Differences in Sedentary Time and Physical Activity Between Female Patients With Fibromyalgia and Healthy Controls

The al-Andalus Project

Víctor Segura-Jiménez,1 Inmaculada C. Álvarez-Gallardo,1 Fernando Estévez-López,2 Alberto Soriano-Maldonado,1 Manuel Delgado-Fernández,1 Francisco B. Ortega,1 Virginia A. Aparicio,3 Ana Carbonell-Baeza,4 Jorge Mota,5 Pedro Silva,5 and Jonatan R. Ruiz1

Objective. To characterize the levels of objectively measured time spent in sedentary activities (sedentary time) and physical activities in female patients with fibromyalgia and compare them with the levels in age-matched healthy control women.

Methods. The study comprised 413 female patients with fibromyalgia (mean ± SD age 51.9 ± 7.4 years) and 188 female control subjects (age 50.9 ± 7.5 years). Sedentary time, the amount of time spent engaged in physical activity, and step counts were measured using triaxial accelerometry. The amounts of time (minutes/day) during which the participants were engaged in sedentary behaviors as well as in physical activity of different intensities (light, moderate, and moderate-to-vigorous) and the step counts were calculated.

Results. The amount of time spent in sedentary behavior was longer in patients with fibromyalgia compared with controls (estimated mean ± SEM difference 39 ± 8 minutes/day; P < 0.001). The patients with fibromyalgia spent less time than controls engaged in light physical activity (mean ± SEM difference −21 ± 7 minutes/day; P = 0.005), moderate physical activity (mean ± SEM difference −17 ± 3 minutes/day; P < 0.001), and moderate-to-vigorous physical activity (mean ± SEM difference −19 ± 3 minutes/day; P < 0.001). The patients with fibromyalgia took fewer steps/day compared with the control subjects (mean ± SEM difference −1,881 ± 262 steps/day; P < 0.001). Only 20.6% of the patients with fibromyalgia and 46.3% of the control subjects fulfilled the recommendation for 150 minutes/week of moderate-to-vigorous physical activity in bouts of at least 10 minutes/bout (χ² = 41.8, P < 0.001). Similarly, only 16.0% of the patients fulfilled the recommendation for ≥10,000 steps/day compared with 44.7% of the control subjects (χ² = 56.8, P < 0.001). Both the patients and the control subjects were more active (physical activity of all intensities and numbers of steps) on weekdays than on weekend days (all P ≤ 0.001).

Conclusion. Female patients with fibromyalgia spent more time in sedentary behaviors and were less physically active than age-matched controls. The low proportions of female patients with fibromyalgia and control subjects who met the physical activity and step count recommendations is worrisome.
Fibromyalgia is a complex multidimensional disorder, with pain as the main symptom (1–3) along with other important physical and psychological non-pain symptoms (2–5). These symptoms restrict most activities of daily living and have a major impact on the quality of life of individuals with fibromyalgia (2).

Different types of exercise interventions have shown beneficial effects on several physical (e.g., pain, tenderness, functionality) and psychological (e.g., anxiety, depression, mood) factors in patients with fibromyalgia (6,7). Despite the benefits of these interventions, the fear of pain seems to limit voluntary physical activity in this population (8,9). As a result, patients with fibromyalgia tend to reduce their daily activity levels (10) and to refrain from any type of physical activity (11) because of their belief that physical activity will aggravate their symptoms. Nonetheless, such behavior significantly worsens their overall symptoms (12,13) and physical function. Available evidence suggests physical activity can improve the quality of life of patients with fibromyalgia (13). Similarly, sedentary behaviors are associated with a greater risk incident of fibromyalgia in the general population (14) and with impaired pain regulation in patients with fibromyalgia (12).

Traditionally, the methods commonly used worldwide to assess physical activity and sedentary behaviors have been self-report instruments (15). However, using questionnaires for this purpose can provide misleading information in the general population (15,16) as well as in the population of patients with fibromyalgia (17,18). Alternatively, accelerometry is one method that has become of broader interest in the research community; it is a simple, valid, and reliable technique to objectively measure sedentary time and physical activity in free-living conditions (activities performed in the home or community) (19–21).

Until recently, little attention has been paid to the objective quantification of sedentary behavior and physical activity in patients with fibromyalgia. In previous case-control studies using accelerometry, the sample sizes were low (n < 40) (10,22,23), which limits generalization of the results. We previously reported the levels of objectively measured time spent in sedentary activity (sedentary time) and physical activity in a sample of 94 female patients with fibromyalgia from Granada (southeast Spain), although an age-matched control group of women without fibromyalgia was not available, and sampling was performed in only one city (24). Given the potential benefits of physical activity for better management of fibromyalgia, it is important to thoroughly quantify and characterize the levels of sedentary behavior and physical activity in a relatively large and representative sample of patients and compare these patients with age-matched individuals without fibromyalgia (healthy control subjects). Based on the fear-avoidance theory (8,9), and given that patients with fibromyalgia usually present with deconditioned physical function and performance (6,13), we hypothesized that female patients with fibromyalgia would spend more time in sedentary behaviors and would be less physically active compared with healthy control subjects. Therefore, the goal of this study was to characterize the levels of objectively measured sedentary time and physical activity in female patients with fibromyalgia and compare them with those in age-matched healthy control women.

