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ACTIVITY AND THE RHEUMATIC DISEASES

Substituting Sedentary Time With Physical Activity in Fibromyalgia and the Association With Quality of Life and Impact of the Disease: The al-Ándalus Project

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Objective. There is an overall awareness of the detrimental health effects of sedentary time (ST) in fibromyalgia; however, data are limited on how replacement of ST with physical activity (PA) of different intensity may be related to health in this condition. The aim of this study was to examine how a substitution of ST with light PA (LPA) or moderate-to-vigorous PA (MVPA) is associated with quality of life and disease impact.

Methods. This study comprised 407 women with fibromyalgia, mean ± SD age 51.4 ± 7.6 years. The time spent in ST and PA was measured with triaxial accelerometry. Quality of life and disease impact were assessed using the Short Form 36 (SF-36) health survey and the Revised Fibromyalgia Impact Questionnaire (FIQR), respectively. The substitution of ST with an equivalent time of LPA or MVPA and the associated outcomes were examined using isotemporal substitution analyses.

Results. Substituting 30 minutes of ST with LPA in the isotemporal model was associated with better scores in bodily pain (B = 0.55), vitality (B = 0.74), and social functioning (B = 1.45) according to the SF-36, and better scores at all of the domains (function, overall impact, symptoms, and total impact) of the FIQR (B ranging from –0.95 to –0.27; all $P < 0.05$). When ST was replaced with MVPA, better physical role (B = 2.30) and social functioning (B = 4.11) of the SF-36 and function of the FIQR (B = –0.73) were observed (all $P < 0.05$).

Conclusion. In regression models, allocation of time of sedentary behavior to either LPA or MVPA was associated with better quality of life and lower disease impact in women with fibromyalgia.

INTRODUCTION

Fibromyalgia is a chronic condition with key symptoms of persistent and widespread pain (1). Other symptoms include, but are not limited to, fatigue, nonrestorative sleep, and/or cognitive difficulties (1). The disease impact of fibromyalgia includes physical disability, psychological distress, severe symptoms, and reduced work status (2). Moreover, patients with fibromyalgia usually have a reduced general quality of life (3), which is the individual perception of health in different spheres of life (physical, mental, and social). Because fibromyalgia has no cure, treatments focus on disease management and improvement of quality of life. Thus, it is relevant to identify modifiable factors that might be related to these fibromyalgia-specific (which pertains to the disease impact) and general (which pertains to the quality of life) health outcomes.

Compelling evidence supports the efficacy of physical exercise interventions in the management of fibromyalgia (4). However, although the benefits of physical exercise interventions in fibromyalgia are endorsed (4), literature regarding guidelines for physical activity (PA) generally do not answer the question of whether low-,

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SIGNIFICANCE & INNOVATIONS

- In women with fibromyalgia, the substitution of 30 minutes of sedentary behavior with physical activity of any intensity was positively associated with different dimensions of quality of life and disease impact.
- The substitution of sedentary time with light physical activity was positively associated with more dimensions of quality of life and impact of fibromyalgia, while moderate-to-vigorous physical activity was related to stronger theoretical changes in the outcomes.

moderate-, or high-intensity physical exercise should be recommended. Moreover, patient acceptability, treatment adherence, premature termination and, most importantly, high dropout rates are serious concerns for exercise-based interventions in fibromyalgia (5). Moderate or even low-intensity physical exercise programs may be more appropriate to achieve long-term results in this group versus high-intensity programs, because individuals with fibromyalgia are so easily sensitized to pain and other symptoms (6). Greater insight into the relationship between PA levels and patient-reported outcome measures may indicate the potential usefulness of stimulating low- and moderate-to-vigorous intensity PA levels.

