Objectively measured sedentary time and physical activity in women with fibromyalgia

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Objectively measured sedentary time and physical activity in women with fibromyalgia; A cross-sectional study

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ARTICLE SUMMARY

Article focus:

- To characterize the levels of objectively measure (i.e. through accelerometry) sedentary time and physical activity among women with fibromyalgia.
- To provide estimates of the adherence to recommended levels of physical activity assessed by accelerometer (30 minutes of at least moderate intensity physical activity on 5 of 7 days).

Key Messages

- Over 60% of women with fibromyalgia meet the physical activity recommendations, that is, 30 min/day of at least moderate intensity physical activity on 5 or more days a week.
- These women spent on average 71% (approximately 10 hours/day) of their waking time in activities that expend little energy.
- Women with fibromyalgia spent at least on average 10 min less on MVPA and 22 min less on sedentary behaviours during weekends compared with week days.

Strengths and Limitations

- Strict standardization of the fieldwork, and the fact that all women were compliant with the measurements procedures is a strength.
- All women had 7 valid days with at least 10 hours of registered time during waking hours.
- To avoid any kind of immediate reactivity, we removed from the analysis the first day of monitoring.
- The cross-sectional design of our study does not allow however establishing any causal relationships. The sample is of convenience, which includes the known limitations of all non-probability

- The accelerometer underestimates physical activities that involve upper body movement, those with minimal vertical displacement such as cycling, water-based activities such as swimming, and it does not capture well the extra energy cost of load-bearing activities.

ABSTRACT

Objectives: To characterize levels of objectively measured sedentary time and physical activity in women with fibromyalgia.

Design: Cross-sectional study.

Setting: Local Association of Fibromyalgia (Granada, Spain).

Participants: The study comprised 94 women with diagnosed fibromyalgia who did not have other severe somatic or psychiatric disorders, or other diseases that prevent physical loading, able to ambulate and to communicate, and capable and willing to provide informed consent.

Primary outcome measures: Sedentary time and physical activity was measured by accelerometry and was expressed as time spent in sedentary behaviours, average intensity (counts/minute) and amount of time (minutes/day) spent in moderate and in moderate-to vigorous-intensity physical activity (MVPA).

Results: The proportion of women meeting the physical activity recommendations of 30 min/day of at least moderate intensity physical activity on 5 or more days a week was 60.6%. Women spent on average 71% of their waking time (approximately 10 hours/day) in sedentary behaviours. Both sedentary behaviour and physical activity levels were similar across age groups, waist circumference and percentage body fat categories, years since clinical diagnosis, marital status, educational level, occupational status, as well as regardless the severity of the disease (all P>0.1). Time spent at moderate physical activity and MVPA was however lower in those with greater BMI (-6.6 min and -7 min, respectively, per body mass index category increase, <25, 25-30, >30 kg/m^2; P values for trend were 0.056 and 0.051, respectively). Women spent on average 10 min less on MVPA (P<0.001) and 22 min less on sedentary behaviours during weekends compared with week days (P=0.051).

Conclusions: These data provide an objective measure of amount of time spent in sedentary activities and in physical activity in women with fibromyalgia.

Extra data is available by emailing ruizj@ugr.es

INTRODUCTION

Fibromyalgia is a pain regulation-related disorder [1]. Patients usually present an increased sensitivity to painful stimuli (hyperalgesia) and lowered pain threshold (allodynia). Additionally to pain, fibromyalgia symptoms typically include severe fatigue, sleep disturbances, paresthesia of extremities, depression, anxiety, joint stiffness, and memory and cognitive difficulties [1 2]. Fibromyalgia is becoming a common syndrome in Western European countries, and estimates indicate a point prevalence of 2.9% that would translate to approximately 6 million people with fibromyalgia [3].

There is increasing evidence about the potential benefits of regular physical activity on fibromyalgia-related symptoms [4-7], and International organizations supports the use of physical activity-based interventions as a complementary tool in the therapeutic armamentarium against fibromyalgia [8]. Physical inactivity is one of the major public health problems of the 21st century [9], and several longitudinal studies showed the negative consequences for health of a sedentary lifestyle [10 11].

The average amount of daily sedentary time as well as physical activity levels and patterns in women with fibromyalgia is rather unknown, and the available information is mainly based on questionnaire data [12-16]. However, physical activities are difficult to recall, quantify and categorize, and it might be even more complex in people with memory and cognitive difficulties such as fibromyalgia patients [14]. Given the limitations of self-report methods, accelerometry (i.e. movement sensors) has become the method of choice for objectively measuring physical activity in free-living conditions. To have an objective diagnosis of the sedentary time as well as of the physical activity levels and patterns in patients with fibromyalgia is of public health and of clinical interest, and might be informative for developing intervention studies directed to the promotion of physical activity in women with fibromyalgia [17].

The purpose of the present study was to characterize the levels of objectively measure (i.e. through accelerometry) sedentary time and physical activity among women with fibromyalgia, and to provide estimates of the adherence to recommended levels of physical activity assessed by accelerometer (30 minutes of at least moderate intensity physical activity on 5 of 7 days).

MATERIAL AND METHODS

Study participants

We sent a formal invitation to participate in the study to all members of a Local Association of Fibromyalgia (Granada, Spain). A total of 116 patients responded, and gave their written informed consent after receiving detailed information about the aims and study procedures. Participants were included in the study if: (i) they met the diagnosis of fibromyalgia according to the American College of Rheumatology criteria [18], (ii) did not have other severe somatic or psychiatric disorders, or other diseases that prevent physical loading (answer "no" to all questions on the Physical Activity Readiness Questionnaire-PAR-Q [19 20], (iii) were able to ambulate and to communicate, (iv) and were capable and willing to provide informed consent. Men were not included in the study (n=6), and women with incomplete physical activity data (n=5) or technical errors in the instrument (n=11) were excluded. A final sample of 94 women with fibromyalgia participated in the study. Age, weight and height, and fibromyalgia severity (assessed by the fibromyalgia impact questionnaire, FIQ) [21 22] was similar between the included and excluded participants (all P>0.1). The study protocol was reviewed and approved by the Ethics Committee of the Hospital Virgen de las Nieves (Granada, Spain). The STROBE guidelines were followed during the course of the research [23].

Measurements

Women were interviewed in the Association of Fibromyalgia (Granada, Spain). They were asked to wear an accelerometer (Actigraph^{TM} GT1M, Pensacola, FL, USA) for 9 consecutive days starting the same day that they received the monitor. The accelerometer was carried over the whole day (24 hrs) except during water-based activities such as bathing or swimming. Accelerometers were initialized as described by the manufacturer, and data were saved in 5 s epochs. Women wore the device on the lower back, secured with an elastic belt, underneath

clothing, near to the center of gravity. The data were downloaded onto a computer using the manufacturer software. Data reduction, cleaning, and analyses were performed using the MAHUffe program (see www.mrc-epid.cam.ac.uk).

Monitor wearing time was calculated by subtracting the sleeping reported time (recorded through a diary) from the total registered time for the entire day (i.e. 1440 minutes). Bouts of 60 continuous minutes of 0 activity intensity counts were also excluded from the analysis, considering these periods as non-wearing time. A recording of more than 20,000 counts per minute (cpm) was considered as a potential malfunction of the accelerometer and the value was excluded from the analyses. The first day of recording was not included in the analysis, neither did the last one. A total of 7 days of recording with a minimum of 10 or more hours of registration per day was necessary to be included in the study analysis.

Sedentary time was estimated as the amount of time accumulated below 100 cpm during periods of wear time [24]. Time spent being sedentary was expressed as total duration (hours/day). Physical activity levels were estimated as follows: (i) Average physical activity, expressed as mean cpm, is a measure of overall physical activity. We calculated mean counts per minute by dividing the sum of total counts per epoch for a valid day by the number of minutes of wear time in that day across all valid days (n=7). (ii) Time engaged in moderate physical activity. We calculated the time engaged in moderate physical activity based upon a standardized cut-off of 1952-5724 cpm [25 26], where 1952 cpm corresponds to walking at 4 km/hour [26]. (iii) We also calculated the time engaged in at least moderate physical activity, including also vigorous intensity (so called, moderate-vigorous physical activity, MVPA), as the amount of time accumulated ≥1925 cpm. Sedentary time, as well as the study physical activity variables was calculated for week days and weekends. We calculated the proportion of women meeting the physical activity recommendations, that is 30 minutes/day of at least moderate-intensity activity on at least 5 of 7 days [27 28].

Weight and height were measured following standard procedures with a scale (InBody 720, Biospace, Seoul, Korea) and a stadiometer (Seca 22, Hamburg, Germany), respectively, and body mass index (BMI, weight in kg divided by height in m^2) was calculated. Percentage body fat was measured with bioelectrical impedance analysis (InBody R20; Biospace, Gateshead, UK). Waist circumference was measured at the level of the umbilicus (Harpenden anthropometric tape Holtain Ltd). Adiposity exposure groups were based on standard clinical definitions for BMI (normal weight: 18.5-24.9 kg/m^2, overweight: 25.0-29.9 kg/m^2, obese: 30.0 kg/m^2 or higher); percent body fat (normal: <30%; obese: ≥30%); and waist circumference (normal: ≤ 80.0 cm; abdominal obesity: > 80 cm). Only one women had a BMI below 18.5 (18 kg/m^2), and was considered to be as normal weight.

Fibromyalgia severity was assessed with the fibromyalgia impact questionnaire (FIQ) [21 22]. FIQ is composed of ten subscales: physical impairment, overall well being, work missed, job difficulty, pain, fatigue, morning tiredness, stiffness, anxiety and depression. The score of each subscale is standardized from 0 to 10. We summed the score of all items, so that the total score range from 0 to 100, with a higher score indicating greater severity. Women were categorized into two groups based on the FIQ total score following published thresholds as FIQ <70 and FIQ ≥70, which corresponds to having moderate or severe fibromyalgia, respectively [29].

Statistical analysis

All statistical analyses were performed with PASW (Predictive Analytics SoftWare, v. 18.0 SPSS Inc., Chicago, IL, USA), and the level of significance was set at $\alpha = 0.05$. Physical activity and sedentary outcome variables were logarithmically transformed to obtain a normal distribution.

We calculated the estimated means of sedentary time, average physical activity, moderate physical activity and MVPA by age group, body mass index and waist circumference category, years since clinical diagnosis, fibromyalgia severity, marital status, educational level and occupational status with analysis of covariance (ANCOVA) adjusting for registered time. Lineal regression analyses were conducted to examine the association of sedentary time, average physical activity, moderate physical activity and MVPA with age group, body mass index, waist circumference and percentage body fat category, years since clinical diagnosis, fibromyalgia severity, marital status, educational level and occupational status by inserting sedentary time and each physical activity outcome variable in separate models as dependent variable; age group, body mass index, waist circumference and percentage body fat category, years since clinical diagnosis, fibromyalgia severity, marital status, educational level and occupational status as independent variables (inserted as ordinal variables); and registered time as confounder.

Mean differences of average sedentary time, physical activity, moderate physical activity and MVPA on week days (Monday to Friday) and on weekend (Saturday and Sunday) were calculated with ANOVA for repeated measures.

We analysed the association of meeting the physical activity recommendations (at least 30 minutes/day of MVPA on 5 of 7 days a week) with age, body mass index, waist circumference and percentage body fat, years since clinical diagnosis, fibromyalgia severity, marital status, educational level and occupational status using binary logistic regression analysis.

RESULTS

All participants had 7 valid days of registration. Mean registered time during waking time was 842±108 minutes/day (~14±1.8 hours). Sedentary time and physical activity intensity levels were similar across age groups, waist circumference and percentage body fat categories, years since clinical diagnosis, fibromyalgia severity, marital status, educational level and occupational status (all P>0.1, Table 1). Moderate physical activity and MVPA were lower in women with greater BMI (-6.6 min and -7 min, respectively, per BMI category increase; P values for trend were 0.056 and 0.051, respectively). Mean estimates of sedentary time and physical activity intensity levels were similar in women with FIQ <70 compared with those with FIQ ≥70 (all P>0.1, Table 1), and the findings persisted when other FIQ threshold (>59 vs. ≥59) was used [30] (data not shown).

The proportion of women meeting the physical activity recommendations by age group, BMI, waist circumference and percentage body fat categories, years since clinical diagnosis, fibromyalgia severity, marital status, educational level and occupational status are shown in Table 2. The proportion of women meeting the physical activity recommendations were 60.6% (n=57, 95%CI: 55.9-65.3%). The OR of meeting the physical activity recommendations tend to be lower in the older group (OR: 0.542, 95%CI: 0.231-1.237, P=0.160), in those with a high waist circumference (OR: 0.556, 95%CI: 0.235-1.312, P=0.180), and in those diagnosed more than 5 years ago (OR: 0.485, 95%CI: 0.206-1.142, P=0.098) (Table 3). The OR of meeting the physical activity recommendations was higher in non-overweight (BMI <25kg/m^2) and in the overweight (BMI=25-30kg/m^2) group compared with the obese peers (OR: 2.046, 95%CI: 0.698-5.997, P=0.192; OR: 2.252, 95%CI: 0.794-6.385, P=0.127) (Table 4). Unemployed women had also higher OR of meeting the recommendations (OR: 2.545, 95%CI: 0.902-7.187, P=0.078). The OR of meeting the physical activity recommendations were lower in women with FIQ ≥70 (OR: 0.690, 95%CI:

0.294-1.620, P=0.395). The findings persisted when another suggested FIQ threshold (>59 vs. ≥59) was used [30] (data not shown). Women spent on average 71% of their waking time (approximately 10 hours/day) in sedentary behaviours.

Sedentary time and physical activity levels during week time (Monday to Friday) and during weekend time (Saturday and Sunday) in women with fibromyalgia are shown in table 4. Mean levels of physical activity were lower during weekend compared with those registered during week days (mean difference: 24 cpm, 95%CI: 7.8-40.2, P=0.004). Likewise, registered time at moderate physical activity and at MVPA was lower during weekend days (mean difference: 10.5 min/day, 95%CI: 5.5-15.5, P<0.001; and 10.6 min/day, 95%CI: 5.5-15.6, P<0.001), respectively). Registered sedentary time was also lower during weekends (mean difference: 22.6 min/day, 95%CI: 0-45.3, P=0.051). Figure 1 shows the sedentary time and physical activity mean time by week and weekend days.

The results did not change when the analyses were adjusted for registered time, or when all variables were entered together in the model (data not shown).

DISCUSSION

The main purpose of the present study was to characterize sedentary time and physical activity in women with diagnosed fibromyalgia, as well as to describe the adherence to recommended levels of physical activity assessed by accelerometer. Over half of the women (60.6%) met the physical activity recommendations (30 min/day of at least moderate intensity physical activity on 5 or more days a week). These women spent on average 71% (approximately 10 hours/day) of their waking time in sedentary behaviours, that is, in activities that expend little energy. We observed that both sedentary behaviour times and physical activity levels were similar across the study demographic factors as well as regardless the severity of the disease. Physical activity (i.e. moderate and MVPA) was however lower in those with greater BMI. Women spent at least on average 10 min less on MVPA and 22 min less on sedentary behaviours during weekends compared with week days.

To our knowledge, this is the first comparable objective quantification of sedentary time and physical activity in women with fibromyalgia. Despite the number of participants in the present study is relatively small, to date, this is the largest series described in adults. We do not know whether these findings apply to men, therefore, future studies should quantify both sedentary time and physical activity in this group of patients. We [31] and others [32] observed gender differences in patients with fibromyalgia, therefore studies focused on examining gender differences on sedentary time and physical activity will provide further insights on whether preventive and interventions strategies should be gender-specific. Modifiable lifestyle factors, such as physical activity, may have a great potential as a public health instrument to prevent and contribute to the treatment of fibromyalgia. Longitudinal studies are also needed to further understand the predictive value of sedentary behaviours and physical activity over the course of the disease, and whether preventive strategies should start already at the early stages of the disease development. To have an objective estimate of the

patient's sedentary behaviour as well as the engagement in physical activity could be used as a potential tool to increase the effectiveness of treatment approaches to reduce disability and enhance quality of life in people with fibromyalgia. Indeed, Fontaine et al. [33] observed that accumulating 30 minutes of lifestyle physical activity throughout the day produces clinically relevant changes in perceived physical function and pain in previously minimally active adults with fibromyalgia.

The present study showed that 60.6% percent of women met the recommendation to accumulate 30 or more min/day of physical activity of at least moderate intensity on most days of the week. The variation in meeting the recommendations was not associated with the study demographic factors, and despite the prevalence of meeting the recommendations tend to be lower in the older group, in the overweight group and in those with a higher waist circumference, in those diagnosed with fibromyalgia more than 5 years ago, and in the retired group, the associations were not statistically significant. Time spent at moderate physical activity and MVPA was however lower in those with greater BMI (-6.6 min and -7 min, respectively, per BMI category increase, <25, 25-30, >30 kg/m^2), which concur with studies in healthy adults [25]. This may have important health implications since obese female fibromyalgia patients seem to have higher levels of pain, anxiety and depression and worse quality of life, as well as lower functional capacity than their normal-weight peers [34].