PATIENTS AND METHODS

Participants. To obtain a representative sample of patients with fibromyalgia from the Andalusian population, we calculated the sample size needed (n = 300) (2). Next, we planned a sex- and province-proportional recruitment strategy (2). Patients with fibromyalgia who were interested in participating in the study were recruited via fibromyalgia associations, e-mail, and social media (radio, internet, newspaper). We asked our fibromyalgia patients to solicit their apparently healthy acquaintances of similar age and sociodemographic characteristics to take part in the study as controls. In addition, we used e-mail and internet advertisements to recruit control subjects. Written informed consent was obtained from all participants (n = 960).

A total of 877 participants (595 patients with fibromyalgia and 282 control subjects) agreed to wear an accelerometer. Patients were required to have a previous diagnosis of fibromyalgia, as determined by a rheumatologist, and were required to meet the American College of Rheumatology (ACR) 1990 criteria for the classification of fibromyalgia (25), not to have acute or terminal illness, not to have severe cognitive impairment (Mini-Mental State Examination [MMSE] score of <10) (26), and to be between the ages of 35 years and 65 years. Thirty-seven of the patients did not have a previous diagnosis of fibromyalgia, 87 did not fulfill the 1990 ACR criteria, and 1 had severe cognitive impairment. The control subjects were required not to meet the 1990 ACR criteria for a diagnosis of fibromyalgia, not to have either acute or terminal illness, and not to have severe cognitive impairment. Six female control subjects fulfilled the 1990 ACR criteria, and 17 female patients with fibromyalgia and 30 female control subjects did not meet the age criterion. Because only 19 male patients with fibromyalgia and 50 male control subjects had accelerometer data, all men were excluded from the analyses. Thus, the study sample fulfilling criteria comprised 433 female patients with fibromyalgia and 196 female control subjects from southern Spain (Andalusia). The Ethics Committee of the Hospital Virgen de las Nieves (Granada, Spain) reviewed and approved the study.

Procedures. On the first day of the study, the MMSE was administered, and participants provided self-reported sociodemographic data. Tender points were assessed according to the 1990 ACR criteria (25), anthropometry measurements were obtained, and body composition was measured. Subsequently, participants received the accelerometer and were given instructions regarding how to make entries in the
sleep diary. Nine days later, participants returned the accelerometers to the research team.

**Measurements. Demographics.** A self-report questionnaire was used to collect the participants' sociodemographic data, such as age, marital status, education level, and occupational status.

**Screening.** Cognitive function. The MMSE (26) is a brief cognitive screening test that assesses 5 areas of cognitive function (using a 0–30 scale, where higher scores indicate better performance) and was used for exclusion criteria purpose only.

Tenderness. Eighteen tender points were assessed according to the ACR 1990 classification criteria for fibromyalgia (25). A standard-pressure algometer (FPK 20; Wagner Instruments) was used. The entire assessment was performed twice, and the mean of 2 alternative measurements at each tender point was obtained. A tender point was considered positive if the patient noted pain at a pressure of ≥4 kg/cm². The total number of positive tender points was recorded for each patient.

**Outcome measures.** Anthropometry and body composition. Body weight (kg) and the percentage of total body fat were measured with a portable 8-polar tactile electrode impedance meter (InBody R20; Biospace). The measurements were made while the impedance meter was not in contact with the participants’ clothing or metal objects. Following the manufacturer’s recommendations, we instructed the participants not to shower, not to engage in intense physical activity, and not to ingest large amounts of fluid and/or food during the 2 hours before measurements were obtained. The validity and reliability of this instrument have been reported elsewhere (27,28). The percentage total body fat was used to classify obese individuals according to the cutoff points published elsewhere (29), as follows: 39%, 41%, and 43% for white women (30,32) and were expressed as minutes per day. Total physical activity (minutes/day) was calculated as the sum of the times involved in physical activity of light and moderate-to-vigorous intensity. Both sedentary and moderate-to-vigorous physical activity bouts were defined as a period of ≥10 consecutive minutes spent in that behavior. The number of sedentary bouts and moderate-to-vigorous physical activity bouts per day, as well as minutes engaged in sedentary bouts and moderate-to-vigorous physical activity bouts per day were calculated. The number of steps was also recorded with the accelerometer. Sedentary time as well as physical activity variables were calculated for weekdays and weekends. Data download, reduction, cleaning, and analyses were performed using ActiGraph software (ActiLife version 6.11.7).