Whereas most effect studies in rheumatic diseases pertain to systematic physical exercise interventions in specific groups, the most frequent intervention is probably education and advice about daily PA given during a consultation or accessed through a brochure or via the internet (7). A positive relationship between total self-reported PA and quality of life in fibromyalgia has been described (8,9). Lifestyle interventions (10,11) and observational studies (12–14) have described the positive influence of light PA (LPA) in the physical function domain of quality of life (10,11) and on fibromyalgia symptoms (10,12–14). Furthermore, an increase of moderate-to-vigorous PA (MVPA) has been shown to promote better physical function and well-being (15), and greater levels of vigorous PA have been associated with less pain, fatigue, and overall impact of the disease (14). Despite these benefits, a high percentage of patients do not achieve the recommended 150 minutes of MVPA per week (16,17) and tend to be highly sedentary (16). While the relationship between PA and symptoms or physical domains of quality of life has been largely addressed in prior research (10–15), evidence is scarce in regard to the potential influence of a reduction of sedentary time (ST), which might be a more attainable goal for some patients. In order to gain insight into the benefits of pursuing this goal, it is necessary to examine how a decrease in ST, through an increase of time in different intensity levels of PA, is specifically related to quality of life and disease impact in fibromyalgia.

ST has been shown to exert a deleterious effect on health in the general population (18). In fibromyalgia, ST has been associated with worse pain regulation (12), overall pain, fatigue, and disease impact (14). Although the inverse relationship between ST and quality of life has been described in other conditions (19,20), the precise association between these 2 factors in fibromyalgia is unknown. Therefore, it would be relevant to determine the benefits of substituting ST with PA. Given that total daily time is finite (24 hours), a decrease of time in 1 specific behavior requires an increase of time in another. The isotemporal substitution model (21) allows study of the effect of time substitution while controlling for the confounding effect of other activities. Therefore, given that ST, LPA, and MVPA have been shown to be associated with fibromyalgia symptoms (12–15), it is possible to determine how replacing time spent in one specific behavior (e.g., ST) with an equal amount of time in another behavior (e.g., LPA) might be related to different health outcomes in individuals with fibromyalgia. Prior applications of isotemporal substitution models on replacement of ST with an equal amount of PA of different intensities have demonstrated positive effects on quality of life and health outcomes in adults (22–25) and the elderly (19,26,27). These findings, however, do not necessarily generalize to patients with fibromyalgia. Therefore, the aim of this study was to analyze how substitution of ST with LPA or MVPA was associated with quality of life and disease impact in women with fibromyalgia.

PATIENTS AND METHODS

Patients from southern Spain (Andalusia) were recruited through fibromyalgia associations via email, letter, and social media. After providing detailed information about the aims and study procedures, participants (n = 646) signed an informed consent. Inclusion criteria for the current study comprised a previous diagnosis by a rheumatologist and meeting the 1990 American College of Rheumatology (ACR) fibromyalgia criteria (28). Participants were excluded if they had either acute or terminal illness, severe cognitive impairment, or were age >65 years (to avoid the influence of other prevalent conditions, such as osteoarthritis). The study was approved by the ethics committee of the Hospital Universitario Virgen de las Nieves.

The assessment protocol was carried out on 2 alternate days. On day 1, a diagnosis of fibromyalgia according to ACR criteria (28) (widespread pain for >3 months and pain with ≤4 kg/cm^2 of pressure reported for 11 or more of 18 tender points) was confirmed. Body composition was also evaluated, and participants filled out self-reported sociodemographic and clinical data questionnaires. The Short Form 36 (SF-36) health survey and the Revised Fibromyalgia Impact Questionnaire (FIQR) were given to patients (along with other questionnaires) to be completed at home. On day 2, questionnaires were collected and checked by the researcher team. Subsequently, accelerometers were pro-

vided and participants received instructions on how to complete sleep diaries.

Quality of life. The SF-36 was used to assess the quality of life. This questionnaire has been validated in Spanish populations (29) and has demonstrated good reliability among patients with chronic pain (30). The SF-36 is composed of 36 items that assess 8 dimensions of health (i.e., physical functioning, physical role, bodily pain, general health, social functioning, emotional role, mental health, and vitality) and 2 component summary scores (i.e., physical and mental health). The score in each dimension is standardized and ranges from 0 (worst health status) to 100 (best health status).