Despite several attempts have been made to objectively quantify sedentary behaviours and physical activity levels and patterns [12 13 35-38], to our knowledge, there are no previous studies showing the prevalence of meeting the physical activity recommendations in women with fibromyalgia, which hamper between study comparisons. Mcloughlin et al. [13] measured physical activity with accelerometry in 26 female fibromyalgia patients aged 42.7±12 years, yet they did not show the prevalence of meeting the recommendations. They showed however that time spent at moderate intensity using the same intensity threshold as used in the present

study [26] was 15±8 minutes/day which is on average ~35 min lower (taking the 51-75 years age group as a reference) than the time observed in the present study. Kaleth et al. [12] also measured physical activity with accelerometry in 30 fibromyalgia patients (27 women), but unfortunately, they showed no physical activity estimates. Kashikar-Zuck et al. [38] measured physical activity with accelerometry in a juvenile primary fibromyalgia syndrome group of adolescents and showed that only 23% achieved 30 minutes/day of at least moderate intensity physical activity, and that only 1 patient achieved the recommended levels of physical activity for their age, that is 60 minutes/day of at least moderate intensity physical activity [27 28]. Data coming from apparently healthy women showed lower rates of meeting the recommendation than those observed in the present study. Hagströmer et al. [25] reported that 48% of a representative sample of Swedish women accumulated 30 minutes/day of MVPA, whereas Troiano et al. [39] showed that less than 5% of a representative sample of women from U.S (2003–2004 National Health and Nutritional Examination Survey) met the physical activity recommendations. Both cultural and methodological procedures followed to measure physical activity may partially explain these differences.

Sedentary behaviours refer to those activities that do not increase resting energy expenditure substantially, that is, no more than 1.5 times resting energy expenditure [40]. These activities involved sitting, reclining and lying down such as watching television, studying, reading, etc. In the present study we observed that women spend on average 10 hours/day (~71%) of their waking time in sedentary activities. Mcloughlin et al. [13] also measured sedentary time with accelerometry, yet data are not comparable with our study because they included sleeping time as a sedentary activity, despite they described that women removed the accelerometer when they planned to sleep. They reported that women with fibromyalgia spend 1154±59 minutes/day at sedentary behaviours, which together with the registered time in other physical activity intensities summed ~1440 min, which is a full day. We observed no

association of sedentary time with any of the study demographic factors. Similarly, women with a higher severity of the disease (FIQ≥70) showed similar sedentary patterns as those with a FIQ<70, which concur with other studies [13].

In the present study, women with fibromyalgia spend less time (~10 minutes/day) on at least moderate intensity physical activity and on sedentary time (~22 minutes/day) during weekends compared with week days. These findings are in agreement with others studies [41]. The observed physical activity reduction during weekends could be partially explained by a reduced transport-related physical activity when commuting to or from work, whereas the reduction of sedentary time could be due to a reduced work-related sitting time. More studies quantifying and characterizing physical activity and sedentary patterns during weekends and week days are needed.

The present study has several limitations. The cross-sectional design of our study does not allow establishing any causal relationships. The sample is of convenience, which includes the known limitations of all non-probability samples, including less representativeness and unknown levels of sampling error. Further studies involving randomly recruited, consecutive patients with fibromyalgia are needed. It should be mentioned that the accelerometer underestimates physical activities that involve upper body movement, those with minimal vertical displacement such as cycling, water-based activities such as swimming, and it does not capture well the extra energy cost of load-bearing activities. However, walking is the most prevalent leisure-time physical activity among women with fibromyalgia [15], and we believe is the type of activity they do at work and for transportation. We do not present data on vigorous physical activity because the time at this intensity range from 0 to 2 min, as it can be observed in table 1 (subtract moderate intensity to MVPA). On average, ~98% of the time spend at MVPA is moderate intensity physical activity. This is consistent with our clinical knowledge of this population, and concur with data from apparently healthy women from Sweden [25].

These low levels of vigorous physical activity could also reflect that the cut point for this intensity was too high, thereby missing many minutes of activity in our population that should have been classified as vigorous physical activity. We have no data on an age-matched group of healthy women, so that direct comparison cannot be made. Mcloughlin et al. [13] observed that female fibromyalgia patients (n=26) were less active than a group of healthy women (n=26), yet the healthy group was younger and had higher level of education than the patients group. One of the advantages of the present study was however the strict standardization of the fieldwork, and the fact that all women were compliant with the measurements procedures. All women had 7 valid days with at least 10 hours of registered time during waking hours. Indeed, the mean daily accelerometer wear time was 14±1.8 hours/day. We do not know whether women modified their habitual sedentary behavior or physical activity during the days they were monitored despite they were advised to keep on with their normal life. To avoid any kind of immediate reactivity, we removed from the analysis the first day of monitoring.

In summary, these data provide an objective measure of amount of time spent in sedentary activities and in physical activity in women with fibromyalgia. These estimates can be used for comparisons with other rheumatologic diseases, as baseline reference levels for monitoring, and to assess the effectiveness of intervention strategies promoting physical activity in women with fibromyalgia.

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Competing Interests

None

Author contributions

JRR: Conception and design of the study, data collection, statistical analysis and interpretation of data, drafting the article

VS: Data collection, interpretation of data, and revising the article critically for important intellectual content

FOP: Conception and design of the study, interpretation of data, and revising the article critically for important intellectual content

IAG: Data collection, interpretation of data, and revising the article critically for important intellectual content

DCM: Data collection, interpretation of data, and revising the article critically for important intellectual content

VAA: Conception and design of the study, data collection, interpretation of data, and revising the article critically for important intellectual content

ACB: Conception and design of the study, data collection, interpretation of data, and revising the article critically for important intellectual content

PF: Statistical analysis, interpretation of data, and revising the article critically for important intellectual content

DMI: Interpretation of data, and revising the article critically for important intellectual content

MDF: Conception and design of the study, data collection, interpretation of data, and revising the article critically for important intellectual content

Data Sharing

Extra data is available by emailing ruizj@ugr.es

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Table 1. Physical activity levels in women with fibromyalgia, by age group, body mass index, waist circumference and percentage body fat category, years since clinical diagnosis, fibromyalgia impact, marital status, educational level and occupational status[a].

		Sedentary (hours/day)			Average PA (counts/minutes)			Moderate PA (min/day)			MVPA (min/day)		
	N	Mean	95% CI		Mean	95% CI		Mean	95% CI		Mean	95% CI	
Age groups (years)													
18-50	41	10.0	9.6	10.5	222	196	248	51	43	59	52	44	60
51-75	52	9.9	9.5	10.3	219	195	242	50	43	58	52	44	59
P value			0.65			0.86			0.96			0.98	
Body mass index[b] category (kg/m^2)													
< 25	29	10.3	9.7	10.8	229	199	260	56	47	65	58	48	67
25-30	34	9.5	9.0	10.0	235	207	263	53	44	61	54	45	63
> 30	27	10.1	9.6	10.7	195	162	227	42	32	52	43	33	54
P for trend			0.63			0.14			0.056			0.051	
Waist circumference category (cm)													
≤80	44	10.2	9.7	10.6	233	208	257	54	47	62	56	48	64
>80	46	9.7	9.3	10.2	209	185	234	47	39	54	48	40	56
P value			0.157			0.187			0.155			0.139	
Body fat (%)													
< 30	13	10.6	9.8	11.4	210	164	256	48	34	63	50	35	65
≥ 30	76	9.8	9.5	10.2	223	204	242	51	45	57	52	46	58
P value			0.93			0.605			0.709			0.774	
Years since clinical diagnosis													
≤ 5 years	47	9.9	9.5	10.3	224	200	248	53	46	61	54	47	62
> 5 years	45	9.8	9.3	10.2	219	194	244	49	41	56	50	43	58
P value			0.650			0.765			0.420			0.489	
Fibromyalgia severity (score)[c]													
< 70	42	9.9	9.4	10.3	226	200	251	51	43	60	53	45	61
≥ 70	50	10.0	9.6	10.5	215	191	238	49	42	57	50	43	58
P value			0.632			0.546			0.725			0.636	
Marital status													

Married	72	9.9	9.6	10.3	217	198	237	50	43	56	51	44 57
Unmarried	22	10.0	9.4	10.7	229	194	264	54	43	65	56	44 67
P value			0.710			0.564			0.510			0.436
Educational level												
Below university degree	71	9.9	9.6	10.3	222	203	242	51	45	57	53	46 59
University degree	22	10.2	9.5	10.8	218	182	253	50	39	61	51	40 63
P value			0.519			0.814			0.791			0.830
Occupational status												
Working	29	9.8	9.3	10.3	222	196	247	51	43	59	52	44 60
Unemployed	41	10.1	9.6	10.7	236	205	266	55	45	64	57	47 66
Retired	24	10.0	9.3	10.6	197	163	232	45	34	56	46	35 57
P for trend			0.619			0.107			0.187			0.159

Abbreviations: CI, confidence interval; PA, physical activity; MVPA, moderate- to vigorous-intensity physical activity.

[a] Estimates and P values were adjusted for registered time.

[b] Weight (kg)/height $(m)^2$.

[c] Assessed with the Fibromyalgia Impact Questionnaire.

Analyses were conducted with physical activity and sedentary outcome variables logarithmically transformed to obtain a normal distribution, yet crude values are presented in the table for easier interpretation.

Table 2. Prevalence of meeting the physical activity recommendations (30 min/day of at least moderate intensity physical activity) on at least 5 days a week.

	N	%	95%CI		Frequency
Age groups (years)					
18-50	41	68.3	51.9%	81.9%	28
51-75	52	53.8	39.5%	67.8%	28
Body mass index category (kg/m^2)					
< 25	29	65.5	45.7%	82.1%	19
25-30	34	67.6	49.5%	82.6%	23
> 30	27	48.1	28.7%	68.1%	13
Waist circumference category (cm)					
≤80	44	68.2	52.4%	81.4%	30
>80	46	54.3	39.0%	69.1%	25
Body fat (%)					
< 30	13	61.5	31.6%	86.1%	8
≥ 30	76	61.8	50.0%	72.8%	47
Years since clinical diagnosis					
≤ 5 years	47	70.2	55.1%	82.7%	33
> 5 years	45	53.3	37.9%	68.3%	24
Fibromyalgia severity					
< 70	42	66.7	50.5%	80.4%	28
≥ 70	50	58	43.2%	71.8%	29
Marital status					
Married	72	61.1	48.9%	72.4%	44
Unmarried	22	59.1	36.4%	79.3%	13
Educational level					
Below university degree	71	62.0	49.7%	73.2%	44
University degree	22	59.1	0.0%	0.0%	13
Occupational status					
Working	29	62.1	42.3%	79.3%	18
Unemployed	41	68.3	51.9%	81.9%	28
Retired	24	45.8	25.6%	67.2%	11
All	94	60.6	52.5%	73.2%	57

Abbreviations: CI, confidence interval.

[a] Assessed with the Fibromyalgia Impact Questionnaire.

Table 3. Odds ratio (OR) and 95% confidence interval (CI) of meeting the physical activity recommendations (30 min/day of at least moderate intensity, 5 of 7 days) by age group, body mass index, waist circumference and percentage body fat category, years since clinical diagnosis, marital status, educational level and occupational status.

	OR	95% CI		P value
Age groups (years)				
18-50	Ref.			
51-75	0.542	0.231	1.273	0.160
Body mass index category (kg/m^2)				
> 30	Ref.			
25-30	2.252	0.794	6.385	0.127
< 25	2.046	0.698	5.997	0.192
Waist circumference category (cm)				
≤80	Ref.			
>80	0.556	0.235	1.312	0.180
Body fat category (%)				
< 30	Ref.			
≥ 30	0.987	0.297	3.309	0.983
Years since clinical diagnosis				
≤ 5 years	Ref.			
> 5 years	0.485	0.206	1.142	0.098
Fibromyalgia severity (score)*				
< 70	Ref.			
≥ 70	0.690	0.294	1.620	0.395
Marital status				
Married	Ref.			
Unmarried	0.919	0.347	2.432	0.865
Educational level				
Below university degree	Ref.			
University degree	0.886	0.334	2.351	0.809
Occupational status				
Retired	Ref.			
Unemployed	2.545	0.902	7.187	0.078
Working	1.934	0.645	5.803	0.239

Abbreviations: Ref., Reference group.

[a] Assessed with the Fibromyalgia Impact Questionnaire.

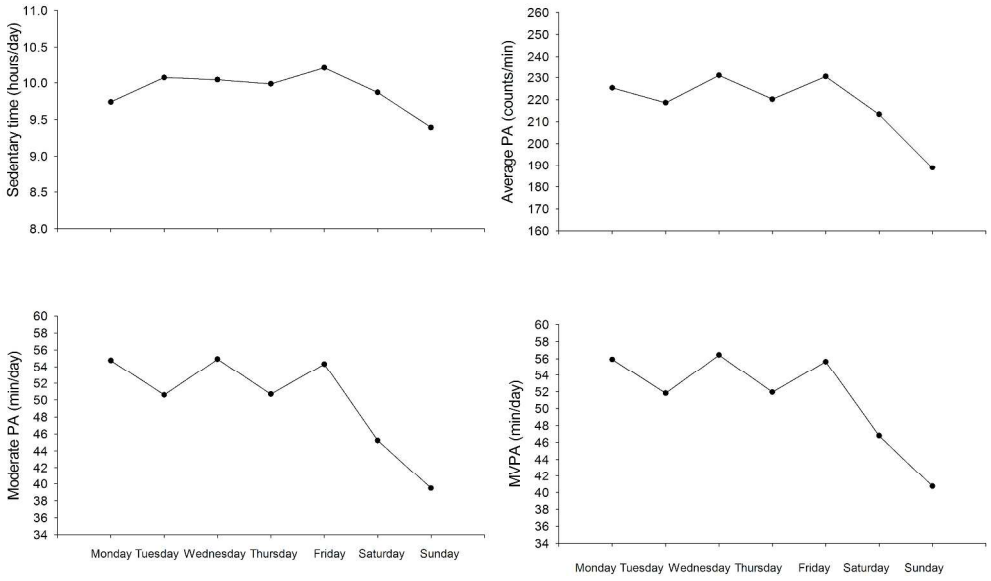
Table 4. Sedentary time and physical activity levels during week time (Monday to Friday) and during weekend time (Saturday and Sunday) in women with fibromyalgia.

	Week		Weekend		Difference			
	mean	sd	mean	sd	mean	95% CI		P value
Sedentary (hours/day)	10.0	2.2	9.6	2.5	0.4	0.0	0.8	0.051
Average PA (counts/min)	225.1	88.5	201.0	98.0	24.0	7.8	40.2	0.004
Moderate PA (min/day)	53.1	28.4	42.6	28.0	10.5	5.5	15.5	<0.001
MVPA (min/day)	54.3	29.1	43.8	29.7	10.6	5.5	15.6	<0.001

Abbreviations: CI, confidence interval; PA, physical activity; MVPA, moderate- to vigorous-intensity physical activity; sd, Standard deviation. Analyses were conducted with physical activity and sedentary outcome variables logarithmically transformed to obtain a normal distribution, yet crude values are presented in the table for easier interpretation.

Figure legend

Figure 1. Sedentary time and physical activity (PA) mean time by week and weekend days.



739x452mm (150 x 150 DPI)

STROBE 2007 (v4) checklist of items to be included in reports of observational studies in epidemiology*

Checklist for cohort, case-control, and cross-sectional studies (combined)

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3
Objectives	3	State specific objectives, including any pre-specified hypotheses	4
Methods			
Study design	4	Present key elements of study design early in the paper	6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6
Participants	6	(*a*) *Cohort study*—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up *Case-control study*—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls *Cross-sectional study*—Give the eligibility criteria, and the sources and methods of selection of participants	6
		(*b*) *Cohort study*—For matched studies, give matching criteria and number of exposed and unexposed *Case-control study*—For matched studies, give matching criteria and the number of controls per case	6
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6-9
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	*6-9*
Bias	9	Describe any efforts to address potential sources of bias	6
Study size	10	Explain how the study size was arrived at	6
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	9
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	9
		(*b*) Describe any methods used to examine subgroups and interactions	9
		(*c*) Explain how missing data were addressed	9
		(*d*) *Cohort study*—If applicable, explain how loss to follow-up was addressed *Case-control study*—If applicable, explain how matching of cases and controls was addressed	9

		Cross-sectional study—If applicable, describe analytical methods taking account of sampling strategy	
		(*e*) Describe any sensitivity analyses	9
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	10-11
		(b) Give reasons for non-participation at each stage	
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	10-11
		(b) Indicate number of participants with missing data for each variable of interest	
		(c) *Cohort study*—Summarise follow-up time (eg, average and total amount)	
Outcome data	15*	*Cohort study*—Report numbers of outcome events or summary measures over time	10-11
		Case-control study—Report numbers in each exposure category, or summary measures of exposure	
		Cross-sectional study—Report numbers of outcome events or summary measures	
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	
		(*b*) Report category boundaries when continuous variables were categorized	
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	
Discussion			
Key results	18	Summarise key results with reference to study objectives	12
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	15-16
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	15-16
Generalisability	21	Discuss the generalisability (external validity) of the study results	15-16
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	17

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

Objectively measured sedentary time and physical activity in women with fibromyalgia

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Objectively measured sedentary time and physical activity in women with fibromyalgia; A cross-sectional study

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ARTICLE SUMMARY

Article focus:

- To characterize the levels of objectively measured sedentary time and physical activity (using accelerometry) in women with fibromyalgia.
- To provide estimates of the adherence to recommended levels of physical activity assessed by accelerometry (30 minutes of moderate-to-vigorous-intensity physical activity on 5 of 7 days).

