST and low levels of PA have less hours of slow wave sleep.[37] Disturbed slow-wave sleep may increase fibromyalgia severity.[38]

Decades of research led to the current concept that chronic pain encompasses multiple and mutually interacting biological, psychological, and social factors. These include—but are not limited to—nature of pain, peripheral and central pain processing mechanisms, physical disability, sleep disturbance, obesity and other health risks, psychological resilience and vulnerabilities (emotions, cognitions, behavior), and social factors (work, support, facilities, financial resources).[39] The relations between all factors of this biopsychosocial model are recognized to be dynamic and reciprocal, with mutually influencing pathways in which changes of one component may induce change in all. The weight of the distinct factors differs between individuals. Following this model, it is likely that PA influences sleep and that sleep influences PA, as indicated in a prospective study in chronic pain and insomnia participants, suggesting that people's perception about their SQ may condition their PA levels.[19] Also, another study observed in a middle-aged to elderly population that regular moderate exercise was associated with a reduction in the prevalence and risk of symptoms of disturbed sleep.[40] Our results suggest that high-intensity levels of PA are not essential to reduce sleep disturbances in patients with fibromyalgia; but light PA might be helpful. Overall, our data and those of other studies indicate that the reduction of ST, enhanced light PA, and improved sleep are potential beneficial targets in the management of fibromyalgia.

Some limitations must be considered. Firstly, the cross-sectional design does not allow to establish causal relationships. Secondly, men were not included. Thirdly, the accelerometer does not discriminate some specific PA activities such as cycling, swimming, or weight lifting. Furthermore, future studies should use self-reported questionnaires to check whether different types of PA present distinctive associations with sleep parameters. Fourthly, although valid and reliable, the Pittsburgh Sleep Quality Index questionnaire is not an objective measure of sleep and cannot, for instance, measure how much time people are in the deep restorative sleep phases. The main strength of the present study is its objective quantification of ST and PA levels, given that self-reported measures have shown poor reliability and validity