Impact of the disease. The FIQR (31) is a disease-specific tool to assess overall fibromyalgia severity through a wide range of symptoms, and comorbidities, related to this chronic condition. It is a self-administered questionnaire with 21 individual questions (rated on a scale of 0–10), divided into 3 linked sets of domains: function, overall impact, and symptoms severity. The FIQR total score ranges from 0 to 100, with a higher score indicating greater impact of the syndrome on an individual's life.

Physical activity intensity levels and sedentary time. Each patient wore a triaxial accelerometer GT3X+ (Actigraph) around the hip (secured with an elastic belt) for nine 24-hour days, except for during water-based activities. Using the default mode filter option, data were collected at a rate of 30 Hz and at epochs of 60 seconds (32). Given that patients received the accelerometer at different times throughout day 1 and because time is needed to eliminate any reactivity to the awareness of being monitored, we excluded this familiarization day from the analysis. The last day (day of device return) was also excluded from the analysis. A total of 7 continuous days with a minimum of 10 valid hours/day were required to be included in the analysis. Data download, reduction, cleaning, and analyses were conducted using the manufacturer software (ActiLife desktop, version 6.11.7).

Accelerometer wear time was calculated by subtracting sleeping time and nonwear periods. Sleeping time was obtained from the sleep diaries, in which patients indicated the time they went to bed and the time that they woke up. According to the Choi algorithm (33), nonwear periods were considered to be any bouts of 90 continuous minutes (30 minutes small-window length and 2 minutes skip tolerance) of 0 counts. Light, moderate, and vigorous PA intensity levels were calculated based upon recommended PA vector magnitude cut points (32,34); 200–2,689, 2,690–6,166, and ≥6,167 counts per minute, respectively. ST was estimated as the time accumulated below 200 cpm during periods of wear time (33). Participants presented extremely low values of vigorous PA (0.4 minutes/day); therefore, vigorous PA was excluded from all of the analyses and MVPA was used instead. A 10-minute activity bout was defined as 10 or more consecutive minutes of ≥2,690 cpm (up to 2 minutes below the cut point allowance). The proportion of women meeting the current PA recommendations for adults ages 18–64 years (at least 150 minutes/week of MVPA accumulated in bouts ≥10 minutes) (17) was also calculated. All values were initially expressed in minutes/day but were converted to units of 30 minutes (1 represents 30 minutes) for better interpretation of the results. To complete this conversion, minutes/day spent in ST, LPA, MVPA, and total wear time were divided by 30.

Other variables. *Tenderness*. Following the 1990 ACR criteria for classification of fibromyalgia (28), we assessed 18 tender points using a standard pressure algometer (FPK 20; Wagner Instruments). We obtained the mean pressure of 2 measurements at each tender point. A tender point was considered as positive when the patient felt pain at pressure ≤4 kg/cm^2. The total number of positive tender points was recorded for each patient.

Sociodemographic and clinical data. We collected sociodemographic and clinical data by using a self-reported questionnaire, including date of birth, marital status (married/not married), education level (university/non-university), and occupational status (working/not working). Furthermore, patients reported the use of antidepressants (yes/no) during the previous 2 weeks. Additionally, to assess an exclusion criterion, participants were asked, "Are you currently diagnosed with an acute or terminal illness?"

Anthropometry and body composition. Weight (kg) and total body fat percentage were assessed using a portable eight-polar tactile-electrode bioelectrical impedance device (InBody R20; Biospace). The validity and reliability of this instrument has been reported elsewhere (35,36). As recommended by the manufacturer, participants were requested not to shower, practice intense PA, or ingest large amounts of fluid and/or food 2 hours before measurement. Patients were also asked not to wear either clothing (except for underwear) or metal objects during the measurement.