We determined the amount of time that the participants spent in moderate-to-vigorous physical activity and the proportion of those meeting the physical activity recommendations for adults ages 18–64 years (33), as follows: 1) for important health benefits, ≥150 minutes/week of physical activity of moderate-to-vigorous intensity; 2) for even greater health benefits, ≥300 minutes/week of physical activity of moderate-to-vigorous intensity. However, according to the physical activity guidelines, moderate-to-vigorous physical activity efforts should last for at least 10 minutes per bout in order to obtain health benefits (33). Therefore, we also calculated the proportion of participants meeting the following physical activity recommendations: 1) for important health benefits, ≥150 minutes/week of physical activity of moderate-to-vigorous physical intensity in bouts of at least 10 minutes each time; 2) for even greater health benefits, ≥300 minutes/week of physical activity of moderate-to-vigorous physical intensity. However, according to the physical activity guidelines, moderate-to-vigorous physical activity efforts should last for at least 10 minutes per bout in order to obtain health benefits (33). Therefore, we also calculated the proportion of participants meeting the following physical activity recommendations: 1) for important health benefits, ≥150 minutes/week of physical activity of moderate-to-vigorous physical intensity in bouts of at least 10 minutes each time; 4) for even greater health benefits, ≥300 minutes/week of physical activity of moderate-to-vigorous physical intensity in bouts of at least 10 minutes each time. The percentage of women fulfilling the step count recommendation (≥10,000 steps/day [34,35]) was also calculated.

**Statistical analysis.** Continuous sociodemographic variables were compared using Student’s t-test, and the chi-square test was used to compare categorical variables. The percentages of participants meeting the physical activity and step count recommendations were calculated.

We conducted one-way analysis of variance to determine mean differences in accelerometer wearing time between the patients with fibromyalgia and the control subjects. Because wearing time differences between patients and controls were observed (mean ± SEM difference = 23 ± 4 minutes/day; P < 0.001), accelerometer wearing time was used as a covariate in the other analyses. We used one-way analysis of covariance (ANCOVA) to determine mean differences in accelerometer-related variables between the patients and control subjects. Accelerometer wearing time, education level, occupational status, percentage body fat, and MMSE score were entered as covariates in all models, because these variables differed between the patients and control subjects. Between-group effect sizes were calculated using Cohen’s d coefficient.
To determine differences between weekdays and weekends in accelerometer-related variables, we performed repeated-measures ANCOVA separately for patients with fibromyalgia and control subjects. Accelerometer wearing time was included as a covariate, because we observed differences in accelerometer wearing time between weekdays (Monday through Friday) and weekends (Saturday and Sunday) in both the patients and the control subjects.

To test the differences between patients and control subjects in vector magnitude (cpm), daily sedentary time, physical activity of light, moderate, and moderate-to-vigorous intensities, and step counts every day of the week, we performed one-way ANCOVA with accelerometer wearing time, education level, occupational status, percentage body fat, and MMSE score as covariates. Separate analyses were conducted for each dependent and fixed-factor variable.

The statistical analysis was conducted using SPSS version 20.0 for Windows. Statistical significance was set at an alpha level of 0.05.

RESULTS

Accelerometry data for 4 participants were lost due to a malfunction during downloading of the data, and 24 participants did not meet the accelerometer criteria. The final sample included in the analyses comprised 413 female patients with fibromyalgia and 188 female control subjects (Table 1). At the time of presentation, the patients with fibromyalgia had a higher body weight, BMI, and percentage total body fat as well as lower height compared with controls (mean differences 3.1 kg; 1.8, 3.1%, and −1.6 cm, respectively; all \( P \leq 0.011 \)). Among patients with fibromyalgia, 86.4% had less than a university degree, compared with 77.7% of control subjects (\( P = 0.007 \)). Furthermore, the patients were less likely to be employed (25.7% of patients versus 40.4% of controls; \( P < 0.001 \)). The prevalence of homemakers was similar between the 2 groups (32.4% versus 36.2%; \( P > 0.05 \)).