Key Messages

- Over 60% of women with fibromyalgia meet the physical activity recommendations, that is, 30 min/day of moderate-to-vigorous-intensity physical activity on 5 or more days a week.
- These women spent about 71% (approximately 10 hours/day) of their waking time in activities that expend little energy.
- Women with fibromyalgia spent on average 10 min less of moderate-to-vigorous-intensity physical activity and 22 min less of sedentary behaviours during weekends compared with weekdays.

Strengths and Limitations

- Strict standardization of the methodology used to measure physical activity and the fact that all women were compliant with the measurements procedures is a strength.
- All women had 7 valid days with at least 10 hours of registered time during waking hours.
- To avoid any kind of immediate reactivity, we removed from the analysis the first day of monitoring.

- The cross-sectional design of our study does not allow however establishing any causal relationships. The sample is of convenience, which includes the known limitations of all non-probability samples.
- The accelerometer underestimates physical activities that involve upper body movement, those with minimal vertical displacement such as cycling, water-based activities such as swimming. Moreover, it does not capture well the extra energy cost of load-bearing activities such as walking while carrying a backpack.

ABSTRACT

Objectives: To characterize levels of objectively measured sedentary time and physical activity in women with fibromyalgia.

Design: Cross-sectional study.

Setting: Local Association of Fibromyalgia (Granada, Spain).

Participants: The study comprised 94 women with diagnosed fibromyalgia who did not have other severe somatic or psychiatric disorders, or other diseases that prevent physical loading, able to ambulate and to communicate, and capable and willing to provide informed consent.

Primary outcome measures: Sedentary time and physical activity was measured by accelerometry and was expressed as time spent in sedentary behaviours, total physical activity (counts/minute) and amount of time (minutes/day) spent in moderate-intensity and in moderate-to vigorous-intensity physical activity (MVPA).

Results: The proportion of women meeting the physical activity recommendations of 30 min/day of MVPA on 5 or more days a week was 60.6%. Women spent on average 71% of their waking time (approximately 10 hours/day) in sedentary behaviours. Both sedentary behaviour and physical activity levels were similar across age groups, waist circumference and percentage body fat categories, years since clinical diagnosis, marital status, educational level, occupational status, as well as regardless the severity of the disease (all P>0.1). Time spent at moderate-intensity physical activity and MVPA was however lower in those with greater BMI (-6.6 min and -7 min respectively, per BMI category increase, <25, 25-30, >30 kg/m^2; P values for trend were 0.056 and 0.051 respectively). Women spent on average 10 min less on MVPA (P<0.001) and 22 min less on sedentary behaviours during weekends compared with weekdays (P=0.051).

Conclusions: These data provide an objective measure of the amount of time spent in sedentary activities and in physical activity in women with fibromyalgia.

Extra data is available by emailing ruizj@ugr.es

INTRODUCTION

Fibromyalgia is a pain regulation-related disorder [1]. Patients usually present an increased sensitivity to painful stimuli (hyperalgesia) and lowered pain threshold (allodynia). In addition to pain, fibromyalgia symptoms typically include severe fatigue, sleep disturbances, paresthesia of extremities, depression, anxiety, joint stiffness, and memory and cognitive difficulties [1 2]. Fibromyalgia is becoming a common syndrome in Western European countries, and estimates indicate a point prevalence of 2.9% which translates to approximately 6 million people with fibromyalgia [3].

There is increasing evidence about the potential benefits of regular physical activity on fibromyalgia-related symptoms [4-7], and International organizations supports the use of physical activity-based interventions as a complementary tool in the therapeutic armamentarium against fibromyalgia [8]. Physical inactivity is one of the major public health problems of the 21st century [9], and several longitudinal studies showed the negative consequences for health of a sedentary lifestyle [10 11].

The average amount of daily sedentary time as well as physical activity in women with fibromyalgia is rather unknown, and the available information is mainly questionnaire-based [12-16]. However, physical activities are difficult to recall, quantify and categorize [17], and it might be even more complex in people with memory and cognitive difficulties such as fibromyalgia patients [14]. Given the limitations of self-report methods, accelerometry (i.e. movement sensors) has become the method of choice for objectively measuring physical activity in free-living conditions [18]. To have an objective diagnosis of the sedentary time as well as of the physical activity levels in patients with fibromyalgia is of public health and of clinical interest, and might be informative for developing intervention studies directed to the promotion of physical activity in women with fibromyalgia [19].

The purpose of the present study was to characterize the levels of objectively measured (using accelerometry) sedentary time and physical activity among women with fibromyalgia, and to provide estimates of the adherence to recommended levels of physical activity [30 minutes of moderate-to-vigorous-intensity physical activity (MVPA) on 5 of 7 days] [20 21].

MATERIAL AND METHODS

Study participants

We sent a formal invitation to participate in the study to all members (n=400) of a Local Association of Fibromyalgia (Granada, Spain). A total of 116 patients responded (response rate 29%), and gave their written informed consent after receiving detailed information about the aims and study procedures. Participants were included in the study if: (i) they met the diagnosis of fibromyalgia according to the American College of Rheumatology criteria [22] (widespread pain for more than 3 months, and pain with 4 kg/cm^2 of pressure reported for 11 or more of 18 tender points), (ii) did not have other severe somatic or psychiatric disorders, or other diseases that prevent physical loading (answer "no" to all questions on the Physical Activity Readiness Questionnaire-PAR-Q [23] [24], (iii) were able to ambulate and to communicate, (iv) and were capable and willing to provide informed consent. Men were not included in the study (n=6), and women with incomplete physical activity data (n=5) or technical errors in the instrument (n=11) were excluded. A final sample of 94 women with fibromyalgia participated in the study. Age, weight and height, and fibromyalgia severity (assessed by the fibromyalgia impact questionnaire, FIQ) [25] [26] was similar between the included and excluded participants (all P>0.1). The study protocol was reviewed and approved by the Ethics Committee of the Hospital Virgen de las Nieves (Granada, Spain). The STROBE guidelines were followed during the course of the research [27].

Measurements

Women were interviewed in the Association of Fibromyalgia (Granada, Spain). They were asked to wear an accelerometer (Actigraph^{TM} GT1M, Pensacola, FL, USA) for 9 consecutive days starting the same day they received the monitor. The accelerometer was carried over the whole day (24 hrs) except during water-based activities such as bathing or swimming.

Accelerometers were initialized as described by the manufacturer, and data were recorded in 5 seconds epochs. Women wore the device on the lower back, secured with an elastic belt, underneath clothing, near to the center of gravity. The data were downloaded onto a computer using the manufacturer software. Data reduction, cleaning and analyses were performed using the MAHUffe program (see http://www.mrc-epid.cam.ac.uk/Research/Programmes/Programme_5/InDepth/Programme%205_Downloads.html).

Monitor wearing time was calculated by subtracting the sleeping reported time (recorded through a diary) from the total registered time for the entire day (i.e. 1440 minutes). Bouts of 60 continuous minutes of 0 activity intensity counts were also excluded from the analysis, considering these periods as non-wearing time [28]. There was no allowance for any minute with counts between 0-100 in the non-wear periods. A recording of more than 20,000 counts per minute (cpm) was considered as a potential malfunction of the accelerometer and the value was excluded from the analyses [28 29]. The first and last days of recording were not included in the analysis. A total of 7 days (full week) of recording with a minimum of 10 or more hours of registration per day was necessary to be included in the study analysis.

Sedentary time was estimated as the amount of time accumulated below 100 cpm during periods of wear time [30]. Time spent being sedentary was expressed as total duration (hours/day). Physical activity levels were estimated as follows: (i) Total physical activity was expressed as mean cpm, and is a measure of overall physical activity. We calculated mean cpm as the sum of total counts per day divided by the number of minutes of wear time in that day; finally calculating the average of all valid days (n=7). (ii) Time engaged in moderate physical activity. We calculated the time engaged in moderate-intensity physical activity based upon a standardized cut-off of 1952-5724 cpm [29 31], where 1952 cpm corresponds to walking at 4 km/hour [31]. (iii) We also calculated the time engaged in MVPA as the amount of

time accumulated ≥1952 cpm. Sedentary time, as well as the study physical activity variables was calculated for weekdays and weekends. We calculated the proportion of women meeting the physical activity recommendations, that is 30 minutes/day of MVPA at least 5 of 7 days [20] [21].

Weight and height were measured following standard procedures with a scale (InBody 720, Biospace, Seoul, Korea) and a stadiometer (Seca 22, Hamburg, Germany) respectively, and body mass index (BMI, weight in kg divided by height in m^2) was calculated. Percentage body fat was measured with bioelectrical impedance analysis (InBody R20; Biospace, Gateshead, UK). Waist circumference was measured at the level of the umbilicus with an anthropometric un-elastic tape (Harpenden anthropometric tape Holtain Ltd). Weight status groups were based on standard clinical definitions for BMI (normal weight: 18.5-24.9 kg/m^2, overweight: 25.0-29.9 kg/m^2, obese: 30.0 kg/m^2 or higher); percentage body fat (normal: <30%; obese: ≥30%); and waist circumference (normal: ≤ 80.0 cm; abdominal obesity: > 80 cm). One woman had a BMI below 18.5 kg/m^2 (18 kg/m^2) and was included in the normal weight group.

Fibromyalgia severity was assessed with the fibromyalgia impact questionnaire (FIQ) [25 26]. FIQ is composed of ten subscales: physical impairment, overall well-being, work missed, job difficulty, pain, fatigue, morning tiredness, stiffness, anxiety and depression. The score of each subscale was standardized from 0 to 10. We summed the score of all items, so that the total score ranged from 0 to 100, with a higher score indicating greater severity. Women were categorized into two groups based on the FIQ total score as FIQ <70 and FIQ ≥70. These thresholds corresponds with having moderate or severe fibromyalgia respectively [32].

Statistical analysis

All statistical analyses were performed with PASW (Predictive Analytics SoftWare, v. 18.0 SPSS Inc., Chicago, IL, USA), and the level of significance was set at $\alpha = 0.05$. Physical activity and sedentary outcome variables were logarithmically transformed to obtain a normal distribution.

We calculated the estimated means of sedentary time, total physical activity, moderate physical activity and MVPA by age group, BMI and waist circumference categories, years since clinical diagnosis, fibromyalgia severity, marital status, educational level and occupational status, after adjusting for registered time. Linear regression analysis was conducted to examine the association of sedentary time, total physical activity, moderate-intensity physical activity and MVPA (inserted as dependent variables) with age group, BMI, waist circumference and percentage body fat categories, years since clinical diagnosis, fibromyalgia severity and educational level (inserted as independent variables). Independent variables were inserted as ordinal variables. As marital status and occupational status categories were not ordinal variables, we conducted one-way analysis of covariance to determine mean differences in sedentary time and physical activity levels among marital status and occupational status categories. Separate analyses were conducted for each dependent and independent variable. Registered time was entered as confounder in all models. Mean differences of sedentary time, physical activity, moderate physical activity and MVPA levels on week days (Monday to Friday) vs. weekend (Saturday and Sunday) were estimated with one-way analysis of variance for repeated measures.

We analysed the association of meeting the physical activity recommendations (≥30 minutes/day of MVPA on 5 of 7 days a week) with age, waist circumference and percentage body fat, years since clinical diagnosis, fibromyalgia severity, marital status, educational level and using binary logistic regression analysis. Multinomial regression analysis was conducted

to examine the association of meeting the physical activity recommendations with BMI and occupational status categories.

RESULTS

All participants had 7 valid days of registration. Mean registered time during waking time was 842±108 minutes/day (~14±1.8 hours). There was no significant association of sedentary time and physical activity with age group, waist circumference and percentage body fat categories, years since clinical diagnosis, fibromyalgia severity, marital status, educational level and occupational status (all P>0.1, Table 1). Levels of moderate-intensity physical activity and MVPA were lower in women with greater BMI ($\hat{\beta}$ = -6.6±3.4 and -7±3.6 min respectively, per BMI category increase (i.e. 18.5-24.9 kg/m^2, 25.0-29.9 kg/m^2, and ≥30.0 kg/m^2; P values for trend were 0.056 and 0.051 respectively, Table 1). Mean estimates of sedentary time and physical activity intensity levels were similar in women with FIQ <70 compared with those with FIQ ≥70 (all P>0.5, Table 1). For sensitivity analyses, we explored whether the association between physical activity intensity levels and FIQ differ when a different FIQ threshold (FIQ ≥59) [33] was used, yet the findings persisted (data not shown).

The proportion of women meeting the physical activity recommendations by age group, BMI, waist circumference and percentage body fat categories, years since clinical diagnosis, fibromyalgia severity, marital status, educational level and occupational status are shown in Table 2. The proportion of women meeting the physical activity recommendations was 60.6% (n=57, 95%CI: 52.5-73.2%). The OR of meeting the physical activity recommendations were lower, yet not reaching statistical significance, in the oldest group (OR: 0.542, 95%CI: 0.231-1.237, P=0.160), in those with a high waist circumference (OR: 0.556, 95%CI: 0.235-1.312, P=0.180), and in those diagnosed with fibromyalgia more than 5 years ago (OR: 0.485, 95%CI: 0.206-1.142, P=0.098) (Table 3). The OR of meeting the physical activity recommendations was higher, yet not reaching statistical significance, in non-overweight (BMI <25kg/m^2) and in the overweight (BMI=25-30kg/m^2) group compared with the obese peers (OR: 2.046, 95%CI: 0.698-5.997, P=0.192; OR: 2.252, 95%CI: 0.794-

6.385, P=0.127) (Table 4). Unemployed women had also higher OR of meeting the recommendations (OR: 2.545, 95%CI: 0.902-7.187, P=0.078). The OR of meeting the physical activity recommendations was lower in women with FIQ ≥70 (OR: 0.690, 95%CI: 0.294-1.620, P=0.395). The findings persisted when another suggested FIQ threshold (>59 vs. ≥59) was used [33] (data not shown). Women spent on average 71% of their waking time (approximately 10 hours/day) in sedentary behaviours. The results did not change after adjusting for registered time (data not shown).

Sedentary time and physical activity levels during weekdays (Monday to Friday) and during weekend time (Saturday and Sunday) in women with fibromyalgia are shown in table 4. Mean levels of physical activity were lower during weekends compared with weekdays (mean difference: 24 cpm, 95%CI: 7.8-40.2, P=0.004). Likewise, registered time at moderate-intensity physical activity and MVPA was lower during weekends (mean difference: 10.5 min/day, 95%CI: 5.5-15.5, P<0.001; and 10.6 min/day, 95%CI: 5.5-15.6, P<0.001), respectively). Mean levels of sedentary time were also lower during weekends (mean difference: 22.6 min/day, 95%CI: 0-45.3, P=0.051). Figure 1 shows the sedentary time and physical activity mean time by week and weekend days.

DISCUSSION

The main purpose of the present study was to characterize levels of sedentary time and physical activity in women with diagnosed fibromyalgia as well as to describe the adherence to recommended levels of physical activity assessed by accelerometry. Over half of the women (60.6%) met the physical activity recommendations (30 min/day of MVPA on 5 or more days a week). These women spent on average 71% (approximately 10 hours/day) of their waking time in sedentary behaviours, that is, in activities that expend little energy. We observed that both sedentary behaviour and physical activity levels were similar across the study demographic factors as well as regardless the severity of the disease. Women spent on average 10 min less on MVPA and 22 min less on sedentary behaviours during weekends compared with weekdays.

The present study showed that 60.6% of women met the recommendation to accumulate 30 or more min/day of physical activity of MVPA on most days of the week. The variation in meeting the recommendations was not associated with the study demographic factors, and despite the prevalence of meeting the recommendations tend to be lower in the oldest group, in the overweight group and in those with a higher waist circumference, in those with fibromyalgia being diagnosed more than 5 years ago, and in the retired group, the associations were not statistically significant. Time spent at moderate-intensity physical activity and MVPA tended to be however lower in those with greater BMI (-6.6 min and -7 min, respectively, per BMI category increase, <25, 25-30, >30 kg/m^2), which concur with studies in healthy adults [29]. This may have important health implications since obese female fibromyalgia patients seem to have higher levels of pain, anxiety and depression and worse quality of life, as well as lower functional capacity than their normal weight peers [34].

Despite several attempts have been made to objectively quantify sedentary behaviours and physical activity levels in people with fibromyalgia [12 13 35-38], to our knowledge, there are

no previous studies showing the prevalence of meeting the physical activity recommendations in women with fibromyalgia, which hamper between study comparisons. Mcloughlin et al. [13] measured physical activity with accelerometry in 26 female fibromyalgia patients aged 42.7±12 years, yet they did not show the prevalence of meeting the recommendations. They showed however that time spent at moderate intensity using the same intensity threshold as used in the present study [31] was 15±8 minutes/day which is on average ~35 minutes lower (using the 51-75 years age group as a reference group) than the time observed in the present study. Kaleth et al. [12] also measured physical activity with accelerometry in 30 fibromyalgia patients (27 women), but unfortunately, they did not show physical activity estimates. Kashikar-Zuck et al. [38] measured physical activity with accelerometry in a juvenile primary fibromyalgia syndrome group of adolescents and showed that only 23% achieved 30 minutes/day of MVPA, and that only 1 patient achieved the recommended levels of physical activity for their age, that is 60 minutes/day of MVPA [20 21]. Data coming from apparently healthy women showed lower rates of meeting the recommendation than those observed in the present study. Hagströmer et al. [29] reported that 48% of a representative sample of Swedish women accumulated 30 minutes/day of MVPA, whereas Troiano et al. [28] showed that less than 5% of a representative sample of women from U.S (2003–2004 National Health and Nutritional Examination Survey) met the physical activity recommendations. Methodological procedures used to measure physical activity may partially explain these differences. Several methodological differences can be noted between our study and the American study: First, whereas in our study all women had 7 valid days with at least 10 hours of registered time during waking hours, in the American study, only 26% of the total sample (adolescent included) had 7 valid days. Of note is that the American study included participants with just with one or more valid days when calculated population adherence estimates; second, while we did not include in the analysis the first day of recording to avoid

any source of reactivity, the American study included all measured days. Besides the mentioned methodological difference, it cannot be discarded that cultural differences might also explain the observed discrepancies between our study and the American study.