Statistical analyses. Descriptive statistics were used to examine the sociodemographic and clinical characteristics of the sample. Multiple linear regression models were used for isotemporal substitution models in order to examine how substituting ST with LPA and MVPA was associated with quality of life and impact of the disease in women with fibromyalgia. The description and rationale behind these analyses have previously been described in detail (21). Briefly, in this model, the finite nature of time was considered so that performing 1 activity results in displacing the time spent in another behavior. These regression models included the total time (sum of ST, LPA, and MVPA, which is the total accelerometer wear time variable) and all of the individual activities (e.g., LPA and MVPA) except for the activity of interest (e.g., ST) as independent variables. The coefficient from the regression analysis for each of the included variables is an estimation of the mean effect

on the outcome of substituting a fixed amount of time (e.g., 30 minutes) of the omitted activity with the same amount of each of the included activities (while holding time spent in other activities constant). For instance, an isotemporal substitution model can be expressed as follows: SF-36 scores = (β_1) LPA + (β_2) MVPA + (β_3) total time + (β_4) covariates.

Because ST is omitted from the model, β_1 expresses the change in quality of life (SF-36 scores of each dimension), which resulted from reallocation of 30 minutes of ST to LPA. The β_2 coefficient would provide the same information in relation to MVPA. Pearson's correlation coefficients were used to check for the association of potential confounders (age, marital status, education level, working status, fat percentage, antidepressant use) with quality of life and impact of the disease. As a result of significant associations ($P < 0.05$) with most of the outcomes, the confounders of age, current occupational status, fat percentage, and use of antidepressants were entered in all models.

Normal probability plots of the standardized residual and scatterplots of residuals were generated to test for normality, linearity, and homoscedasticity. Non-autocorrelation assumption was also met using the Durbin-Watson test ($1.5<d<2.5$ for all regression models). No multicollinearity problems among the predictor variables of the model were found (all variance inflation factor statistics <10.0). All analyses were performed using the Statistical Package for Social Sciences, version 20.0, and variables were significant at $P < 0.05$.

RESULTS

The flow chart of the participants included in this study is shown in Figure 1. The final sample size included in the analyses comprised 407 women with fibromyalgia. Table 1 provides an overview of the patients' sociodemographic and clinical characteristics according to the achievement of the PA recommendations (at least 150 minutes a week, per week of MVPA, in bouts of ≥10 minutes) (17).

In the isotemporal substitution models for the SF-36 scores (Table 2), replacing 30 minutes of sedentary behavior with 30 minutes of LPA was associated with better bodily pain ($B = 0.55$ [95% confidence interval (95% CI) 0.03, 1.07]), vitality ($B = 0.74$ [95% CI 0.09, 1.39]), and social functioning ($B = 1.45$ [95% CI 0.61, 2.30]), all $P < 0.05$. Replacement of 30 minutes of sedentary behavior with 30 minutes of MVPA was associated with better physical role ($B = 2.30$ [95% CI 0.2, 4.38]) and social functioning ($B = 4.11$ [95% CI 1.78, 6.44]), all $P < 0.05$.

When the FIQR was modeled as the outcome variable (Table 3), replacing 30 minutes of ST with the same amount of LPA was associated with better functioning ($B = –0.32$ [95% CI –0.55, –0.09]), overall impact ($B = –0.27$ [95% CI –0.45, –0.08]), symptoms ($B = –0.37$ [95% CI –0.63, –0.11]), and total impact of the disease ($B = –0.95$ [95% CI –1.52, –0.38), all $P < 0.01$.