Patients with fibromyalgia who were categorized as nonobese, those with less than a university degree, and those who were employed were prone to spending less

Table 1. Anthropometric, body composition, and sociodemographic characteristics of the study participants*

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Fibromyalgia patients (n = 413)</th>
<th>Controls (n = 188)</th>
<th>( P )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, mean ± SD years</td>
<td>51.9 ± 7.4</td>
<td>50.9 ± 7.5</td>
<td>0.126</td>
</tr>
<tr>
<td>Weight, mean ± SD kg</td>
<td>71.2 ± 13.9</td>
<td>68.1 ± 12.2</td>
<td>0.011</td>
</tr>
<tr>
<td>Height, mean ± SD cm</td>
<td>157.9 ± 5.9</td>
<td>159.5 ± 6.4</td>
<td>0.002</td>
</tr>
<tr>
<td>BMI, mean ± SD kg/m²</td>
<td>28.6 ± 5.4</td>
<td>26.8 ± 4.4</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Total body fat, mean ± SD %</td>
<td>40.1 ± 7.5</td>
<td>37.0 ± 7.2</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>MMSE, mean ± SD (scale 0–30)</td>
<td>28.4 ± 2.0</td>
<td>28.0 ± 2.1</td>
<td>0.008</td>
</tr>
</tbody>
</table>

Marital status
- Employed 106 (25.7) 76 (40.4) 0.007
- Not married 98 (23.7) 50 (26.7) 0.428
- Married 315 (76.3) 137 (73.3) 0.001
- Homemaker 134 (32.4) 68 (36.2) 0.26 (0.10–0.42)
- Unemployed 173 (41.9) 44 (23.4) 0.007

Education level
- Below university degree 357 (86.4) 146 (77.7) 0.007
- University degree 55 (13.6) 42 (22.3) 0.007

Occupational status
- Employed 106 (25.7) 76 (40.4) <0.001†
- Homemaker 134 (32.4) 68 (36.2) 0.26 (0.10–0.42)
- Unemployed 173 (41.9) 44 (23.4) 0.007

* Except where indicated otherwise, values are the number (%). BMI = body mass index; MMSE = Mini-Mental State Examination.
† Employed versus unemployed.

Table 2. Accelerometry measures in patients with fibromyalgia and control subjects*

<table>
<thead>
<tr>
<th>Physical activity variables</th>
<th>Fibromyalgia patients (n = 404)</th>
<th>Controls (n = 184)</th>
<th>( P )</th>
<th>Effect size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accelerometer wear time, minutes/day</td>
<td>924 (916–931)</td>
<td>947 (936–957)</td>
<td>&lt;0.001</td>
<td>0.32 (0.16–0.48)</td>
</tr>
<tr>
<td>Axis 1, cpm</td>
<td>302 (289–314)</td>
<td>377 (358–395)</td>
<td>&lt;0.001</td>
<td>0.59 (0.43–0.76)</td>
</tr>
<tr>
<td>Axis 2, cpm</td>
<td>327 (315–338)</td>
<td>375 (358–392)</td>
<td>&lt;0.001</td>
<td>0.41 (0.25–0.57)</td>
</tr>
<tr>
<td>Axis 3, cpm</td>
<td>440 (426–453)</td>
<td>509 (488–530)</td>
<td>&lt;0.001</td>
<td>0.49 (0.33–0.66)</td>
</tr>
<tr>
<td>Vector magnitude, cpm</td>
<td>632 (612–651)</td>
<td>743 (714–773)</td>
<td>&lt;0.001</td>
<td>0.56 (0.39–0.72)</td>
</tr>
<tr>
<td>Sedentary time, minutes/day</td>
<td>461 (452–470)</td>
<td>422 (408–435)</td>
<td>&lt;0.001</td>
<td>0.43 (0.26–0.59)</td>
</tr>
<tr>
<td>Sedentary bouts, no./day</td>
<td>12 (12–12)</td>
<td>11 (11–12)</td>
<td>0.018</td>
<td>0.22 (0.05–0.38)</td>
</tr>
<tr>
<td>Sedentary bouts, minutes/day</td>
<td>279 (270–288)</td>
<td>247 (233–260)</td>
<td>&lt;0.001</td>
<td>0.35 (0.18–0.51)</td>
</tr>
<tr>
<td>Time per sedentary bout, minutes</td>
<td>23 (23–24)</td>
<td>22 (21–23)</td>
<td>0.001</td>
<td>0.31 (0.15–0.47)</td>
</tr>
<tr>
<td>Light PA, minutes/day</td>
<td>425 (417–433)</td>
<td>446 (434–457)</td>
<td>0.005</td>
<td>0.26 (0.10–0.42)</td>
</tr>
<tr>
<td>Moderate PA, minutes/day</td>
<td>45 (42–48)</td>
<td>62 (58–67)</td>
<td>&lt;0.001</td>
<td>0.56 (0.40–0.73)</td>
</tr>
<tr>
<td>MVPA, minutes/day</td>
<td>45 (42–48)</td>
<td>64 (59–68)</td>
<td>&lt;0.001</td>
<td>0.59 (0.42–0.75)</td>
</tr>
<tr>
<td>MVPA bouts, no./day</td>
<td>0.8 (0.7–0.9)</td>
<td>1.3 (1.1–1.4)</td>
<td>&lt;0.001</td>
<td>0.48 (0.31–0.64)</td>
</tr>
<tr>
<td>MVPA bouts, minutes/day</td>
<td>13 (11–14)</td>
<td>23 (21–26)</td>
<td>&lt;0.001</td>
<td>0.59 (0.42–0.75)</td>
</tr>
<tr>
<td>Length of MVPA bout, minutes</td>
<td>12 (11–13)</td>
<td>17 (16–19)</td>
<td>&lt;0.001</td>
<td>0.57 (0.40–0.73)</td>
</tr>
<tr>
<td>Total PA, minutes/day</td>
<td>470 (461–479)</td>
<td>509 (496–523)</td>
<td>&lt;0.001</td>
<td>0.43 (0.26–0.59)</td>
</tr>
<tr>
<td>Step count, no./day</td>
<td>7,468 (716–7,748)</td>
<td>9,349 (8,928–9,769)</td>
<td>&lt;0.001</td>
<td>0.65 (0.49–0.82)</td>
</tr>
</tbody>
</table>