Sedentary behaviours refer to those activities that do not increase resting energy expenditure substantially, that is, no more than 1.5 times resting energy expenditure [39]. These activities involved sitting, reclining and lying down such as watching television, studying, reading, etc. In the present study we observed that women spend on average 10 hours/day (~71%) of their waking time in sedentary activities, which is similar to that observed in Portuguese women [40], and slightly higher than American and Swedish women (about 7-8 hours) [29] . Mcloughlin et al. [13] also measured sedentary time with accelerometry, yet data are not comparable with our study because they included sleeping time as a sedentary activity. They reported that women with fibromyalgia spend 1,154±59 minutes/day at sedentary behaviours, which together with the registered time in other physical activity intensities summed ~1,440 min, which is a full day. We observed no association of sedentary time with any of the study demographic factors, which concur with the Swedish study by Hagströmer et al. [29]. Similarly, women with a higher severity of the disease (FIQ≥70) showed similar sedentary patterns as those with a FIQ<70, which concur with the findings reported by McLoughlin et al. [13].

In our study, women with fibromyalgia spend less time (~10 minutes/day) on MVPA and on sedentary time (~22 minutes/day) during weekends compared with weekdays. These findings are in agreement with other study [41]. The observed physical activity reduction during weekends could be partially explained by a reduced transport-related physical activity when commuting to or from work, whereas the reduction of sedentary time could be due to a reduced work-related sitting time. More studies quantifying and characterizing physical activity and sedentary patterns during weekends and weekdays are needed.

The present study has several limitations. The cross-sectional design of our study does not allow establishing any causal relationship. The sample is of convenience and includes the known limitations of all non-probability samples, including less representativeness and unknown levels of sampling error. Further studies involving randomly recruited patients with fibromyalgia are needed. Of note is also the relatively low response rate (29%). We cannot discard that women who accepted to participate in this study are those more aware of the importance of having an active lifestyle, which may have influenced the results. It should also be mentioned that the accelerometer underestimates physical activities that involve upper body movement, those with minimal vertical displacement such as cycling, water-based activities such as swimming, and it does not capture well the extra energy cost of load-bearing activities, such as walking while carrying a backpack. Nevertheless, walking is the most prevalent leisure-time physical activity among women with fibromyalgia [15], and is likely the type of activity they do at work and for transportation. We used the same cut-points for all ages and BMI levels as suggested elsewhere [29]. Use of a single cut point for all ages and BMI levels may however lead to an underestimate of moderate-intensity activity for the older and heavier group by not accounting for the decline in exercise capacity with age and weight. We do not present data on vigorous physical activity because the time spent at this intensity ranged from 0 to 2 min (see table 1, subtract moderate intensity to MVPA). On average, ~98% of the time spend at MVPA is moderate-intensity physical activity. This is consistent with the available clinical knowledge on this population, and concur with data from apparently healthy women from Sweden [29]. The observed low levels of vigorous physical activity could also suggest that the cut point for this intensity was too high, thereby missing many minutes of activity in our population that should have been classified as vigorous physical activity. Unfortunately, we have no data on an age- and culturally-matched group of healthy women, so that direct comparison cannot be made. Mcloughlin et al. [13] observed that

female fibromyalgia patients (n=26) were less active than a group of healthy women (n=26), yet the healthy group was younger and had higher level of education than the patients group. Despite the number of participants in the present study is relatively small, to date, this is the largest series described in adults. We do not know whether these findings apply to men, therefore, future studies should quantify both sedentary time and physical activity in this group of patients. We [42] and others [43] observed gender differences in patients with fibromyalgia, therefore studies focused on examining gender differences on sedentary time and physical activity will provide further insights on whether preventive and interventions strategies should be gender-specific.

One of the strengths of the present study was however the strict standardization of methodology used to measure physical activity, and the fact that all women were compliant with the measurements procedures. All women had 7 valid days with at least 10 hours of registered time during waking hours. Indeed, the mean daily accelerometer wear time was 14±1.8 hours/day. We do not know whether women modified their habitual sedentary behavior or physical activity during the days they were monitored despite they were advised to keep on with their normal life. To avoid any kind of immediate reactivity, we removed from the analysis the first day of monitoring.

Modifiable lifestyle factors, such as physical activity, may have a great potential as a public health instrument to prevent and contribute to the treatment of fibromyalgia. Longitudinal studies are also needed to further understand the predictive value of sedentary behaviours and physical activity over the course of the disease, and whether preventive strategies should start at the early stages of the disease development. To have an objective estimate of the patient's sedentary behaviour as well as the engagement in physical activity could be used as a potential tool to increase the effectiveness of treatment approaches as well as to reduce disability and enhance quality of life in people with fibromyalgia. Indeed,

Fontaine et al. [44] observed that accumulating 30 minutes of moderate-intensity physical activity throughout the day produces clinically relevant changes in perceived physical function and pain in previously minimally active adults with fibromyalgia.

In summary, these data provide an objective measure of amount of time spent in sedentary activities and in physical activity in women with fibromyalgia. These estimates can be used for comparisons with other rheumatologic diseases, as baseline reference levels for monitoring, and to assess the effectiveness of intervention strategies promoting physical activity in women with fibromyalgia.

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Author contributions

JRR: Conception and design of the study, data collection, statistical analysis and interpretation of data, drafting the article

VSJ: Data collection, interpretation of data, and revising the article critically for important intellectual content

FOP: Conception and design of the study, interpretation of data, and revising the article critically for important intellectual content

IAG: Data collection, interpretation of data, and revising the article critically for important intellectual content

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VAA: Conception and design of the study, data collection, interpretation of data, and revising the article critically for important intellectual content

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PF: Statistical analysis, interpretation of data, and revising the article critically for important intellectual content

DMI: Interpretation of data, and revising the article critically for important intellectual content

MDF: Conception and design of the study, data collection, interpretation of data, and revising the article critically for important intellectual content

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Table 1. Sedentary time and physical activity levels in women with fibromyalgia, by age group, body mass index, waist circumference and percentage body fat category, years since clinical diagnosis, fibromyalgia impact, marital status, educational level and occupational status[a].

		Sedentary (hours/day)			Total PA (counts/minutes)			Moderate PA (min/day)			MVPA (min/day)		
	N	Mean	95% CI		Mean	95% CI		Mean	95% CI		Mean	95% CI	
Age groups (years)													
18-50	41	10.0	9.6	10.5	222	196	248	51	43	59	52	44	60
51-75	52	9.9	9.5	10.3	219	195	242	50	43	58	52	44	59
P value			0.65			0.86			0.96			0.98	
Body mass index[b] category (kg/m^2)													
< 25	29	10.3	9.7	10.8	229	199	260	56	47	65	58	48	67
25-30	34	9.5	9.0	10.0	235	207	263	53	44	61	54	45	63
> 30	27	10.1	9.6	10.7	195	162	227	42	32	52	43	33	54
P for trend			0.63			0.14			0.056			0.051	
Waist circumference category (cm)													
≤80	44	10.2	9.7	10.6	233	208	257	54	47	62	56	48	64
>80	46	9.7	9.3	10.2	209	185	234	47	39	54	48	40	56
P value			0.157			0.187			0.155			0.139	
Body fat (%)													
< 30	13	10.6	9.8	11.4	210	164	256	48	34	63	50	35	65
≥ 30	76	9.8	9.5	10.2	223	204	242	51	45	57	52	46	58
P value			0.93			0.605			0.709			0.774	
Years since clinical diagnosis													
≤ 5 years	47	9.9	9.5	10.3	224	200	248	53	46	61	54	47	62
> 5 years	45	9.8	9.3	10.2	219	194	244	49	41	56	50	43	58
P value			0.650			0.765			0.420			0.489	
Fibromyalgia severity (score)[c]													
< 70	42	9.9	9.4	10.3	226	200	251	51	43	60	53	45	61
≥ 70	50	10.0	9.6	10.5	215	191	238	49	42	57	50	43	58
P value			0.632			0.546			0.725			0.636	
Marital status													

Married	72	9.9	9.6	10.3	217	198	237	50	43	56	51	44 57
Unmarried	22	10.0	9.4	10.7	229	194	264	54	43	65	56	44 67
P value			0.710			0.564			0.510			0.436
Educational level												
Below university degree	71	9.9	9.6	10.3	222	203	242	51	45	57	53	46 59
University degree	22	10.2	9.5	10.8	218	182	253	50	39	61	51	40 63
P value			0.519			0.814			0.791			0.830
Occupational status												
Working	29	9.8	9.3	10.3	222	196	247	51	43	59	52	44 60
Unemployed	41	10.1	9.6	10.7	236	205	266	55	45	64	57	47 66
Retired	24	10.0	9.3	10.6	197	163	232	45	34	56	46	35 57
P value			0.619			0.107			0.187			0.159

Abbreviations: CI, confidence interval; PA, physical activity; MVPA, moderate- to vigorous-intensity physical activity.

[a] Estimates and P values were adjusted for registered time.

[b] Weight (kg)/height $(m)^2$.

[c] Assessed with the Fibromyalgia Impact Questionnaire.

Analyses were conducted with physical activity and sedentary outcome variables logarithmically transformed to obtain a normal distribution, yet crude values are presented in the table for easier interpretation.

Table 2. Prevalence of meeting the physical activity recommendations (30 min/day of moderate-to-vigorous-intensity physical activity) on at least 5 days a week.

	N	%	95%CI		Frequency
Age groups (years)					
18-50	41	68.3	51.9	81.9	28
51-75	52	53.8	39.5	67.8	28
Body mass index category (kg/m^2)					
< 25	29	65.5	45.7	82.1	19
25-30	34	67.6	49.5	82.6	23
> 30	27	48.1	28.7	68.1	13
Waist circumference category (cm)					
≤80	44	68.2	52.4	81.4	30
>80	46	54.3	39.0	69.1	25
Body fat (%)					
< 30	13	61.5	31.6	86.1	8
≥ 30	76	61.8	50.0	72.8	47
Years since clinical diagnosis					
≤ 5 years	47	70.2	55.1	82.7	33
> 5 years	45	53.3	37.9	68.3	24
Fibromyalgia severity					
< 70	42	66.7	50.5	80.4	28
≥ 70	50	58	43.2	71.8	29
Marital status					
Married	72	61.1	48.9	72.4	44
Unmarried	22	59.1	36.4	79.3	13
Educational level					
Below university degree	71	62.0	49.7	73.2	44
University degree	22	59.1	0.0	0.0	13
Occupational status					
Working	29	62.1	42.3	79.3	18
Unemployed	41	68.3	51.9	81.9	28
Retired	24	45.8	25.6	67.2	11
All	94	60.6	52.5	73.2	57

Abbreviations: CI, confidence interval (expressed in %).

[a] Assessed with the Fibromyalgia Impact Questionnaire.

Table 3. Odds ratio (OR) and 95% confidence interval (CI) of meeting the physical activity recommendations (30 min/day of moderate-to-vigorous-intensity physical activity, 5 of 7 days) by age group, body mass index, waist circumference and percentage body fat category, years since clinical diagnosis, marital status, educational level and occupational status.

	OR	95% CI		P value
Age groups (years)				
18-50	Ref.			
51-75	0.542	0.231	1.273	0.160
Body mass index category (kg/m^2)				
> 30	Ref.			
25-30	2.252	0.794	6.385	0.127
< 25	2.046	0.698	5.997	0.192
Waist circumference category (cm)				
≤80	Ref.			
>80	0.556	0.235	1.312	0.180
Body fat category (%)				
< 30	Ref.			
≥ 30	0.987	0.297	3.309	0.983
Years since clinical diagnosis				
≤ 5 years	Ref.			
> 5 years	0.485	0.206	1.142	0.098
Fibromyalgia severity (score)*				
< 70	Ref.			
≥ 70	0.690	0.294	1.620	0.395
Marital status				
Married	Ref.			
Unmarried	0.919	0.347	2.432	0.865
Educational level				
Below university degree	Ref.			
University degree	0.886	0.334	2.351	0.809
Occupational status				
Retired	Ref.			
Unemployed	2.545	0.902	7.187	0.078
Working	1.934	0.645	5.803	0.239

Abbreviations: Ref., Reference group.

* Assessed with the Fibromyalgia Impact Questionnaire.

Table 4. Sedentary time and physical activity levels during weekdays (Monday to Friday) and during weekends (Saturday and Sunday) in women with fibromyalgia.

	Week		Weekend		Difference			
	mean	sd	mean	sd	mean	95% CI		P value
Sedentary (hours/day)	10.0	2.2	9.6	2.5	0.4	0.0	0.8	0.051
Total PA (counts/min)	225.1	88.5	201.0	98.0	24.0	7.8	40.2	0.004
Moderate PA (min/day)	53.1	28.4	42.6	28.0	10.5	5.5	15.5	<0.001
MVPA (min/day)	54.3	29.1	43.8	29.7	10.6	5.5	15.6	<0.001

Abbreviations: CI, confidence interval; PA, physical activity; MVPA, moderate-to-vigorous-intensity physical activity; sd, Standard deviation.
Analyses were conducted with physical activity and sedentary outcome variables logarithmically transformed to obtain a normal distribution, yet crude values are presented in the table for easier interpretation.

Figure legend

Figure 1. Sedentary time and physical activity (PA) mean time by week and weekend days.

Objectively measured sedentary time and physical activity in women with fibromyalgia; A cross-sectional study

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ARTICLE SUMMARY

Article focus:

- To characterize the levels of objectively measured sedentary time and physical activity (using accelerometry) in women with fibromyalgia.
- To provide estimates of the adherence to recommended levels of physical activity assessed by accelerometry (30 minutes of moderate-to-vigorous-intensity physical activity on 5 of 7 days).

Key Messages

- Over 60% of women with fibromyalgia meet the physical activity recommendations, that is, 30 min/day of moderate-to-vigorous-intensity physical activity on 5 or more days a week.
- These women spent about 71% (approximately 10 hours/day) of their waking time in activities that expend little energy.
- Women with fibromyalgia spent on average 10 min less of moderate-to-vigorous-intensity physical activity and 22 min less of sedentary behaviours during weekends compared with weekdays.

Strengths and Limitations

- Strict standardization of the methodology used to measure physical activity and the fact that all women were compliant with the measurements procedures is a strength.
- All women had 7 valid days with at least 10 hours of registered time during waking hours.
- To avoid any kind of immediate reactivity, we removed from the analysis the first day of monitoring.

- The cross-sectional design of our study does not allow however establishing any causal relationships. The sample is of convenience, which includes the known limitations of all non-probability samples.
- The accelerometer underestimates physical activities that involve upper body movement, those with minimal vertical displacement such as cycling, water-based activities such as swimming. Moreover, it does not capture well the extra energy cost of load-bearing activities such as walking while carrying a backpack.

ABSTRACT

Objectives: To characterize levels of objectively measured sedentary time and physical activity in women with fibromyalgia.

Design: Cross-sectional study.

Setting: Local Association of Fibromyalgia (Granada, Spain).

Participants: The study comprised 94 women with diagnosed fibromyalgia who did not have other severe somatic or psychiatric disorders, or other diseases that prevent physical loading, able to ambulate and to communicate, and capable and willing to provide informed consent.

Primary outcome measures: Sedentary time and physical activity was measured by accelerometry and was expressed as time spent in sedentary behaviours, total physical activity (counts/minute) and amount of time (minutes/day) spent in moderate-intensity and in moderate-to vigorous-intensity physical activity (MVPA).

Results: The proportion of women meeting the physical activity recommendations of 30 min/day of MVPA on 5 or more days a week was 60.6%. Women spent on average 71% of their waking time (approximately 10 hours/day) in sedentary behaviours. Both sedentary behaviour and physical activity levels were similar across age groups, waist circumference and percentage body fat categories, years since clinical diagnosis, marital status, educational level, occupational status, as well as regardless the severity of the disease (all P>0.1). Time spent at moderate-intensity physical activity and MVPA was however lower in those with greater BMI (-6.6 min and -7 min respectively, per BMI category increase, <25, 25-30, >30 kg/m^2; P values for trend were 0.056 and 0.051 respectively). Women spent on average 10 min less on MVPA (P<0.001) and 22 min less on sedentary behaviours during weekends compared with weekdays (P=0.051).

Conclusions: These data provide an objective measure of the amount of time spent in sedentary activities and in physical activity in women with fibromyalgia.

Extra data is available by emailing ruizj@ugr.es

INTRODUCTION

Fibromyalgia is a pain regulation-related disorder [1]. Patients usually present an increased sensitivity to painful stimuli (hyperalgesia) and lowered pain threshold (allodynia). In addition to pain, fibromyalgia symptoms typically include severe fatigue, sleep disturbances, paresthesia of extremities, depression, anxiety, joint stiffness, and memory and cognitive difficulties [1 2]. Fibromyalgia is becoming a common syndrome in Western European countries, and estimates indicate a point prevalence of 2.9% which translates to approximately 6 million people with fibromyalgia [3].