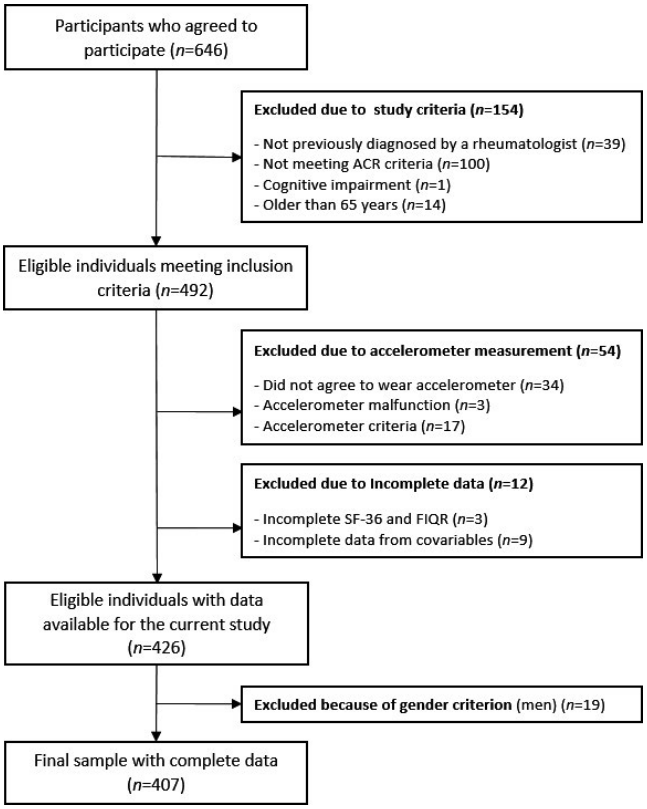

Figure 1. Flow diagram of inclusion of women with fibromyalgia from the al-Ándalus project included in the present study (n = 407). ACR = American College of Rheumatology; FIQR = Revised Fibromyalgia Impact Questionnaire; SF-36 = Short-Form 36 health survey.

Substituting 30 minutes of ST with 30 minutes of MVPA was only associated with better functioning ($B = –0.73$ [95% CI –1.37, –0.09]), $P = 0.025$.

DISCUSSION

Our study demonstrated that the substitution of 30 minutes of ST with LPA yielded better scores in the bodily pain, vitality, and the social functioning domains of the SF-36 and in all domains of the FIQR (function, symptoms, overall impact, and total impact). When this amount of ST was conferred instead to MVPA, patients presented better physical role and social functioning according to the SF-36 and better scores in the function domain of the FIQR. Our results complement previous research (8,9) by estimation of how varying the distribution of ST, LPA, and MVPA throughout the waking hours is related to patient quality of life and impact of the disease.

Overall, the results of the isotemporal substitution models allocation of ST to LPA showed smaller estimated effects, but in more dimensions (B rating from 0.55 to 1.4 in 7 dimensions) of quality of life and impact of the disease in comparison to those models

Table 1. Clinical and sociodemographic characteristics of women with fibromyalgia by achievement of PA recommendations*

	Total (n = 407)	Not meeting PA recommendations (n = 321)	Meeting PA recommendations (n = 86)
Age, years	51.4 ± 7.6	51.7 ± 7.6	50.3 ± 7.5
Married, no. (%)	311 (76.4)	250 (77.9)	61 (70.9)
College, no. (%)	58 (14.3)	46 (14.3)	12 (14.0)
Currently working, no. (%)	107 (26.3)	78 (24.3)	29 (33.7)
Total tender points (11–18)	16.7 ± 2.0	16.8 ± 1.9	16.5 ± 2.2
Algometer score (18–144)	43.2 ± 13.4	42.8 ± 13.3	45.0 ± 14.0
Total body fat percentage	40.1 ± 7.6	40.6 ± 7.7	38.3 ± 6.8
Antidepressant use, no. (%)	232 (57.0)	198 (61.7)	34 (39.5)
Disease impact, FIQR (0–100)			
Function	17.2 ± 6.4	17.9 ± 6.2	14.6 ± 6.7
Overall impact	12.5 ± 5.4	12.9 ± 5.2	11.1 ± 6.0
Symptoms	34.7 ± 7.6	35.5 ± 7.5	31.8 ± 7.5
Total score	64.4 ± 16.7	66.3 ± 16.0	57.5 ± 17.7
Health-related quality of life, SF-36 (0–100)			
Physical function	39.2 ± 18.9	37.9 ± 18.7	44.2 ± 18.8
Physical role	33.2 ± 21.2	31.8 ± 21.2	38.7 ± 20.2
Bodily pain	21.2 ± 14.7	19.8 ± 14.2	26.3 ± 15.5
General health	28.5 ± 15.3	27.9 ± 14.9	30.9 ± 16.6
Vitality	22.3 ± 17.7	21.3 ± 17.1	26.2 ± 19.3
Social functioning	43.7 ± 24.7	41.5 ± 24.2	51.7 ± 24.6
Emotional role	56.9 ± 27.9	55.8 ± 28.8	61.1 ± 24.2
Mental health	46.2 ± 19.7	45.0 ± 19.6	50.8 ± 19.5
Physical component	29.5 ± 6.9	29.1 ± 6.9	31.2 ± 6.7
Mental component	36.0 ± 11.6	35.3 ± 11.7	38.5 ± 11.3
PA and sedentary time (min/day)			
Accelerometer wear time	923.0 ± 78.9	921.2 ± 83.0	930.0 ± 61.3
Sedentary time	460.1 ± 104.1	473.3 ± 104.7	410.8 ± 86.1
Light PA	418.6 ± 91.8	414.2 ± 96.9	435.2 ± 67.2
Moderate PA	43.9 ± 29.5	33.5 ± 19.9	82.6 ± 27.6
MVPA	44.3 ± 30.1	33.7 ± 20.0	84.0 ± 28.1