* Values are the estimated mean (95% confidence interval). Between-group differences were tested by analysis of covariance. Accelerometer wearing time, education level, occupational status, percentage body fat, and Mini-Mental State Examination score were used as covariates. MVPA = moderate-to-vigorous physical activity.
time in sedentary behaviors and greater time in light physical activity than those who were obese, had a university degree, and were unemployed, respectively (all $P < 0.05$) (for additional information, see Supplementary Table 1, available on the *Arthritis & Rheumatology* web site at http://onlinelibrary.wiley.com/doi/10.1002/art.39252/abstract). Among the patients with fibromyalgia, those who were older, obese, and unemployed were prone to spending less time in moderate-to-vigorous physical activity compared with those who were younger, nonobese, and employed, respectively) (all $P < 0.05$). Among both the patients and control subjects, those who were married had a higher level of light physical activity compared with unmarried women ($P < 0.05$). Among the control subjects, those who were obese, unmarried, and had a university degree spent more time in sedentary behaviors than those who were nonobese, married, and did not have a university degree, respectively (all $P < 0.05$).

Sedentary time was longer in patients compared with controls (estimated mean ± SEM difference 39 ± 8 minutes/day; $P < 0.001$), whereas the patients with fibromyalgia spent less time engaged in light physical activity (mean ± SEM difference 221 ± 7 minutes/day; $P = 0.005$), moderate physical activity (mean ± SEM difference 48 ± 34 minutes/day; $P = 0.001$), and moderate-to-vigorous physical activity (mean ± SEM difference 48 ± 34 minutes/day; $P = 0.001$). Table 3 shows the sedentary time, physical activity levels, and step count during weekdays (Monday through Friday) and weekends (Saturday and Sunday) in female patients with fibromyalgia and control subjects.

### Table 3. Sedentary time, physical activity levels, and step count during weekdays and weekends (Monday through Friday) and weekends (Saturday and Sunday) in female patients with fibromyalgia and control subjects*

<table>
<thead>
<tr>
<th></th>
<th>Fibromyalgia patients (n = 413)</th>
<th>Control subjects (n = 188)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Weekdays</td>
<td>Weekend</td>
</tr>
<tr>
<td>Wearing time, minutes/day</td>
<td>932 (924–940)</td>
<td>903 (894–913)</td>
</tr>
<tr>
<td>Sedentary time, minutes/day</td>
<td>456 (446–466)</td>
<td>470 (459–482)</td>
</tr>
<tr>
<td>Light PA, minutes/day</td>
<td>428 (419–437)</td>
<td>399 (389–409)</td>
</tr>
<tr>
<td>Moderate PA, minutes/day</td>
<td>47</td>
<td>34 (31–36)</td>
</tr>
<tr>
<td>MVPA, minutes/day</td>
<td>48 (44–51)</td>
<td>34 (31–37)</td>
</tr>
<tr>
<td>Total time in PA, minutes/day</td>
<td>475 (465–486)</td>
<td>433 (422–444)</td>
</tr>
<tr>
<td>Step count, no./day</td>
<td>7,809 (7,495–8,123)</td>
<td>6,040 (5,761–6,318)</td>
</tr>
</tbody>
</table>

* Values are the mean (95% confidence interval). Analyses were performed using repeated-measures analysis of covariance. Values were adjusted for the difference between weekdays and weekends in accelerometer wearing time. MVPA = moderate-to-vigorous physical activity.

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**Figure 1.** Percentages of female patients with fibromyalgia and healthy controls achieving the recommended levels of moderate-to-vigorous physical activity (MVPA) and the recommended number of steps per day. The chi-square test was used to determine between-group differences. All differences were significant ($P < 0.001$).
The criterion of moderate-to-vigorous physical activity for ≥150 minutes/week was met by 75.1% of the patients with fibromyalgia compared with 93.6% of the control subjects (Figure 1) \((\chi^2 = 28.8, P < 0.001)\). A total of 42.9% of the patients and 71.3% of the controls engaged in at least 300 minutes/week of moderate-to-vigorous physical activity (mean ± SEM difference 2,181 ± 262 steps/day; \(P < 0.001\)) (Table 2).