There is increasing evidence about the potential benefits of regular physical activity on fibromyalgia-related symptoms [4-7], and International organizations supports the use of physical activity-based interventions as a complementary tool in the therapeutic armamentarium against fibromyalgia [8]. Physical inactivity is one of the major public health problems of the 21st century [9], and several longitudinal studies showed the negative consequences for health of a sedentary lifestyle [10 11].

The average amount of daily sedentary time as well as physical activity in women with fibromyalgia is rather unknown, and the available information is mainly questionnaire-based [12-16]. However, physical activities are difficult to recall, quantify and categorize [17], and it might be even more complex in people with memory and cognitive difficulties such as fibromyalgia patients [14]. Given the limitations of self-report methods, accelerometry (i.e. movement sensors) has become the method of choice for objectively measuring physical activity in free-living conditions [18]. To have an objective diagnosis of the sedentary time as well as of the physical activity levels in patients with fibromyalgia is of public health and of clinical interest, and might be informative for developing intervention studies directed to the promotion of physical activity in women with fibromyalgia [19].

The purpose of the present study was to characterize the levels of objectively measured (using accelerometry) sedentary time and physical activity among women with fibromyalgia, and to provide estimates of the adherence to recommended levels of physical activity [30 minutes of moderate-to-vigorous-intensity physical activity (MVPA) on 5 of 7 days] [20 21].

MATERIAL AND METHODS

Study participants

We sent a formal invitation to participate in the study to all members (n=400) of a Local Association of Fibromyalgia (Granada, Spain). A total of 116 patients responded (response rate 29%), and gave their written informed consent after receiving detailed information about the aims and study procedures. Participants were included in the study if: (i) they met the diagnosis of fibromyalgia according to the American College of Rheumatology criteria [22] (widespread pain for more than 3 months, and pain with 4 kg/cm^2 of pressure reported for 11 or more of 18 tender points), (ii) did not have other severe somatic or psychiatric disorders, or other diseases that prevent physical loading (answer "no" to all questions on the Physical Activity Readiness Questionnaire-PAR-Q [23] [24], (iii) were able to ambulate and to communicate, (iv) and were capable and willing to provide informed consent. Men were not included in the study (n=6), and women with incomplete physical activity data (n=5) or technical errors in the instrument (n=11) were excluded. A final sample of 94 women with fibromyalgia participated in the study. Age, weight and height, and fibromyalgia severity (assessed by the fibromyalgia impact questionnaire, FIQ) [25] [26] was similar between the included and excluded participants (all P>0.1). The study protocol was reviewed and approved by the Ethics Committee of the Hospital Virgen de las Nieves (Granada, Spain). The STROBE guidelines were followed during the course of the research [27].

Measurements

Women were interviewed in the Association of Fibromyalgia (Granada, Spain). They were asked to wear an accelerometer (Actigraph^{TM} GT1M, Pensacola, FL, USA) for 9 consecutive days starting the same day they received the monitor. The accelerometer was carried over the whole day (24 hrs) except during water-based activities such as bathing or swimming.

Accelerometers were initialized as described by the manufacturer, and data were recorded in 5 seconds epochs. Women wore the device on the lower back, secured with an elastic belt, underneath clothing, near to the center of gravity. The data were downloaded onto a computer using the manufacturer software. Data reduction, cleaning and analyses were performed using the MAHUffe program (see http://www.mrc-epid.cam.ac.uk/Research/Programmes/Programme_5/InDepth/Programme%205_Downloads.html).

Monitor wearing time was calculated by subtracting the sleeping reported time (recorded through a diary) from the total registered time for the entire day (i.e. 1440 minutes). Bouts of 60 continuous minutes of 0 activity intensity counts were also excluded from the analysis, considering these periods as non-wearing time [28]. There was no allowance for any minute with counts between 0-100 in the non-wear periods. A recording of more than 20,000 counts per minute (cpm) was considered as a potential malfunction of the accelerometer and the value was excluded from the analyses [28 29]. The first and last days of recording were not included in the analysis. A total of 7 days (full week) of recording with a minimum of 10 or more hours of registration per day was necessary to be included in the study analysis.

Sedentary time was estimated as the amount of time accumulated below 100 cpm during periods of wear time [30]. Time spent being sedentary was expressed as total duration (hours/day). Physical activity levels were estimated as follows: (i) Total physical activity was expressed as mean cpm, and is a measure of overall physical activity. We calculated mean cpm as the sum of total counts per day divided by the number of minutes of wear time in that day; finally calculating the average of all valid days (n=7). (ii) Time engaged in moderate physical activity. We calculated the time engaged in moderate-intensity physical activity based upon a standardized cut-off of 1952-5724 cpm [29 31], where 1952 cpm corresponds to walking at 4 km/hour [31]. (iii) We also calculated the time engaged in MVPA as the amount of

time accumulated ≥1952 cpm. Sedentary time, as well as the study physical activity variables was calculated for weekdays and weekends. We calculated the proportion of women meeting the physical activity recommendations, that is 30 minutes/day of MVPA at least 5 of 7 days [20] [21].

Weight and height were measured following standard procedures with a scale (InBody 720, Biospace, Seoul, Korea) and a stadiometer (Seca 22, Hamburg, Germany) respectively, and body mass index (BMI, weight in kg divided by height in m^2) was calculated. Percentage body fat was measured with bioelectrical impedance analysis (InBody R20; Biospace, Gateshead, UK). Waist circumference was measured at the level of the umbilicus with an anthropometric un-elastic tape (Harpenden anthropometric tape Holtain Ltd). Weight status groups were based on standard clinical definitions for BMI (normal weight: 18.5-24.9 kg/m^2, overweight: 25.0-29.9 kg/m^2, obese: 30.0 kg/m^2 or higher); percentage body fat (normal: <30%; obese: ≥30%); and waist circumference (normal: ≤ 80.0 cm; abdominal obesity: > 80 cm). One woman had a BMI below 18.5 kg/m^2 (18 kg/m^2) and was included in the normal weight group.

Fibromyalgia severity was assessed with the fibromyalgia impact questionnaire (FIQ) [25 26]. FIQ is composed of ten subscales: physical impairment, overall well-being, work missed, job difficulty, pain, fatigue, morning tiredness, stiffness, anxiety and depression. The score of each subscale was standardized from 0 to 10. We summed the score of all items, so that the total score ranged from 0 to 100, with a higher score indicating greater severity. Women were categorized into two groups based on the FIQ total score as FIQ <70 and FIQ ≥70. These thresholds corresponds with having moderate or severe fibromyalgia respectively [32].

Statistical analysis

All statistical analyses were performed with PASW (Predictive Analytics SoftWare, v. 18.0 SPSS Inc., Chicago, IL, USA), and the level of significance was set at $\alpha = 0.05$. Physical activity and sedentary outcome variables were logarithmically transformed to obtain a normal distribution.

We calculated the estimated means of sedentary time, total physical activity, moderate physical activity and MVPA by age group, BMI and waist circumference categories, years since clinical diagnosis, fibromyalgia severity, marital status, educational level and occupational status, after adjusting for registered time. Linear regression analysis was conducted to examine the association of sedentary time, total physical activity, moderate-intensity physical activity and MVPA (inserted as dependent variables) with age group, BMI, waist circumference and percentage body fat categories, years since clinical diagnosis, fibromyalgia severity and educational level (inserted as independent variables). Independent variables were inserted as ordinal variables. As marital status and occupational status categories were not ordinal variables, we conducted one-way analysis of covariance to determine mean differences in sedentary time and physical activity levels among marital status and occupational status categories. Separate analyses were conducted for each dependent and independent variable. Registered time was entered as confounder in all models. Mean differences of sedentary time, physical activity, moderate physical activity and MVPA levels on week days (Monday to Friday) vs. weekend (Saturday and Sunday) were estimated with one-way analysis of variance for repeated measures.

We analysed the association of meeting the physical activity recommendations (≥30 minutes/day of MVPA on 5 of 7 days a week) with age, waist circumference and percentage body fat, years since clinical diagnosis, fibromyalgia severity, marital status, educational level and using binary logistic regression analysis. Multinomial regression analysis was conducted

to examine the association of meeting the physical activity recommendations with BMI and occupational status categories.

RESULTS

All participants had 7 valid days of registration. Mean registered time during waking time was 842±108 minutes/day (~14±1.8 hours). There was no significant association of sedentary time and physical activity with age group, waist circumference and percentage body fat categories, years since clinical diagnosis, fibromyalgia severity, marital status, educational level and occupational status (all P>0.1, Table 1). Levels of moderate-intensity physical activity and MVPA were lower in women with greater BMI ($\hat{\beta}$ = -6.6±3.4 and -7±3.6 min respectively, per BMI category increase (i.e. 18.5-24.9 kg/m^2, 25.0-29.9 kg/m^2, and ≥30.0 kg/m^2; P values for trend were 0.056 and 0.051 respectively, Table 1). Mean estimates of sedentary time and physical activity intensity levels were similar in women with FIQ <70 compared with those with FIQ ≥70 (all P>0.5, Table 1). For sensitivity analyses, we explored whether the association between physical activity intensity levels and FIQ differ when a different FIQ threshold (FIQ ≥59) [33] was used, yet the findings persisted (data not shown).

The proportion of women meeting the physical activity recommendations by age group, BMI, waist circumference and percentage body fat categories, years since clinical diagnosis, fibromyalgia severity, marital status, educational level and occupational status are shown in Table 2. The proportion of women meeting the physical activity recommendations was 60.6% (n=57, 95%CI: 52.5-73.2%). The OR of meeting the physical activity recommendations were lower, yet not reaching statistical significance, in the oldest group (OR: 0.542, 95%CI: 0.231-1.237, P=0.160), in those with a high waist circumference (OR: 0.556, 95%CI: 0.235-1.312, P=0.180), and in those diagnosed with fibromyalgia more than 5 years ago (OR: 0.485, 95%CI: 0.206-1.142, P=0.098) (Table 3). The OR of meeting the physical activity recommendations was higher, yet not reaching statistical significance, in non-overweight (BMI <25kg/m^2) and in the overweight (BMI=25-30kg/m^2) group compared with the obese peers (OR: 2.046, 95%CI: 0.698-5.997, P=0.192; OR: 2.252, 95%CI: 0.794-

6.385, P=0.127) (Table 4). Unemployed women had also higher OR of meeting the recommendations (OR: 2.545, 95%CI: 0.902-7.187, P=0.078). The OR of meeting the physical activity recommendations was lower in women with FIQ ≥70 (OR: 0.690, 95%CI: 0.294-1.620, P=0.395). The findings persisted when another suggested FIQ threshold (>59 vs. ≥59) was used [33] (data not shown). Women spent on average 71% of their waking time (approximately 10 hours/day) in sedentary behaviours. The results did not change after adjusting for registered time (data not shown).

Sedentary time and physical activity levels during weekdays (Monday to Friday) and during weekend time (Saturday and Sunday) in women with fibromyalgia are shown in table 4. Mean levels of physical activity were lower during weekends compared with weekdays (mean difference: 24 cpm, 95%CI: 7.8-40.2, P=0.004). Likewise, registered time at moderate-intensity physical activity and MVPA was lower during weekends (mean difference: 10.5 min/day, 95%CI: 5.5-15.5, P<0.001; and 10.6 min/day, 95%CI: 5.5-15.6, P<0.001), respectively). Mean levels of sedentary time were also lower during weekends (mean difference: 22.6 min/day, 95%CI: 0-45.3, P=0.051). Figure 1 shows the sedentary time and physical activity mean time by week and weekend days.

DISCUSSION

The main purpose of the present study was to characterize levels of sedentary time and physical activity in women with diagnosed fibromyalgia as well as to describe the adherence to recommended levels of physical activity assessed by accelerometry. Over half of the women (60.6%) met the physical activity recommendations (30 min/day of MVPA on 5 or more days a week). These women spent on average 71% (approximately 10 hours/day) of their waking time in sedentary behaviours, that is, in activities that expend little energy. We observed that both sedentary behaviour and physical activity levels were similar across the study demographic factors as well as regardless the severity of the disease. Women spent on average 10 min less on MVPA and 22 min less on sedentary behaviours during weekends compared with weekdays.

The present study showed that 60.6% of women met the recommendation to accumulate 30 or more min/day of physical activity of MVPA on most days of the week. The variation in meeting the recommendations was not associated with the study demographic factors, and despite the prevalence of meeting the recommendations tend to be lower in the oldest group, in the overweight group and in those with a higher waist circumference, in those with fibromyalgia being diagnosed more than 5 years ago, and in the retired group, the associations were not statistically significant. Time spent at moderate-intensity physical activity and MVPA tended to be however lower in those with greater BMI (-6.6 min and -7 min, respectively, per BMI category increase, <25, 25-30, >30 kg/m^2), which concur with studies in healthy adults [29]. This may have important health implications since obese female fibromyalgia patients seem to have higher levels of pain, anxiety and depression and worse quality of life, as well as lower functional capacity than their normal weight peers [34].

Despite several attempts have been made to objectively quantify sedentary behaviours and physical activity levels in people with fibromyalgia [12 13 35-38], to our knowledge, there are

no previous studies showing the prevalence of meeting the physical activity recommendations in women with fibromyalgia, which hamper between study comparisons. Mcloughlin et al. [13] measured physical activity with accelerometry in 26 female fibromyalgia patients aged 42.7±12 years, yet they did not show the prevalence of meeting the recommendations. They showed however that time spent at moderate intensity using the same intensity threshold as used in the present study [31] was 15±8 minutes/day which is on average ~35 minutes lower (using the 51-75 years age group as a reference group) than the time observed in the present study. Kaleth et al. [12] also measured physical activity with accelerometry in 30 fibromyalgia patients (27 women), but unfortunately, they did not show physical activity estimates. Kashikar-Zuck et al. [38] measured physical activity with accelerometry in a juvenile primary fibromyalgia syndrome group of adolescents and showed that only 23% achieved 30 minutes/day of MVPA, and that only 1 patient achieved the recommended levels of physical activity for their age, that is 60 minutes/day of MVPA [20 21]. Data coming from apparently healthy women showed lower rates of meeting the recommendation than those observed in the present study. Hagströmer et al. [29] reported that 48% of a representative sample of Swedish women accumulated 30 minutes/day of MVPA, whereas Troiano et al. [28] showed that less than 5% of a representative sample of women from U.S (2003–2004 National Health and Nutritional Examination Survey) met the physical activity recommendations. Methodological procedures used to measure physical activity may partially explain these differences. Several methodological differences can be noted between our study and the American study: First, whereas in our study all women had 7 valid days with at least 10 hours of registered time during waking hours, in the American study, only 26% of the total sample (adolescent included) had 7 valid days. Of note is that the American study included participants with just with one or more valid days when calculated population adherence estimates; second, while we did not include in the analysis the first day of recording to avoid

any source of reactivity, the American study included all measured days. Besides the mentioned methodological difference, it cannot be discarded that cultural differences might also explain the observed discrepancies between our study and the American study.

Sedentary behaviours refer to those activities that do not increase resting energy expenditure substantially, that is, no more than 1.5 times resting energy expenditure [39]. These activities involved sitting, reclining and lying down such as watching television, studying, reading, etc. In the present study we observed that women spend on average 10 hours/day (~71%) of their waking time in sedentary activities, which is similar to that observed in Portuguese women [40], and slightly higher than American and Swedish women (about 7-8 hours) [29] . Mcloughlin et al. [13] also measured sedentary time with accelerometry, yet data are not comparable with our study because they included sleeping time as a sedentary activity. They reported that women with fibromyalgia spend 1,154±59 minutes/day at sedentary behaviours, which together with the registered time in other physical activity intensities summed ~1,440 min, which is a full day. We observed no association of sedentary time with any of the study demographic factors, which concur with the Swedish study by Hagströmer et al. [29]. Similarly, women with a higher severity of the disease (FIQ≥70) showed similar sedentary patterns as those with a FIQ<70, which concur with the findings reported by McLoughlin et al. [13].

In our study, women with fibromyalgia spend less time (~10 minutes/day) on MVPA and on sedentary time (~22 minutes/day) during weekends compared with weekdays. These findings are in agreement with other study [41]. The observed physical activity reduction during weekends could be partially explained by a reduced transport-related physical activity when commuting to or from work, whereas the reduction of sedentary time could be due to a reduced work-related sitting time. More studies quantifying and characterizing physical activity and sedentary patterns during weekends and weekdays are needed.