* Values are the mean ± SD unless indicated otherwise. Physical activity (PA) recommendation = accumulation of ≥150 minutes of moderate-to-vigorous PA (MVPA)/week, in bouts of ≥10 minutes. FIQR = Revised Fibromyalgia Impact Questionnaire; SF-36 = Short Form 36 health survey.

allocating ST to MVPA (*B* rating from 0.73 to 4.1 in 3 dimensions). Although MVPA is recommended for health benefits (17), the intensity of PA that best correlates with quality of life in fibromyalgia is still unknown and presents mixed results in other populations. Replacement of ST with MVPA showed greater benefits for quality of life in adults (22), whereas increasing LPA might be more effective in the elderly (19,26), except for physical domains that were associated with higher intensities. The results of our study are more similar to those in the elderly population, probably due to similarities observed when demonstrating a reduced fitness level (37).

LPA is of special relevance among individuals with reduced physical capacity (17) or inactive individuals (38), given that low intensity levels of PA are shown to be stimuli that elicit improvements in health (17,38). In fibromyalgia, small increases in LPA have been associated with improvement of key symptoms (10). Because women with fibromyalgia are highly sedentary (16), it is plausible that in this group, PA at one of the adequate intensities (in order to achieve benefits) falls below the recommendations of moderate-to-vigorous intensity for the general population (17). Increases in daily MVPA might, however, also be of interest for patients with fibromyalgia because of its association with a lower physical disease impact, as shown in the current and in a previous study (15). Therefore, a graded sustainable and thus, feasible strategy to achieve health benefits in this condition might be

Table 2. Coefficients for the isotemporal substitution analyses examining the association of reallocating 30 minutes/day of sedentary time to LPA or MVPA with quality of life (n = 407)*

	LPA			MVPA		
	B	95% CI	*P*	*B*	95 % CI	*P*
SF-36 dimension						
Physical function	0.64	−0.06, 1.34	0.074	1.77	−0.16, 3.70	0.072
Physical role	0.47	−0.29, 1.22	0.227	2.30†	0.21, 4.38†	0.031†
Bodily pain	0.55†	0.03, 1.07†	0.040†	0.85	−0.59, 2.29	0.247
General health	0.08	−0.48, 0.65	0.768	0.15	−1.41, 1.70	0.853
Vitality	0.74†	0.09, 1.39†	0.026†	1.69	−0.10, 3.48	0.064
Social functioning	1.45†	0.61, 2.30†	0.001†	4.11†	1.78, 6.44†	0.001†
Emotional role	0.70	−0.28, 1.69	0.160	0.65	−2.07, 3.36	0.640
Mental health	0.08	−0.63, 0.78	0.829	0.88	−1.06, 2.82	0.374
Physical component	0.19	−0.06, 0.45	0.138	0.61	−0.10, 1.32	0.093
Mental component	0.31	−0.09, 0.72	0.129	0.73	−0.38, 1.85	0.197

* Isotemporal substitution model included all activity variables (light physical activity [LPA], moderate-to-vigorous physical activity [MVPA]), total wear time, and covariates [age, current occupational status, fat percentage, and antidepressant use]). Coefficients of 1 represent reallocation of 30 minutes/day. Sedentary time was reallocated to either LPA or MVPA. *B* = nonstandardized regression coefficient; 95% CI = 95% confidence interval; SF-36 = Short-Form 36 health survey.
† Significant values.

to first replace inactivity with LPA and to eventually increase PA to moderate intensity levels.