The patients with fibromyalgia accumulated fewer steps/day compared with control subjects (mean ± SEM difference −1,881 ± 262 steps/day; \(P < 0.001\)) (Table 2).
vigorouse physical activity ($\chi^2 = 41.8, P < 0.001$). When the criteria took into account the need for bouts of at least 10 minutes/bout of moderate-to-vigorous physical activity, only 20.6% of the patients and 46.3% of the controls met the recommendation for 150 minutes/week of moderate-to-vigorous physical activity ($\chi^2 = 41.8, P < 0.001$). The percentages of patients and controls satisfying the step count recommendation were 16.0% and 44.7%, respectively ($\chi^2 = 56.8, P < 0.001$).

There were differences in the average amount of time spent engaged in sedentary activities and physical activity of all intensities, total physical activity, and step counts between the weekdays and the weekend (all $P \leq 0.001$), with greater activity levels on weekdays in both groups, with the exception of sedentary time in the control group ($P = 0.099$) (Table 3).

Patients with fibromyalgia had lower accelerometer vector magnitude (cpm), spent more time in sedentary behavior, took fewer steps/day, and spent less time engaged in physical activity of light, moderate, and moderate-to-vigorous intensities compared with controls, on every day of the week (Monday through Sunday) (all $P < 0.05$) (Figures 2 and 3).

DISCUSSION

The results of the present study show that the female patients with fibromyalgia were overall more sedentary and less physically active than the control subjects. The patients with fibromyalgia spent, on average, 48% of their waking time engaged in sedentary behaviors (~8 hours/day). Although they spent, on average, ~45 minutes/day in moderate-to-vigorous physical activity, overall, these activities were not continuous for at least 10 minutes. Only 20.6% of the patients met the weekly physical activity recommendations, whereas 46.3% of controls did meet these recommendations. Similarly, only 16.0% of the patients fulfilled the recommendation for ~10,000 steps/day compared with 44.7% of the control group. It is noteworthy that both the patients with fibromyalgia and the control subjects tended to be less physically active during the weekends, with both groups spending ~40 minutes/day or less on total physical activity on Saturday and Sunday compared with weekdays.

To the best of our knowledge, this is the most comprehensive examination of objectively measured sedentary time and physical activity in a relatively large sample of female patients with fibromyalgia and healthy control subjects. Furthermore, this is the first representative population-based study of a large region that covers the entire area of southern Spain (2). Two previous studies showed no clear differences between patients with fibromyalgia and control subjects in the levels of daytime activity, although they demonstrated reduced peak activity levels (22) and general reduced activity levels in fibromyalgia patients with comorbid depression (23). However, these studies had a rather low sample size ($n < 40$), the groups were not matched for age, and the monitors were placed on the wrist (22,23). More recently, McLoughlin et al (10) observed that female patients with fibromyalgia ($n = 26$) were less active than healthy control subjects ($n = 26$), which concurs with our findings. In that study, however, the control subjects were younger and had a higher level of education than the patients with fibromyalgia, which makes an accurate comparison difficult. Moreover, those investigators used a different model of accelerometer, which hampers further comparisons. Nonetheless, it is worth mentioning that the mean difference in accelerometer counts per minute between the patients with fibromyalgia and control subjects in the aforementioned study and the vertical axis in the present study are similar (approximately ~70 cpm, respectively).

Sedentary time has been directly associated with aggravation of pain processing in female patients with fibromyalgia (12). In the current study, the female patients with fibromyalgia spent ~8 hours/day engaged in sedentary activities and more time in sedentary bouts of at least 10 minutes compared with control subjects. In a previous pilot study (24), we showed that female patients with fibromyalgia spent ~10 hours/day in sedentary behaviors. Female patients with fibromyalgia in the current study spent, on average, ~2 hours/day less in sedentary behaviors compared with those in our pilot study (24). These differences might be mainly attributable to the use of different accelerometers and different scoring processes (24).

In the current study, the patients with fibromyalgia spent 48% of their waking time in sedentary activities, compared with, on average, 44% in controls (i.e., controls spent ~40 minutes/day less than patients with fibromyalgia). Strikingly, McLoughlin et al (10) reported no differences between the patients with fibromyalgia and the control subjects. However, because they included sleeping time as sedentary time, it cannot be ascertained whether differences between real sedentary time could be masked by the inclusion of sleeping time as a sedentary behavior (10).