The present study has several limitations. The cross-sectional design of our study does not allow establishing any causal relationship. The sample is of convenience and includes the known limitations of all non-probability samples, including less representativeness and unknown levels of sampling error. Further studies involving randomly recruited patients with fibromyalgia are needed. Of note is also the relatively low response rate (29%). We cannot discard that women who accepted to participate in this study are those more aware of the importance of having an active lifestyle, which may have influenced the results. It should also be mentioned that the accelerometer underestimates physical activities that involve upper body movement, those with minimal vertical displacement such as cycling, water-based activities such as swimming, and it does not capture well the extra energy cost of load-bearing activities, such as walking while carrying a backpack. Nevertheless, walking is the most prevalent leisure-time physical activity among women with fibromyalgia [15], and is likely the type of activity they do at work and for transportation. We used the same cut-points for all ages and BMI levels as suggested elsewhere [29]. Use of a single cut point for all ages and BMI levels may however lead to an underestimate of moderate-intensity activity for the older and heavier group by not accounting for the decline in exercise capacity with age and weight. We do not present data on vigorous physical activity because the time spent at this intensity ranged from 0 to 2 min (see table 1, subtract moderate intensity to MVPA). On average, ~98% of the time spend at MVPA is moderate-intensity physical activity. This is consistent with the available clinical knowledge on this population, and concur with data from apparently healthy women from Sweden [29]. The observed low levels of vigorous physical activity could also suggest that the cut point for this intensity was too high, thereby missing many minutes of activity in our population that should have been classified as vigorous physical activity. Unfortunately, we have no data on an age- and culturally-matched group of healthy women, so that direct comparison cannot be made. Mcloughlin et al. [13] observed that

female fibromyalgia patients (n=26) were less active than a group of healthy women (n=26), yet the healthy group was younger and had higher level of education than the patients group. Despite the number of participants in the present study is relatively small, to date, this is the largest series described in adults. We do not know whether these findings apply to men, therefore, future studies should quantify both sedentary time and physical activity in this group of patients. We [42] and others [43] observed gender differences in patients with fibromyalgia, therefore studies focused on examining gender differences on sedentary time and physical activity will provide further insights on whether preventive and interventions strategies should be gender-specific.

One of the strengths of the present study was however the strict standardization of methodology used to measure physical activity, and the fact that all women were compliant with the measurements procedures. All women had 7 valid days with at least 10 hours of registered time during waking hours. Indeed, the mean daily accelerometer wear time was 14±1.8 hours/day. We do not know whether women modified their habitual sedentary behavior or physical activity during the days they were monitored despite they were advised to keep on with their normal life. To avoid any kind of immediate reactivity, we removed from the analysis the first day of monitoring.

Modifiable lifestyle factors, such as physical activity, may have a great potential as a public health instrument to prevent and contribute to the treatment of fibromyalgia. Longitudinal studies are also needed to further understand the predictive value of sedentary behaviours and physical activity over the course of the disease, and whether preventive strategies should start at the early stages of the disease development. To have an objective estimate of the patient's sedentary behaviour as well as the engagement in physical activity could be used as a potential tool to increase the effectiveness of treatment approaches as well as to reduce disability and enhance quality of life in people with fibromyalgia. Indeed,

Fontaine et al. [44] observed that accumulating 30 minutes of moderate-intensity physical activity throughout the day produces clinically relevant changes in perceived physical function and pain in previously minimally active adults with fibromyalgia.

In summary, these data provide an objective measure of amount of time spent in sedentary activities and in physical activity in women with fibromyalgia. These estimates can be used for comparisons with other rheumatologic diseases, as baseline reference levels for monitoring, and to assess the effectiveness of intervention strategies promoting physical activity in women with fibromyalgia.

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Author contributions

JRR: Conception and design of the study, data collection, statistical analysis and interpretation of data, drafting the article

VSJ: Data collection, interpretation of data, and revising the article critically for important intellectual content

FOP: Conception and design of the study, interpretation of data, and revising the article critically for important intellectual content

IAG: Data collection, interpretation of data, and revising the article critically for important intellectual content

DCM: Data collection, interpretation of data, and revising the article critically for important intellectual content

VAA: Conception and design of the study, data collection, interpretation of data, and revising the article critically for important intellectual content

ACB: Conception and design of the study, data collection, interpretation of data, and revising the article critically for important intellectual content

PF: Statistical analysis, interpretation of data, and revising the article critically for important intellectual content

DMI: Interpretation of data, and revising the article critically for important intellectual content

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Table 1. Sedentary time and physical activity levels in women with fibromyalgia, by age group, body mass index, waist circumference and percentage body fat category, years since clinical diagnosis, fibromyalgia impact, marital status, educational level and occupational status[a].

		Sedentary (hours/day)			Total PA (counts/minutes)			Moderate PA (min/day)			MVPA (min/day)		
	N	Mean	95% CI		Mean	95% CI		Mean	95% CI		Mean	95% CI	
Age groups (years)													
18-50	41	10.0	9.6	10.5	222	196	248	51	43	59	52	44	60
51-75	52	9.9	9.5	10.3	219	195	242	50	43	58	52	44	59
P value			0.65			0.86			0.96			0.98	
Body mass index[b] category (kg/m^2)													
< 25	29	10.3	9.7	10.8	229	199	260	56	47	65	58	48	67
25-30	34	9.5	9.0	10.0	235	207	263	53	44	61	54	45	63
> 30	27	10.1	9.6	10.7	195	162	227	42	32	52	43	33	54
P for trend			0.63			0.14			0.056			0.051	
Waist circumference category (cm)													
≤80	44	10.2	9.7	10.6	233	208	257	54	47	62	56	48	64
>80	46	9.7	9.3	10.2	209	185	234	47	39	54	48	40	56
P value			0.157			0.187			0.155			0.139	
Body fat (%)													
< 30	13	10.6	9.8	11.4	210	164	256	48	34	63	50	35	65
≥ 30	76	9.8	9.5	10.2	223	204	242	51	45	57	52	46	58
P value			0.93			0.605			0.709			0.774	
Years since clinical diagnosis													
≤ 5 years	47	9.9	9.5	10.3	224	200	248	53	46	61	54	47	62
> 5 years	45	9.8	9.3	10.2	219	194	244	49	41	56	50	43	58
P value			0.650			0.765			0.420			0.489	
Fibromyalgia severity (score)[c]													
< 70	42	9.9	9.4	10.3	226	200	251	51	43	60	53	45	61
≥ 70	50	10.0	9.6	10.5	215	191	238	49	42	57	50	43	58
P value			0.632			0.546			0.725			0.636	
Marital status													

Married	72	9.9	9.6	10.3	217	198	237	50	43	56	51	44 57
Unmarried	22	10.0	9.4	10.7	229	194	264	54	43	65	56	44 67
P value			0.710			0.564			0.510			0.436
Educational level												
Below university degree	71	9.9	9.6	10.3	222	203	242	51	45	57	53	46 59
University degree	22	10.2	9.5	10.8	218	182	253	50	39	61	51	40 63
P value			0.519			0.814			0.791			0.830
Occupational status												
Working	29	9.8	9.3	10.3	222	196	247	51	43	59	52	44 60
Unemployed	41	10.1	9.6	10.7	236	205	266	55	45	64	57	47 66
Retired	24	10.0	9.3	10.6	197	163	232	45	34	56	46	35 57
P value			0.619			0.107			0.187			0.159

Abbreviations: CI, confidence interval; PA, physical activity; MVPA, moderate- to vigorous-intensity physical activity.

[a] Estimates and P values were adjusted for registered time.

[b] Weight (kg)/height $(m)^2$.

[c] Assessed with the Fibromyalgia Impact Questionnaire.

Analyses were conducted with physical activity and sedentary outcome variables logarithmically transformed to obtain a normal distribution, yet crude values are presented in the table for easier interpretation.

Table 2. Prevalence of meeting the physical activity recommendations (30 min/day of moderate-to-vigorous-intensity physical activity) on at least 5 days a week.

	N	%	95%CI		Frequency
Age groups (years)					
18-50	41	68.3	51.9	81.9	28
51-75	52	53.8	39.5	67.8	28
Body mass index category (kg/m^2)					
< 25	29	65.5	45.7	82.1	19
25-30	34	67.6	49.5	82.6	23
> 30	27	48.1	28.7	68.1	13
Waist circumference category (cm)					
≤80	44	68.2	52.4	81.4	30
>80	46	54.3	39.0	69.1	25
Body fat (%)					
< 30	13	61.5	31.6	86.1	8
≥ 30	76	61.8	50.0	72.8	47
Years since clinical diagnosis					
≤ 5 years	47	70.2	55.1	82.7	33
> 5 years	45	53.3	37.9	68.3	24
Fibromyalgia severity					
< 70	42	66.7	50.5	80.4	28
≥ 70	50	58	43.2	71.8	29
Marital status					
Married	72	61.1	48.9	72.4	44
Unmarried	22	59.1	36.4	79.3	13
Educational level					
Below university degree	71	62.0	49.7	73.2	44
University degree	22	59.1	0.0	0.0	13
Occupational status					
Working	29	62.1	42.3	79.3	18
Unemployed	41	68.3	51.9	81.9	28
Retired	24	45.8	25.6	67.2	11
All	94	60.6	52.5	73.2	57

Abbreviations: CI, confidence interval (expressed in %).

[a] Assessed with the Fibromyalgia Impact Questionnaire.

Table 3. Odds ratio (OR) and 95% confidence interval (CI) of meeting the physical activity recommendations (30 min/day of moderate-to-vigorous-intensity physical activity, 5 of 7 days) by age group, body mass index, waist circumference and percentage body fat category, years since clinical diagnosis, marital status, educational level and occupational status.

	OR	95% CI		P value
Age groups (years)				
18-50	Ref.			
51-75	0.542	0.231	1.273	0.160
Body mass index category (kg/m^2)				
> 30	Ref.			
25-30	2.252	0.794	6.385	0.127
< 25	2.046	0.698	5.997	0.192
Waist circumference category (cm)				
≤80	Ref.			
>80	0.556	0.235	1.312	0.180
Body fat category (%)				
< 30	Ref.			
≥ 30	0.987	0.297	3.309	0.983
Years since clinical diagnosis				
≤ 5 years	Ref.			
> 5 years	0.485	0.206	1.142	0.098
Fibromyalgia severity (score)*				
< 70	Ref.			
≥ 70	0.690	0.294	1.620	0.395
Marital status				
Married	Ref.			
Unmarried	0.919	0.347	2.432	0.865
Educational level				
Below university degree	Ref.			
University degree	0.886	0.334	2.351	0.809
Occupational status				
Retired	Ref.			
Unemployed	2.545	0.902	7.187	0.078
Working	1.934	0.645	5.803	0.239

Abbreviations: Ref., Reference group.

* Assessed with the Fibromyalgia Impact Questionnaire.

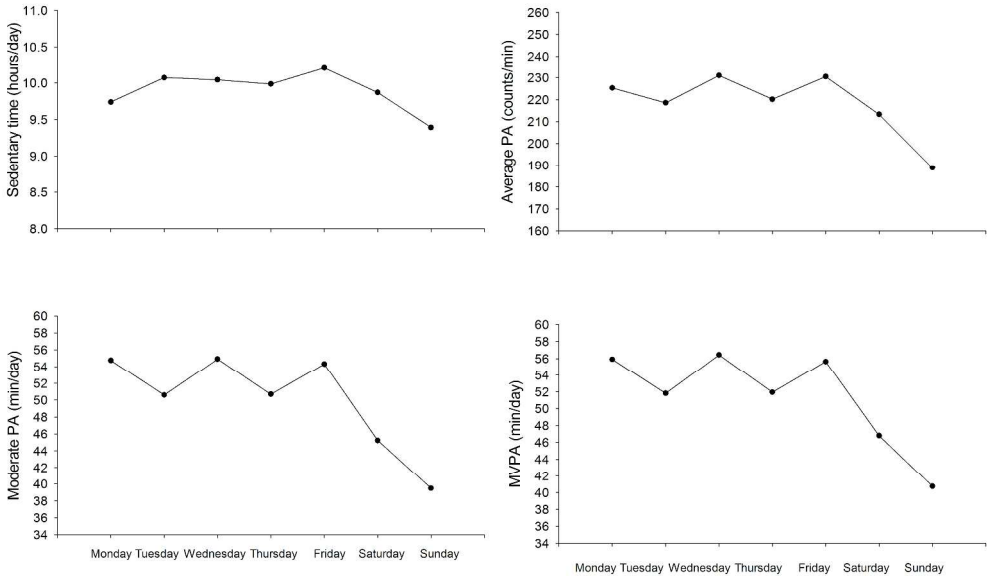
Table 4. Sedentary time and physical activity levels during weekdays (Monday to Friday) and during weekends (Saturday and Sunday) in women with fibromyalgia.

	Week		Weekend		Difference			
	mean	sd	mean	sd	mean	95% CI		P value
Sedentary (hours/day)	10.0	2.2	9.6	2.5	0.4	0.0	0.8	0.051
Total PA (counts/min)	225.1	88.5	201.0	98.0	24.0	7.8	40.2	0.004
Moderate PA (min/day)	53.1	28.4	42.6	28.0	10.5	5.5	15.5	<0.001
MVPA (min/day)	54.3	29.1	43.8	29.7	10.6	5.5	15.6	<0.001

Abbreviations: CI, confidence interval; PA, physical activity; MVPA, moderate-to-vigorous-intensity physical activity; sd, Standard deviation. Analyses were conducted with physical activity and sedentary outcome variables logarithmically transformed to obtain a normal distribution, yet crude values are presented in the table for easier interpretation.

Figure legend

Figure 1. Sedentary time and physical activity (PA) mean time by week and weekend days.



739x452mm (150 x 150 DPI)

STROBE 2007 (v4) checklist of items to be included in reports of observational studies in epidemiology*

Checklist for cohort, case-control, and cross-sectional studies (combined)

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3
Objectives	3	State specific objectives, including any pre-specified hypotheses	4
Methods			
Study design	4	Present key elements of study design early in the paper	6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6
Participants	6	(*a*) *Cohort study*—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up *Case-control study*—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls *Cross-sectional study*—Give the eligibility criteria, and the sources and methods of selection of participants	6
		(*b*) *Cohort study*—For matched studies, give matching criteria and number of exposed and unexposed *Case-control study*—For matched studies, give matching criteria and the number of controls per case	6
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6-9
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	*6-9*
Bias	9	Describe any efforts to address potential sources of bias	6
Study size	10	Explain how the study size was arrived at	6
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	9
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	9
		(*b*) Describe any methods used to examine subgroups and interactions	9
		(*c*) Explain how missing data were addressed	9
		(*d*) *Cohort study*—If applicable, explain how loss to follow-up was addressed *Case-control study*—If applicable, explain how matching of cases and controls was addressed	9

		Cross-sectional study—If applicable, describe analytical methods taking account of sampling strategy	
		(*e*) Describe any sensitivity analyses	9
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	10-11
		(b) Give reasons for non-participation at each stage	
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	10-11
		(b) Indicate number of participants with missing data for each variable of interest	
		(c) *Cohort study*—Summarise follow-up time (eg, average and total amount)	
Outcome data	15*	*Cohort study*—Report numbers of outcome events or summary measures over time	10-11
		Case-control study—Report numbers in each exposure category, or summary measures of exposure	
		Cross-sectional study—Report numbers of outcome events or summary measures	
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	
		(*b*) Report category boundaries when continuous variables were categorized	
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	
Discussion			
Key results	18	Summarise key results with reference to study objectives	12
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	15-16
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	15-16
Generalisability	21	Discuss the generalisability (external validity) of the study results	15-16
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	17

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

'Objectively measured sedentary time and physical activity in women with fibromyalgia; A cross-sectional study'

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'Objectively measured sedentary time and physical activity in women with fibromyalgia; A cross-sectional study'

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ARTICLE SUMMARY

Article focus:

- To characterize the levels of objectively measured sedentary time and physical activity (using accelerometry) in women with fibromyalgia.
- To provide estimates of the adherence to recommended levels of physical activity assessed by accelerometry (30 minutes of moderate-to-vigorous-intensity physical activity on 5 of 7 days).

Key Messages

- Over 60% of women with fibromyalgia meet the physical activity recommendations, that is, 30 min/day of moderate-to-vigorous-intensity physical activity on 5 or more days a week.
- These women spent about 71% (approximately 10 hours/day) of their waking time in activities that expend little energy.
- Women with fibromyalgia spent on average 10 min less of moderate-to-vigorous-intensity physical activity and 22 min less of sedentary behaviours during weekends compared with weekdays.

Strengths and Limitations

- Strict standardization of the methodology used to measure physical activity and the fact that all women were compliant with the measurements procedures is a strength.
- All women had 7 valid days with at least 10 hours of registered time during waking hours.
- To avoid any kind of immediate reactivity, we removed from the analysis the first day of monitoring.

- The cross-sectional design of our study does not allow however establishing any causal relationships. The sample is of convenience, which includes the known limitations of all non-probability samples.
- The accelerometer underestimates physical activities that involve upper body movement, those with minimal vertical displacement such as cycling, water-based activities such as swimming. Moreover, it does not capture well the extra energy cost of load-bearing activities such as walking while carrying a backpack.

ABSTRACT

Objectives: To characterize levels of objectively measured sedentary time and physical activity in women with fibromyalgia.

Design: Cross-sectional study.

Setting: Local Association of Fibromyalgia (Granada, Spain).

Participants: The study comprised 94 women with diagnosed fibromyalgia who did not have other severe somatic or psychiatric disorders, or other diseases that prevent physical loading, able to ambulate and to communicate, and capable and willing to provide informed consent.

Primary outcome measures: Sedentary time and physical activity was measured by accelerometry and was expressed as time spent in sedentary behaviours, average physical activity intensity (counts/minute) and amount of time (minutes/day) spent in moderate-intensity and in moderate-to vigorous-intensity physical activity (MVPA).

Results: The proportion of women meeting the physical activity recommendations of 30 min/day of MVPA on 5 or more days a week was 60.6%. Women spent on average 71% of their waking time (approximately 10 hours/day) in sedentary behaviours. Both sedentary behaviour and physical activity levels were similar across age groups, waist circumference and percentage body fat categories, years since clinical diagnosis, marital status, educational level, occupational status, as well as regardless the severity of the disease (all P>0.1). Time spent at moderate-intensity physical activity and MVPA was however lower in those with greater BMI (-6.6 min and -7 min respectively, per BMI category increase, <25, 25-30, >30 kg/m^2; P values for trend were 0.056 and 0.051 respectively). Women spent on average 10 min less on MVPA (P<0.001) and 22 min less on sedentary behaviours during weekends compared with weekdays (P=0.051).