Increases of time in MVPA were positively related to the physical role domain of the SF-36 and in the function domain of the FIQR. In fact, this affinity is consistent with the closeness between these domains of both questionnaires (2). Similar to the results of our study, a previous study (15) showed improvements in the function domain of the FIQR after an intervention aimed at increasing MVPA among patients with fibromyalgia. The physical role in the SF-36 includes limitations in the kind and amount of work due to physical problems. Physical barriers to continue working, such as physical capacity and symptoms (39), have been associated with MVPA (15,17), which is in agreement with the results of the current study. Patients who increase their level of PA might also be more confident and present greater self-efficacy to engage in movement-related tasks of daily living that require physical effort (40) and perceive less limitations in functional status (8). Therefore, promotion of PA of moderate-to-vigorous intensity as an ultimate goal seems to be a safe strategy (15) of special interest for benefits in the physical domains of quality of life in women with fibromyalgia.

In the present study, when ST was substituted with LPA, better reported bodily pain, vitality, and lower impact of symptoms were observed. The results of our study are consistent with previous interventions where increasing steps per day resulted in better reported pain interference (11) and intensity (10). Moreover, low levels of PA have been previously linked to better brain responses in pain modulation regions of patients with fibromyalgia (13). The chronic widespread pain in fibromyalgia may be due to or modulated by an altered processing of nociceptive signals in the central nervous system, known as central sensitization (41). The pain relief promotion mechanisms of PA are thought to act on central pain facilitation (reduced *N*-methyl-D-aspartate receptor phosphorylation [41,42]) and endogenous inhibitory systems (reduced serotonin

Table 3. Coefficients for the isotemporal substitution analyses examining the association of reallocating 30 minutes/day of sedentary time to LPA and MVPA with impact of the disease (n = 407)*

	LPA			MVPA		
FIQR domain†	*B*	95 % CI	*P*	*B*	95% CI	*P*
Function	−0.32†	−0.55, −0.09†	0.008†	−0.73†	−1.37, −0.09†	0.025†
Overall impact	−0.27†	−0.45, −0.08†	0.006†	−0.26	−0.77, 0.26	0.331
Symptoms	−0.37†	−0.63, 0.11†	0.006†	−0.18	−0.90, 0.54	0.619
Total impact	−0.95†	−1.52, 0.38†	0.001†	−1.17	−2.74, 0.40	0.143

* Isotemporal substitution model included all activity variables (light physical activity [LPA], moderate-to-vigorous physical activity [MVPA]), total wear time and covariates [age, current occupational status, fat percentage, and antidepressant use]). Coefficients of 1 represent reallocation of 30 minutes/day. Sedentary time was reallocated to either LPA or MVPA. *B* = nonstandardized regression coefficient; 95% CI = 95% confidence interval; SF-36 = Short-Form 36 health survey; FIQR = Revised Fibromyalgia Impact Questionnaire.
† Significant values.

transporter expression, increased serotonin levels, and increased opioids in pathways, including different brain areas [12,13] such as the periaqueductal grey and rostral ventromedial medulla [42,43]). Although the amount of PA needed to elicit pain modulatory mechanisms is not clear, maintenance of even a low level of PA and/or avoidance of periods of sustained ST have been related to modulation of the central nervous system in fibromyalgia (12).