Sedentary time in our control group was lower than that in Portuguese and Canadian women (36,37) and similar to that in American and Swedish women (~8 hours/day) (38,39). Nevertheless, not only sedentary time but also time in sedentary bouts have been
positively associated with cardiovascular disease risk (37,40). Future studies should elucidate whether the number and length (minutes) of sedentary bouts might also lead to worsening of symptoms in patients with fibromyalgia.

We observed that female patients with fibromyalgia spent less time engaged in physical activity of different intensities (and, as a result, in total physical activity) on weekends, which is consistent with a previous study in female patients with fibromyalgia (24). The time spent in physical activity of different intensity levels, however, varied between studies probably due to the use of different accelerometers. Similarly, we observed that female control subjects also tended to decrease their physical activity on weekends, which is consistent with the results of a study in adults ages 50–60 years (41). Therefore, it appears that a common behavior in both female patients with fibromyalgia and controls is to spend less time engaged in physical activity on weekends. Furthermore, the patients in the present study spent a greater amount of time in sedentary behaviors on weekends compared with weekdays. This behavior was similar in the control subjects, although the difference in sedentary behaviors between weekdays and weekend was borderline significant. Health promotion strategies to decrease sedentary time and increase the time spent in physical activity on weekends are warranted.

A total of 75.1% of female patients with fibromyalgia enrolled in the present study engaged in at least 150 minutes/week of moderate-to-vigorous physical activity. This is not consistent with the proportion of female patients with fibromyalgia (60.6%) meeting the physical activity recommendation in our previous study. However, according to the US Department of Health and Human Services guidelines for physical activity (33), moderate-to-vigorous physical activity must be accumulated in bouts of at least 10 minutes in order to compute the total moderate-to-vigorous physical activity minutes/day. The body responds to physical activity in ways that have important positive effects on the musculoskeletal, cardiovascular, respiratory, endocrine, and immune systems. It appears that 10 continuous minutes of moderate-to-vigorous physical activity is the minimum amount required to provide some protection against selected chronic diseases and all-cause mortality (33). When we considered this criterion, only 20.6% of our female patients with fibromyalgia satisfied the physical activity recommendations.

It is noteworthy that the necessity of performing moderate-to-vigorous physical activity in bouts of at least 10 minutes was not considered in our pilot study, and that a uniaxial accelerometer was used (24). In the present study, 46.3% of the control subjects met the physical activity recommendations; this proportion is similar to or even greater than that previously observed in women of the same age in other populations (39,42–44). When the bout restriction was not considered, a high percentage of women enrolled in the present study engaged in at least 150 minutes/week of moderate-to-vigorous physical activity.

The strikingly high levels of moderate-to-vigorous physical activity and, consequently, the elevated proportion of participants meeting the physical activity recommendations in the present study might be attributable to diverse factors, such as 1) compliance in the present study (~15.5 hours of accelerometer wearing time), which is ~3 hours greater than that in previous studies (10,24,38,39,42–44), and 2) use of vector-magnitude cut-points for the triaxial accelerometer has yielded higher estimates of time engaged in moderate-to-vigorous physical activity than vertical axis cut-point for the GT1M accelerometer (45). Future population-based studies using the GT3X+ accelerometer are needed in order to perform appropriate comparisons.

Walking is the most common method of physical activity in the general population, and the number of steps/day has been associated with key fibromyalgia symptoms (46). Step counts are an interesting indicator of total daily ambulatory activity, regardless of the speed at which steps are taken. Although there is not a clear consensus about the number of steps/day recommended to achieve the moderate-to-vigorous physical activity recommendations, a total of ≥10,000 steps/day has been considered a reasonable target for healthy adults (35). Although accelerometers have shown some disagreement (greater estimates) with pedometers in terms of steps/day, the majority of studies have used uniaxial accelerometers (47). In this context, a recent study showed 98.5% agreement between the GT3X+ accelerometer and the Yamax SW-701 pedometer, which is commonly used in free-living settings as a referent monitor for counting steps (48). In the present study, only 16.0% of the fibromyalgia group met the recommendation for ≥10,000 steps/day (34,35), whereas 44.7% of the controls met this recommendation.

To our knowledge, there is only one study in which the patients with fibromyalgia (n = 199, 95.5% female) were primarily sedentary, with an average step count of ~4,019 steps/day (46). This is lower than the estimated mean count of 7,468 steps/day in the fibromyalgia patients in the present study. Differences between the study by Kaleth et al (46) and the current study might be dependent on the accelerometer model (uniaxial versus triaxial), total registered time (daytime only versus 24 hours), and/or the number of days wearing the
monitor (4 days versus 7 days). Unfortunately, the study by Kaleth et al did not include a control group for comparison purposes and, as far as we know, there are no previous reports of the mean steps/day in patients with fibromyalgia.