Conclusions: These data provide an objective measure of the amount of time spent in sedentary activities and in physical activity in women with fibromyalgia.

Extra data is available by emailing ruizj@ugr.es

INTRODUCTION

Fibromyalgia is a pain regulation-related disorder [1]. Patients usually present an increased sensitivity to painful stimuli (hyperalgesia) and lowered pain threshold (allodynia). In addition to pain, fibromyalgia symptoms typically include severe fatigue, sleep disturbances, paresthesia of extremities, depression, anxiety, joint stiffness, and memory and cognitive difficulties [1 2]. Fibromyalgia is becoming a common syndrome in Western European countries, and estimates indicate a point prevalence of 2.9% which translates to approximately 6 million people with fibromyalgia [3].

There is increasing evidence about the potential benefits of regular physical activity on fibromyalgia-related symptoms [4-7], and International organizations supports the use of physical activity-based interventions as a complementary tool in the therapeutic armamentarium against fibromyalgia [8]. Physical inactivity is one of the major public health problems of the 21st century [9], and several longitudinal studies showed the negative consequences for health of a sedentary lifestyle [10 11].

The average amount of daily sedentary time as well as physical activity in women with fibromyalgia is rather unknown, and the available information is mainly questionnaire-based [12-16]. However, physical activities are difficult to recall, quantify and categorize [17], and it might be even more complex in people with memory and cognitive difficulties such as fibromyalgia patients [14]. Given the limitations of self-report methods, accelerometry (i.e. movement sensors) has become the method of choice for objectively measuring physical activity in free-living conditions [18]. To have an objective diagnosis of the sedentary time as well as of the physical activity levels in patients with fibromyalgia is of public health and of clinical interest, and might be informative for developing intervention studies directed to the promotion of physical activity in women with fibromyalgia [19].

The purpose of the present study was to characterize the levels of objectively measured (using accelerometry) sedentary time and physical activity among women with fibromyalgia, and to provide estimates of the adherence to recommended levels of physical activity [30 minutes of moderate-to-vigorous-intensity physical activity (MVPA) on 5 of 7 days] [20 21].

MATERIAL AND METHODS

Study participants

We sent a formal invitation to participate in the study to all members (n=400) of a Local Association of Fibromyalgia (Granada, Spain). A total of 116 patients responded (response rate 29%), and gave their written informed consent after receiving detailed information about the aims and study procedures. Participants were included in the study if: (i) they met the diagnosis of fibromyalgia according to the American College of Rheumatology criteria [22] (widespread pain for more than 3 months, and pain with 4 kg/cm^2 of pressure reported for 11 or more of 18 tender points), (ii) did not have other severe somatic or psychiatric disorders, or other diseases that prevent physical loading (answer "no" to all questions on the Physical Activity Readiness Questionnaire-PAR-Q [23] [24], (iii) were able to ambulate and to communicate, (iv) and were capable and willing to provide informed consent. Men were not included in the study (n=6), and women with incomplete physical activity data (n=5) or technical errors in the instrument (n=11) were excluded. A final sample of 94 women with fibromyalgia participated in the study. Age, weight and height, and fibromyalgia severity (assessed by the fibromyalgia impact questionnaire, FIQ) [25] [26] was similar between the included and excluded participants (all P>0.1). The study protocol was reviewed and approved by the Ethics Committee of the Hospital Virgen de las Nieves (Granada, Spain). The STROBE guidelines were followed during the course of the research [27].

Measurements

Women were interviewed in the Association of Fibromyalgia (Granada, Spain). They were asked to wear an accelerometer (Actigraph^{TM} GT1M, Pensacola, FL, USA) for 9 consecutive days starting the same day they received the monitor. The accelerometer was carried over the whole day (24 hrs) except during water-based activities such as bathing or swimming.

Accelerometers were initialized as described by the manufacturer, and data were recorded in 5 seconds epochs. Women wore the device on the lower back, secured with an elastic belt, underneath clothing, near to the center of gravity. The data were downloaded onto a computer using the manufacturer software. Data reduction, cleaning and analyses were performed using the MAHUffe program (see http://www.mrc-epid.cam.ac.uk/Research/Programmes/Programme_5/InDepth/Programme%205_Downloads.html).

Monitor wearing time was calculated by subtracting the sleeping reported time (recorded through a diary) from the total registered time for the entire day (i.e. 1440 minutes). Bouts of 60 continuous minutes of 0 activity intensity counts were also excluded from the analysis, considering these periods as non-wearing time [28]. There was no allowance for any minute with counts between 0-100 in the non-wear periods. A recording of more than 20,000 counts per minute (cpm) was considered as a potential malfunction of the accelerometer and the value was excluded from the analyses [28 29]. The first and last days of recording were not included in the analysis. A total of 7 days (full week) of recording with a minimum of 10 or more hours of registration per day was necessary to be included in the study analysis.

Sedentary time was estimated as the amount of time accumulated below 100 cpm during periods of wear time [30]. Time spent being sedentary was expressed as total duration (hours/day). Physical activity levels were estimated as follows: (i) Average physical activity intensity was expressed as mean cpm, and is a measure of overall physical activity. We calculated mean cpm as the sum of total counts per day divided by the number of minutes of wear time in that day; finally calculating the average of all valid days (n=7). (ii) Time engaged in moderate physical activity. We calculated the time engaged in moderate-intensity physical activity based upon a standardized cut-off of 1952-5724 cpm [29 31], where 1952 cpm corresponds to walking at 4 km/hour [31]. (iii) We also calculated the time engaged in MVPA as

the amount of time accumulated ≥1952 cpm. Sedentary time, as well as the study physical activity variables was calculated for weekdays and weekends. We calculated the proportion of women meeting the physical activity recommendations, that is 30 minutes/day of MVPA at least 5 of 7 days [20 21].

Weight and height were measured following standard procedures with a scale (InBody 720, Biospace, Seoul, Korea) and a stadiometer (Seca 22, Hamburg, Germany) respectively, and body mass index (BMI, weight in kg divided by height in m^2) was calculated. Percentage body fat was measured with bioelectrical impedance analysis (InBody R20; Biospace, Gateshead, UK). Waist circumference was measured at the level of the umbilicus with an anthropometric un-elastic tape (Harpenden anthropometric tape Holtain Ltd). Weight status groups were based on standard clinical definitions for BMI (normal weight: 18.5-24.9 kg/m^2, overweight: 25.0-29.9 kg/m^2, obese: 30.0 kg/m^2 or higher); percentage body fat (normal: <30%; obese: ≥30%); and waist circumference (normal: ≤ 80.0 cm; abdominal obesity: > 80 cm). One woman had a BMI below 18.5 kg/m^2 (18 kg/m^2) and was included in the normal weight group.

Fibromyalgia severity was assessed with the fibromyalgia impact questionnaire (FIQ) [25 26]. FIQ is composed of ten subscales: physical impairment, overall well-being, work missed, job difficulty, pain, fatigue, morning tiredness, stiffness, anxiety and depression. The score of each subscale was standardized from 0 to 10. We summed the score of all items, so that the total score ranged from 0 to 100, with a higher score indicating greater severity. Women were categorized into two groups based on the FIQ total score as FIQ <70 and FIQ ≥70. These thresholds corresponds with having moderate or severe fibromyalgia respectively [32].

Statistical analysis

All statistical analyses were performed with PASW (Predictive Analytics SoftWare, v. 18.0 SPSS Inc., Chicago, IL, USA), and the level of significance was set at $\alpha = 0.05$. Physical activity and sedentary outcome variables were logarithmically transformed to obtain a normal distribution.

We calculated the estimated means of sedentary time, average physical activity intensity, moderate physical activity and MVPA by age group, BMI and waist circumference categories, years since clinical diagnosis, fibromyalgia severity, marital status, educational level and occupational status, after adjusting for registered time. Linear regression analysis was conducted to examine the association of sedentary time, average physical activity intensity, moderate-intensity physical activity and MVPA (inserted as dependent variables) with age group, BMI, waist circumference and percentage body fat categories, years since clinical diagnosis, fibromyalgia severity and educational level (inserted as independent variables). Independent variables were inserted as ordinal variables. As marital status and occupational status categories were not ordinal variables, we conducted one-way analysis of covariance to determine mean differences in sedentary time and physical activity levels among marital status and occupational status categories. Separate analyses were conducted for each dependent and independent variable. Registered time was entered as confounder in all models. Mean differences of sedentary time, physical activity, moderate physical activity and MVPA levels on week days (Monday to Friday) vs. weekend (Saturday and Sunday) were estimated with one-way analysis of variance for repeated measures.

We analysed the association of meeting the physical activity recommendations (≥30 minutes/day of MVPA on 5 of 7 days a week) with age, waist circumference and percentage body fat, years since clinical diagnosis, fibromyalgia severity, marital status, educational level and using binary logistic regression analysis. Multinomial regression analysis was conducted

to examine the association of meeting the physical activity recommendations with BMI and occupational status categories.

RESULTS

All participants had 7 valid days of registration. Mean registered time during waking time was 842±108 minutes/day (~14±1.8 hours). There was no significant association of sedentary time and physical activity with age group, waist circumference and percentage body fat categories, years since clinical diagnosis, fibromyalgia severity, marital status, educational level and occupational status (all P>0.1, Table 1). Levels of moderate-intensity physical activity and MVPA were lower in women with greater BMI ($\hat{\beta}$ = -6.6±3.4 and -7±3.6 min respectively, per BMI category increase (i.e. 18.5-24.9 kg/m^2, 25.0-29.9 kg/m^2, and ≥30.0 kg/m^2; P values for trend were 0.056 and 0.051 respectively, Table 1). Mean estimates of sedentary time and physical activity intensity levels were similar in women with FIQ <70 compared with those with FIQ ≥70 (all P>0.5, Table 1). For sensitivity analyses, we explored whether the association between physical activity intensity levels and FIQ differ when a different FIQ threshold (FIQ ≥59) [33] was used, yet the findings persisted (data not shown).

The proportion of women meeting the physical activity recommendations by age group, BMI, waist circumference and percentage body fat categories, years since clinical diagnosis, fibromyalgia severity, marital status, educational level and occupational status are shown in Table 2. The proportion of women meeting the physical activity recommendations was 60.6% (n=57, 95%CI: 52.5-73.2%). The OR of meeting the physical activity recommendations were lower, yet not reaching statistical significance, in the oldest group (OR: 0.542, 95%CI: 0.231-1.237, P=0.160), in those with a high waist circumference (OR: 0.556, 95%CI: 0.235-1.312, P=0.180), and in those diagnosed with fibromyalgia more than 5 years ago (OR: 0.485, 95%CI: 0.206-1.142, P=0.098) (Table 3). The OR of meeting the physical activity recommendations was higher, yet not reaching statistical significance, in non-overweight (BMI <25kg/m^2) and in the overweight (BMI=25-30kg/m^2) group compared with the obese peers (OR: 2.046, 95%CI: 0.698-5.997, P=0.192; OR: 2.252, 95%CI: 0.794-

6.385, P=0.127) (Table 4). Unemployed women had also higher OR of meeting the recommendations (OR: 2.545, 95%CI: 0.902-7.187, P=0.078). The OR of meeting the physical activity recommendations was lower in women with FIQ ≥70 (OR: 0.690, 95%CI: 0.294-1.620, P=0.395). The findings persisted when another suggested FIQ threshold (>59 vs. ≥59) was used [33] (data not shown). Women spent on average 71% of their waking time (approximately 10 hours/day) in sedentary behaviours. The results did not change after adjusting for registered time (data not shown).

Sedentary time and physical activity levels during weekdays (Monday to Friday) and during weekend time (Saturday and Sunday) in women with fibromyalgia are shown in table 4. Mean levels of physical activity were lower during weekends compared with weekdays (mean difference: 24 cpm, 95%CI: 7.8-40.2, P=0.004). Likewise, registered time at moderate-intensity physical activity and MVPA was lower during weekends (mean difference: 10.5 min/day, 95%CI: 5.5-15.5, P<0.001; and 10.6 min/day, 95%CI: 5.5-15.6, P<0.001), respectively). Mean levels of sedentary time were also lower during weekends (mean difference: 22.6 min/day, 95%CI: 0-45.3, P=0.051). Figure 1 shows the sedentary time and physical activity mean time by week and weekend days.

DISCUSSION

The main purpose of the present study was to characterize levels of sedentary time and physical activity in women with diagnosed fibromyalgia as well as to describe the adherence to recommended levels of physical activity assessed by accelerometry. Over half of the women (60.6%) met the physical activity recommendations (30 min/day of MVPA on 5 or more days a week). These women spent on average 71% (approximately 10 hours/day) of their waking time in sedentary behaviours, that is, in activities that expend little energy. We observed that both sedentary behaviour and physical activity levels were similar across the study demographic factors as well as regardless the severity of the disease. Women spent on average 10 min less on MVPA and 22 min less on sedentary behaviours during weekends compared with weekdays.

The present study showed that 60.6% of women met the recommendation to accumulate 30 or more min/day of physical activity of MVPA on most days of the week. The variation in meeting the recommendations was not associated with the study demographic factors, and despite the prevalence of meeting the recommendations tend to be lower in the oldest group, in the overweight group and in those with a higher waist circumference, in those with fibromyalgia being diagnosed more than 5 years ago, and in the retired group, the associations were not statistically significant. Time spent at moderate-intensity physical activity and MVPA tended to be however lower in those with greater BMI (-6.6 min and -7 min, respectively, per BMI category increase, <25, 25-30, >30 kg/m^2), which concur with studies in healthy adults [29]. This may have important health implications since obese female fibromyalgia patients seem to have higher levels of pain, anxiety and depression and worse quality of life, as well as lower functional capacity than their normal weight peers [34].

Despite several attempts have been made to objectively quantify sedentary behaviours and physical activity levels in people with fibromyalgia [12 13 35-38], to our knowledge, there are

no previous studies showing the prevalence of meeting the physical activity recommendations in women with fibromyalgia, which hamper between study comparisons. Mcloughlin et al. [13] measured physical activity with accelerometry in 26 female fibromyalgia patients aged 42.7±12 years, yet they did not show the prevalence of meeting the recommendations. They showed however that time spent at moderate intensity using the same intensity threshold as used in the present study [31] was 15±8 minutes/day which is on average ~35 minutes lower (using the 51-75 years age group as a reference group) than the time observed in the present study. Kaleth et al. [12] also measured physical activity with accelerometry in 30 fibromyalgia patients (27 women), but unfortunately, they did not show physical activity estimates. Kashikar-Zuck et al. [38] measured physical activity with accelerometry in a juvenile primary fibromyalgia syndrome group of adolescents and showed that only 23% achieved 30 minutes/day of MVPA, and that only 1 patient achieved the recommended levels of physical activity for their age, that is 60 minutes/day of MVPA [20 21].

Data coming from apparently healthy women showed lower rates of meeting the recommendation than those observed in the present study [28 29 39 40]. Hagströmer et al. [29] reported that 48% of a representative sample of Swedish women accumulated 30 minutes/day of MVPA, and data from the Canadian Health Measures Survey [40] showed that less than 5% engaged in 30 minutes/day of MVPA at least 5 of 7 days. Similarly, findings from the National Health and Nutritional Examination Survey (NHANES) 2003–2004 indicated that less than 5% of a representative sample of women from U.S [28] met the physical activity recommendations, and 7% of U.S women met the physical activity recommendations in 2005–2006 (NHANES) [39]. Methodological procedures used to measure physical activity such as number of valid days included in the analysis, exclusion of the first recording day to avoid reactivity and criteria used to define compliance, may partially explain the observed differences among studies. Whereas in our study all women had 7 valid days with at least 10

hours of registered time during waking hours, in the other studies participants with 4 valid days were included in the study. Of note is that, for example, the NHANES 2003–2004 [28] study included participants with just with one or more valid days when calculated population adherence estimates. Besides the above-mentioned methodological difference, it cannot be discarded however that cultural differences might also explain the observed discrepancies.

Sedentary behaviours refer to those activities that do not increase resting energy expenditure substantially, that is, no more than 1.5 times resting energy expenditure [41]. These activities involved sitting, reclining and lying down such as watching television, studying, reading, etc. In the present study we observed that women spend on average 10 hours/day (~71%) of their waking time in sedentary activities, which is similar to that observed in Portuguese women [42], and slightly higher than American and Swedish women (about 7-8 hours) [29] . Mcloughlin et al. [13] also measured sedentary time with accelerometry, yet data are not comparable with our study because they included sleeping time as a sedentary activity. They reported that women with fibromyalgia spend 1,154±59 minutes/day at sedentary behaviours, which together with the registered time in other physical activity intensities summed ~1,440 min, which is a full day. We observed no association of sedentary time with any of the study demographic factors, which concur with the Swedish study by Hagströmer et al. [29]. Similarly, women with a higher severity of the disease (FIQ≥70) showed similar sedentary patterns as those with a FIQ<70, which concur with the findings reported by McLoughlin et al. [13].