Fatigue, which is strongly linked to pain and its mechanisms (44), also has a great impact on quality of life (44). In agreement with our results in the vitality domain of the SF-36, the level of fatigue has been related to LPA in fibromyalgia (14) and other pain conditions such as arthritis (45). However, a lifestyle intervention increasing self-selected LPA, unlike the findings of our study, did not produce changes in the fatigue severity of patients with fibromyalgia (12). The heterogeneity in tools to assess the multiple facets of fatigue (44) and the use of different accelerometers and thresholds to categorize PA may be representative of the impediments to making direct comparisons to prior studies. Previous research in healthy women has also stressed the importance of meeting the recommended level of MVPA and reduction of prolonged sedentary behavior for a better energy and fatigue profile (46). In the present study, we also observed a borderline association between increasing MVPA and vitality, but our analyses only showed a significant estimated association derived from reallocation of ST to LPA. Accordingly, it has been observed that greater improvements in fatigue observed with moderate-intensity exercise in a healthy population may not extend to sedentary people with persistent fatigue (47), who can benefit from low-intensity activities (47). The central nervous system appears to also be involved in the relationship between PA and fatigue (48). More specifically, PA might perhaps have a positive influence on fatigue in fibromyalgia through changes in insulin-like growth factor 1 and resistin levels (48), yet further research is needed on this topic.

The estimated benefits of LPA in all domains of the FIQR are also in line with previous PA interventions, where a change from sedentary to low active habits reduced the total disease impact of patients with fibromyalgia (10). The magnitude of the effect, 10.2 points reduction in the total score in the previous study (10) versus 0.95 points reduction in the total score in the present study, differed notably from our estimations. Several underlying methodological issues that might account for these differences include that the FIQ (previous version of the FIQR) presents different weighting among domains, with more importance given to symptoms instead of function as opposed to the FIQR (2); the lifestyle intervention not only aimed to increase PA but also coping and adherence strategies; and there are differences in study designs. In light of these findings, strategies for health promotion among these patients might also target the replacement of sedentary behaviors with activities of light intensity, which are also the most likely activities in which patients would be expected to engage (13).

The greatest estimated benefits were detected in the social functioning domain of the SF-36 as a result of substituting ST with LPA or MVPA. Similar to the results of our study, a study by Suorsa et al (49) showed lower social contact in the most sedentary fibromyalgia patients. This group of patients usually present social isolation concerns (50) and a high prevalence of loneliness (51) that might be negatively influenced by the decreased communication that sedentary behaviors entail (52). Conversely, it is likely that the practice of PA provides opportunities for social interactions, especially during accessible activities that are shared experiences such as walking, which may support our findings. Nonetheless, further intervention designs are needed to ascertain the nature of this relationship.

Strengths of our study included a relatively large sample size of women with fibromyalgia represented from southern Spain (Andalusia) and the use of accelerometers to objectively assess PA instead of self-reported measures (53). In addition, we used general (SF-36) and disease-specific (FIQR) instruments, providing a more comprehensive view of the actual reported health status of these patients (54). Furthermore, the robustness of our analyses was also enhanced by considering a reasonable number of potential confounders.

Limitations included the cross-sectional study design; thus, the associations found in a between-subjects analysis cannot be explained via a causal pathway as a within-subject mechanism. Indeed, previous research has shown how quality of life can discriminate different levels of PA (8). Therefore, some of the relationships found work in both directions. Additionally, due to the large quantity of factors related to quality of life and the impact of the disease, it is difficult to ascertain the true association between the variables. Given that only women took part in this study, future studies should investigate whether these associations also occur in men.

In conclusion, this study showed preliminary evidence that replacement of 30 minutes of ST with PA of either light or moderate-to-vigorous intensity was positively associated with different domains of quality of life and impact of the disease in fibromyalgia. When ST was substituted with LPA, better bodily pain, social function, vitality, and disease impact were observed. When ST was substituted with MVPA, we detected better scores in physical role, social functioning, and function. These results may seem to be a simple message to communicate in clinical practice; however, longitudinal and intervention studies on actual behavioral reallocation effects are needed to further confirm our findings.

AUTHOR CONTRIBUTIONS

All authors were involved in drafting the article or revising it critically for important intellectual content, and all authors approved the final version to be submitted for publication. Ms Gavilán-Carrera had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

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