Physical inactivity is a major problem in the 21st century, and the time spent in sedentary behaviors is progressively increasing in the global population (33). Therefore, we might consider that the female control subjects in the current study were physically inactive, which could be the reason why differences between groups were modest, with an overall small/medium effect size. For instance, the patients with fibromyalgia engaged in 19 fewer minutes/day of moderate-to-vigorous physical activity compared with controls, which may be considered only a slight difference. However, we must consider that this corresponds to a weekly difference of 133 minutes of moderate-to-vigorous physical activity between the patients with fibromyalgia and the control subjects. Furthermore, the patients with fibromyalgia engaged in 70 fewer minutes/week of moderate-to-vigorous physical activity bouts compared with the controls; this might be considered clinically relevant, because bouts of moderate-to-vigorous physical activity have been shown to protect against selected chronic diseases and all-cause mortality (33).

The cross-sectional design of the present study does not allow the establishment of any causal relationships. Male subjects were not included in the current study due to the small sample size, and future studies in this population are warranted. Also, it is well known that accelerometers might underestimate some types of physical activity, such as those involving continuous upper body movement or load-bearing activities and those with minimal vertical displacement (e.g., cycling). Nonetheless, these types of activities are not prevalent among patients with fibromyalgia (49). Furthermore, although participants received instructions to wear the accelerometer on their hips, we do not know whether they adhered to this criterion. It is noteworthy that sedentary time and physical activity estimates derived from accelerometry depend on epoch lengths, axes, and cut points.

We cannot extrapolate cut points for a given epoch length to other epoch lengths. In this context, we chose 60-second epoch and vector magnitude cut points as suggested in previous studies (30,32). Nonetheless, there is a need for international consensus regarding accelerometry data processing procedures in order to allow between-study comparisons. A strength of the present study is the relatively large sample size, which was calculated to achieve representativeness of the Andalusian (southern Spain) population of patients with fibromyalgia (2). We also adhered to strict standardization of the accelerometry methodology by requiring 7 valid days of wearing time, whereas generally 4 days are required. The average accelerometer wearing time was ~15.5 hours/day, which is longer than the recommended 13 hours/day needed to provide a valid measure of daily physical activity (50).

In summary, the present study provides an overview of the amount of time spent in objectively measured sedentary time and physical activity in a relatively large sample of female patients with fibromyalgia and age-matched control subjects. The results of the present study were consistent across all of the accelerometer-related measures and suggest that female patients with fibromyalgia spend more time engaged in sedentary behaviors and less time in physical activity of all intensities compared with age-matched controls. Approximately 16–20% of patients fulfilled the physical activity and step count recommendations, which represents a higher proportion than that observed in international studies in adult populations (~5%). Finally, it is important to encourage not only female patients with fibromyalgia, but also those without fibromyalgia to engage in daily physical activity behaviors, especially during the weekends, because they usually are less physically active during this period compared with weekdays. These data can be used to assess the efficacy of different intervention programs aimed at promoting physical activity in this population.

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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 published. Dr. Segura-Jiménez 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.

Study conception and design. Segura-Jiménez, Ruiz.


Analysis and interpretation of data. Segura-Jiménez, Ortega, Mota, Silva, Ruiz.

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39. Hagstromer M, Troiano RP, Stojstrom M, Bergman D. Levels and patterns of objectively assessed physical activity: a compari-
The patient, a 37-year-old woman, presented with a 10-year history of intermittent buttock discomfort and back stiffness. On physical examination, Patrick’s test produced slight right buttock discomfort, and Schober test yielded a normal result. The C-reactive protein level was normal, and HLA–B27 was positive. Anteroposterior radiography of the lumbar spine showed erosive changes in both sacroiliac joints and thick radiodense lines along the apophyseal joints bilaterally (A) (arrow). The anterior view of a 3-dimensional computed tomography scan showed no definite bridging syndesmophyte (B), but the posterior view revealed total ankylosis of apophyseal joints from the low thoracic to sacral level (C) (arrows). Apophyseal joints of the spine are often affected in ankylosing spondylitis (AS), and it is not uncommon that apophyseal joint ankylosis of the lumbar spine is present without bridging syndesmophytes, as seen in our patient. In one study, apophyseal joint ankylosis of the lumbar spine unaccompanied by bridging syndesmophytes was found in 21% of patients with AS (1). In another, impaired spinal mobility was highly correlated with radiographic changes in apophyseal joints of the lumbar spine in AS (2). Our patient is unique in that spinal mobility was preserved despite the total ankylosis of the apophyseal joints. This is, to our knowledge, the first presentation of the 3-dimensional appearance of ankylosed apophyseal joints in AS.


Yune-Jung Park, MD
Ki-Jo Kim, MD
Kyung-Su Park, MD
Catholic University of Korea College of Medicine
Seoul, Republic of Korea

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Clinical Images: Three-dimensional appearance of apophyseal joint ankylosis