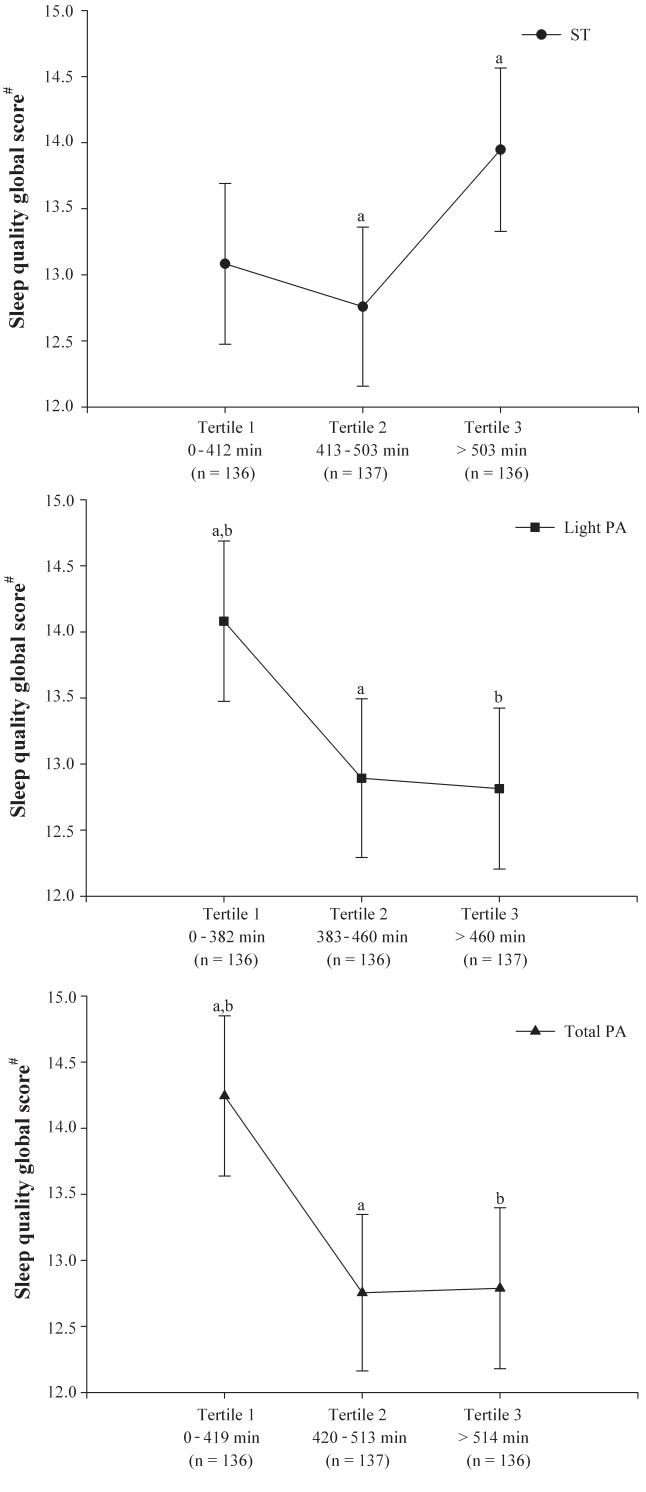

FIGURE 1 Low (1), middle (2), and high (3) scores on sedentary time (ST), light and total physical activity (PA) with sleep quality global score from the Pittsburgh Sleep Quality Index in women with fibromyalgia study sample (n = 409). The estimated means (dots) and 95% confidence intervals (CIs, error bars) represent values after adjustment for age, total body fat percentage, marital status, educational level, sleep or relaxation medication, and regular menstruation. Common superscripts indicate significant differences ($P < 0.05$) between the components with the same letter after Bonferroni's correction. #Lower values indicate better sleep quality

in this population.[21] Furthermore, the accelerometer criteria employed were stricter than those used in previous studies.[15] Another strength is the large and representative study sample.[3]

In conclusion, lower ST and greater PA levels are associated with better SQ in women with fibromyalgia. This result demonstrates that those patients with fibromyalgia who reduce periods of inactivity and perform light PA could be better sleepers, which might contribute to a lower severity of the disease. Moreover, meeting the PA recommendations (150 minutes/week MVPA in bouts ≥10 minutes) would be associated with better SQ. This interconnectedness suggests the usefulness of examining intervention studies assessing the effects of different intensities of physical activity or exercise programs on SQ in patients with fibromyalgia.

5 | PERSPECTIVE

This is the first study checking that higher ST and lower levels in light and total PA are associated with worse SQ. Overall, the results suggest that women with fibromyalgia who are

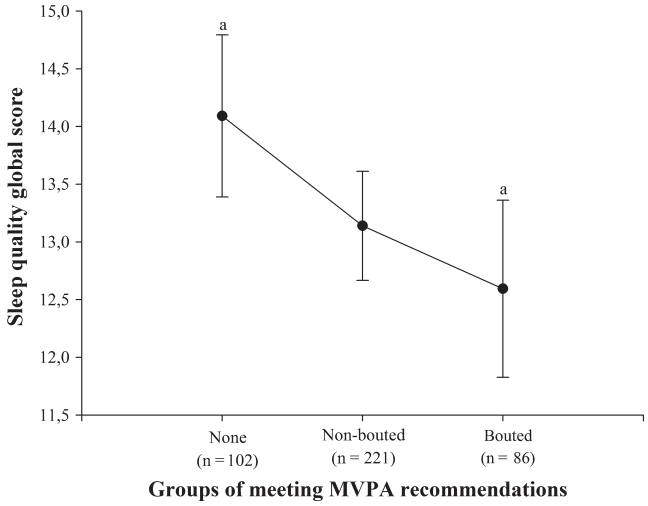

FIGURE 2 Association between the engagement in moderate-to-vigorous physical activity (MVPA) recommendations, with or without accounting for a minimum of 10 min bouts, with sleep quality global score from the Pittsburgh Sleep Quality Index in women with fibromyalgia study sample (n = 409). None: <150 min/week MVPA (either non-bouted or bouted); Non-bouted: meeting 150 min/week non-bouted MVPA; Bouted: meeting 150 min/week bouted MVPA. The estimated means (dots) and 95% confidence intervals (CIs, error bars) represent values after adjustment for age, total body fat percentage, marital status, educational level, sleep or relaxation medication, and regular menstruation. [a]Indicate significant differences ($P < 0.05$) between the components after Bonferroni's correction. #Lower values indicate better sleep quality

highly sedentary and low physically active show worse SQ than those who are low sedentary and high physically active. These findings are clinically important because they could be a starting point for non-pharmacological treatment to improve sleep in women with fibromyalgia. A take-home message for this population might be: "be as less sedentary as possible, and try to move throughout the day." Future longitudinal studies are warranted to confirm these results.

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