In our study, women with fibromyalgia spend less time (~10 minutes/day) on MVPA and on sedentary time (~22 minutes/day) during weekends compared with weekdays. These findings are in agreement with the results reported by Cooper et al. [43]. The observed physical activity reduction during weekends could be partially explained by a reduced transport-related physical activity when commuting to or from work, whereas the reduction of sedentary time

could be due to a reduced work-related sitting time. More studies quantifying and characterizing physical activity and sedentary patterns during weekends and weekdays are needed.

The present study has several limitations. The cross-sectional design of our study does not allow establishing any causal relationship. The sample is of convenience and includes the known limitations of all non-probability samples, including less representativeness and unknown levels of sampling error. Further studies involving randomly recruited patients with fibromyalgia are needed. Of note is also the relatively low response rate (29%). We cannot discard that women who accepted to participate in this study are those more aware of the importance of having an active lifestyle, which may have influenced the results. It should also be mentioned that the accelerometer underestimates physical activities that involve upper body movement, those with minimal vertical displacement such as cycling, water-based activities such as swimming, and it does not capture well the extra energy cost of load-bearing activities, such as walking while carrying a backpack. Nevertheless, walking is the most prevalent leisure-time physical activity among women with fibromyalgia [15], and is likely the type of activity they do at work and for transportation. We used the same cut-points for all ages and BMI levels as has been done in previous studies [28 29]. Use of a single cut point for all ages and BMI levels may however lead to an underestimate of moderate-intensity activity for the older and heavier group by not accounting for the decline in exercise capacity with age and weight. We do not present data on vigorous physical activity because the time spent at this intensity ranged from 0 to 2 min (see table 1, subtract moderate intensity to MVPA). On average, ~98% of the time spend at MVPA is moderate-intensity physical activity. This is consistent with the available clinical knowledge on this population, and concur with data from apparently healthy women from Sweden [29]. The observed low levels of vigorous physical activity could also suggest that the cut point for this intensity was too high, thereby missing

many minutes of activity in our population that should have been classified as vigorous physical activity. Unfortunately, we have no data on an age- and culturally-matched group of healthy women, so that direct comparison cannot be made. Mcloughlin et al. [13] observed that female fibromyalgia patients (n=26) were less active than a group of healthy women (n=26), yet the healthy group was younger and had higher level of education than the patients group. Despite the number of participants in the present study is relatively small, to date, this is the largest series described in adults. We do not know whether these findings apply to men, therefore, future studies should quantify both sedentary time and physical activity in this group of patients. We [44] and others [45] observed gender differences in patients with fibromyalgia, therefore studies focused on examining gender differences on sedentary time and physical activity will provide further insights on whether preventive and interventions strategies should be gender-specific.

One of the strengths of the present study was however the strict standardization of methodology used to measure physical activity, and the fact that all women were compliant with the measurements procedures. All women had 7 valid days with at least 10 hours of registered time during waking hours. Indeed, the mean daily accelerometer wear time was 14±1.8 hours/day. We do not know whether women modified their habitual sedentary behavior or physical activity during the days they were monitored despite they were advised to keep on with their normal life. To avoid any kind of immediate reactivity, we removed from the analysis the first day of monitoring.

Modifiable lifestyle factors, such as physical activity, may have a great potential as a public health instrument to prevent and contribute to the treatment of fibromyalgia. Longitudinal studies are also needed to further understand the predictive value of sedentary behaviours and physical activity over the course of the disease, and whether preventive strategies should start at the early stages of the disease development. To have an objective

estimate of the patient's sedentary behaviour as well as the engagement in physical activity could be used as a potential tool to increase the effectiveness of treatment approaches as well as to reduce disability and enhance quality of life in people with fibromyalgia. Indeed, Fontaine et al. [46] observed that accumulating 30 minutes of moderate-intensity physical activity throughout the day produces clinically relevant changes in perceived physical function and pain in previously minimally active adults with fibromyalgia.

In summary, these data provide an objective measure of amount of time spent in sedentary activities and in physical activity in women with fibromyalgia. These estimates can be used for comparisons with other rheumatologic diseases, as baseline reference levels for monitoring, and to assess the effectiveness of intervention strategies promoting physical activity in women with fibromyalgia.

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Author contributions

JRR: Conception and design of the study, data collection, statistical analysis and interpretation of data, drafting the article

VSJ: Data collection, interpretation of data, and revising the article critically for important intellectual content

FOP: Conception and design of the study, interpretation of data, and revising the article critically for important intellectual content

IAG: Data collection, interpretation of data, and revising the article critically for important intellectual content

DCM: Data collection, interpretation of data, and revising the article critically for important intellectual content

VAA: Conception and design of the study, data collection, interpretation of data, and revising the article critically for important intellectual content

ACB: Conception and design of the study, data collection, interpretation of data, and revising the article critically for important intellectual content

PF: Statistical analysis, interpretation of data, and revising the article critically for important intellectual content

DMI: Interpretation of data, and revising the article critically for important intellectual content

MDF: Conception and design of the study, data collection, interpretation of data, and revising the article critically for important intellectual content

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Table 1. Sedentary time and physical activity levels in women with fibromyalgia, by age group, body mass index, waist circumference and percentage body fat category, years since clinical diagnosis, fibromyalgia impact, marital status, educational level and occupational status[a].

	Sedentary (hours/day)			Average PA (counts/minutes)			Moderate PA (min/day)			MVPA (min/day)		
	N	Mean	95% CI	Mean	95% CI		Mean	95% CI		Mean	95% CI	
Age groups (years)												
18-50	41	10.0	9.6 10.5	222	196	248	51	43	59	52	44	60
51-75	52	9.9	9.5 10.3	219	195	242	50	43	58	52	44	59
P value			0.65		0.86			0.96			0.98	
Body mass index[b] category (kg/m^2)												
< 25	29	10.3	9.7 10.8	229	199	260	56	47	65	58	48	67
25-30	34	9.5	9.0 10.0	235	207	263	53	44	61	54	45	63
> 30	27	10.1	9.6 10.7	195	162	227	42	32	52	43	33	54
P for trend			0.63		0.14			0.056			0.051	
Waist circumference category (cm)												
≤80	44	10.2	9.7 10.6	233	208	257	54	47	62	56	48	64
>80	46	9.7	9.3 10.2	209	185	234	47	39	54	48	40	56
P value			0.157		0.187			0.155			0.139	
Body fat (%)												
< 30	13	10.6	9.8 11.4	210	164	256	48	34	63	50	35	65
≥ 30	76	9.8	9.5 10.2	223	204	242	51	45	57	52	46	58
P value			0.93		0.605			0.709			0.774	
Years since clinical diagnosis												
≤ 5 years	47	9.9	9.5 10.3	224	200	248	53	46	61	54	47	62
> 5 years	45	9.8	9.3 10.2	219	194	244	49	41	56	50	43	58
P value			0.650		0.765			0.420			0.489	
Fibromyalgia severity (score)[c]												
< 70	42	9.9	9.4 10.3	226	200	251	51	43	60	53	45	61
≥ 70	50	10.0	9.6 10.5	215	191	238	49	42	57	50	43	58
P value			0.632		0.546			0.725			0.636	
Marital status												

Married	72	9.9	9.6	10.3	217	198	237	50	43	56	51	44 57
Unmarried	22	10.0	9.4	10.7	229	194	264	54	43	65	56	44 67
P value			0.710			0.564			0.510			0.436
Educational level												
Below university degree	71	9.9	9.6	10.3	222	203	242	51	45	57	53	46 59
University degree	22	10.2	9.5	10.8	218	182	253	50	39	61	51	40 63
P value			0.519			0.814			0.791			0.830
Occupational status												
Working	29	9.8	9.3	10.3	222	196	247	51	43	59	52	44 60
Unemployed	41	10.1	9.6	10.7	236	205	266	55	45	64	57	47 66
Retired	24	10.0	9.3	10.6	197	163	232	45	34	56	46	35 57
P value			0.619			0.107			0.187			0.159

Abbreviations: CI, confidence interval; PA, physical activity; MVPA, moderate- to vigorous-intensity physical activity.

[a] Estimates and P values were adjusted for registered time.

[b] Weight (kg)/height $(m)^2$.

[c] Assessed with the Fibromyalgia Impact Questionnaire.

Analyses were conducted with physical activity and sedentary outcome variables logarithmically transformed to obtain a normal distribution, yet crude values are presented in the table for easier interpretation.

Table 2. Prevalence of meeting the physical activity recommendations (30 min/day of moderate-to-vigorous-intensity physical activity) on at least 5 days a week.

	N	%	95%CI		Frequency
Age groups (years)					
18-50	41	68.3	51.9	81.9	28
51-75	52	53.8	39.5	67.8	28
Body mass index category (kg/m^2)					
< 25	29	65.5	45.7	82.1	19
25-30	34	67.6	49.5	82.6	23
> 30	27	48.1	28.7	68.1	13
Waist circumference category (cm)					
≤80	44	68.2	52.4	81.4	30
>80	46	54.3	39.0	69.1	25
Body fat (%)					
< 30	13	61.5	31.6	86.1	8
≥ 30	76	61.8	50.0	72.8	47
Years since clinical diagnosis					
≤ 5 years	47	70.2	55.1	82.7	33
> 5 years	45	53.3	37.9	68.3	24
Fibromyalgia severity					
< 70	42	66.7	50.5	80.4	28
≥ 70	50	58	43.2	71.8	29
Marital status					
Married	72	61.1	48.9	72.4	44
Unmarried	22	59.1	36.4	79.3	13
Educational level					
Below university degree	71	62.0	49.7	73.2	44
University degree	22	59.1	0.0	0.0	13
Occupational status					
Working	29	62.1	42.3	79.3	18
Unemployed	41	68.3	51.9	81.9	28
Retired	24	45.8	25.6	67.2	11
All	94	60.6	52.5	73.2	57

Abbreviations: CI, confidence interval (expressed in %).

[a] Assessed with the Fibromyalgia Impact Questionnaire.

Table 3. Odds ratio (OR) and 95% confidence interval (CI) of meeting the physical activity recommendations (30 min/day of moderate-to-vigorous-intensity physical activity, 5 of 7 days) by age group, body mass index, waist circumference and percentage body fat category, years since clinical diagnosis, marital status, educational level and occupational status.

	OR	95% CI		P value
Age groups (years)				
18-50	Ref.			
51-75	0.542	0.231	1.273	0.160
Body mass index category (kg/m^2)				
> 30	Ref.			
25-30	2.252	0.794	6.385	0.127
< 25	2.046	0.698	5.997	0.192
Waist circumference category (cm)				
≤80	Ref.			
>80	0.556	0.235	1.312	0.180
Body fat category (%)				
< 30	Ref.			
≥ 30	0.987	0.297	3.309	0.983
Years since clinical diagnosis				
≤ 5 years	Ref.			
> 5 years	0.485	0.206	1.142	0.098
Fibromyalgia severity (score)*				
< 70	Ref.			
≥ 70	0.690	0.294	1.620	0.395
Marital status				
Married	Ref.			
Unmarried	0.919	0.347	2.432	0.865
Educational level				
Below university degree	Ref.			
University degree	0.886	0.334	2.351	0.809
Occupational status				
Retired	Ref.			
Unemployed	2.545	0.902	7.187	0.078
Working	1.934	0.645	5.803	0.239

Abbreviations: Ref., Reference group.

* Assessed with the Fibromyalgia Impact Questionnaire.

Table 4. Sedentary time and physical activity levels during weekdays (Monday to Friday) and during weekends (Saturday and Sunday) in women with fibromyalgia.

	Week		Weekend		Difference			
	mean	sd	mean	sd	mean	95% CI		P value
Sedentary (hours/day)	10.0	2.2	9.6	2.5	0.4	0.0	0.8	0.051
Average PA (counts/min)	225.1	88.5	201.0	98.0	24.0	7.8	40.2	0.004
Moderate PA (min/day)	53.1	28.4	42.6	28.0	10.5	5.5	15.5	<0.001
MVPA (min/day)	54.3	29.1	43.8	29.7	10.6	5.5	15.6	<0.001

Abbreviations: CI, confidence interval; PA, physical activity; MVPA, moderate-to-vigorous-intensity physical activity; sd, Standard deviation.
Analyses were conducted with physical activity and sedentary outcome variables logarithmically transformed to obtain a normal distribution, yet crude values are presented in the table for easier interpretation.

Figure legend

Figure 1. Sedentary time and physical activity (PA) mean time by week and weekend days.

Objectively measured sedentary time and physical activity in women with fibromyalgia; A cross-sectional study

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ARTICLE SUMMARY

Article focus:

- To characterize the levels of objectively measured sedentary time and physical activity (using accelerometry) in women with fibromyalgia.
- To provide estimates of the adherence to recommended levels of physical activity assessed by accelerometry (30 minutes of moderate-to-vigorous-intensity physical activity on 5 of 7 days).

Key Messages

- Over 60% of women with fibromyalgia meet the physical activity recommendations, that is, 30 min/day of moderate-to-vigorous-intensity physical activity on 5 or more days a week.
- These women spent about 71% (approximately 10 hours/day) of their waking time in activities that expend little energy.
- Women with fibromyalgia spent on average 10 min less of moderate-to-vigorous-intensity physical activity and 22 min less of sedentary behaviours during weekends compared with weekdays.

Strengths and Limitations

- Strict standardization of the methodology used to measure physical activity and the fact that all women were compliant with the measurements procedures is a strength.
- All women had 7 valid days with at least 10 hours of registered time during waking hours.
- To avoid any kind of immediate reactivity, we removed from the analysis the first day of monitoring.

- The cross-sectional design of our study does not allow however establishing any causal relationships. The sample is of convenience, which includes the known limitations of all non-probability samples.
- The accelerometer underestimates physical activities that involve upper body movement, those with minimal vertical displacement such as cycling, water-based activities such as swimming. Moreover, it does not capture well the extra energy cost of load-bearing activities such as walking while carrying a backpack.

ABSTRACT

Objectives: To characterize levels of objectively measured sedentary time and physical activity in women with fibromyalgia.

Design: Cross-sectional study.

Setting: Local Association of Fibromyalgia (Granada, Spain).

Participants: The study comprised 94 women with diagnosed fibromyalgia who did not have other severe somatic or psychiatric disorders, or other diseases that prevent physical loading, able to ambulate and to communicate, and capable and willing to provide informed consent.

Primary outcome measures: Sedentary time and physical activity was measured by accelerometry and was expressed as time spent in sedentary behaviours, average physical activity intensity (counts/minute) and amount of time (minutes/day) spent in moderate-intensity and in moderate-to vigorous-intensity physical activity (MVPA).

Results: The proportion of women meeting the physical activity recommendations of 30 min/day of MVPA on 5 or more days a week was 60.6%. Women spent on average 71% of their waking time (approximately 10 hours/day) in sedentary behaviours. Both sedentary behaviour and physical activity levels were similar across age groups, waist circumference and percentage body fat categories, years since clinical diagnosis, marital status, educational level, occupational status, as well as regardless the severity of the disease (all P>0.1). Time spent at moderate-intensity physical activity and MVPA was however lower in those with greater BMI (-6.6 min and -7 min respectively, per BMI category increase, <25, 25-30, >30 kg/m^2; P values for trend were 0.056 and 0.051 respectively). Women spent on average 10 min less on MVPA (P<0.001) and 22 min less on sedentary behaviours during weekends compared with weekdays (P=0.051).

Conclusions: These data provide an objective measure of the amount of time spent in sedentary activities and in physical activity in women with fibromyalgia.

Extra data is available by emailing ruizj@ugr.es

INTRODUCTION

Fibromyalgia is a pain regulation-related disorder [1]. Patients usually present an increased sensitivity to painful stimuli (hyperalgesia) and lowered pain threshold (allodynia). In addition to pain, fibromyalgia symptoms typically include severe fatigue, sleep disturbances, paresthesia of extremities, depression, anxiety, joint stiffness, and memory and cognitive difficulties [1 2]. Fibromyalgia is becoming a common syndrome in Western European countries, and estimates indicate a point prevalence of 2.9% which translates to approximately 6 million people with fibromyalgia [3].

There is increasing evidence about the potential benefits of regular physical activity on fibromyalgia-related symptoms [4-7], and International organizations supports the use of physical activity-based interventions as a complementary tool in the therapeutic armamentarium against fibromyalgia [8]. Physical inactivity is one of the major public health problems of the 21st century [9], and several longitudinal studies showed the negative consequences for health of a sedentary lifestyle [10 11].

The average amount of daily sedentary time as well as physical activity in women with fibromyalgia is rather unknown, and the available information is mainly questionnaire-based [12-16]. However, physical activities are difficult to recall, quantify and categorize [17], and it might be even more complex in people with memory and cognitive difficulties such as fibromyalgia patients [14]. Given the limitations of self-report methods, accelerometry (i.e. movement sensors) has become the method of choice for objectively measuring physical activity in free-living conditions [18]. To have an objective diagnosis of the sedentary time as well as of the physical activity levels in patients with fibromyalgia is of public health and of clinical interest, and might be informative for developing intervention studies directed to the promotion of physical activity in women with fibromyalgia [19].

The purpose of the present study was to characterize the levels of objectively measured (using accelerometry) sedentary time and physical activity among women with fibromyalgia, and to provide estimates of the adherence to recommended levels of physical activity [30 minutes of moderate-to-vigorous-intensity physical activity (MVPA) on 5 of 7 days] [20 21].

MATERIAL AND METHODS

Study participants

We sent a formal invitation to participate in the study to all members (n=400) of a Local Association of Fibromyalgia (Granada, Spain). A total of 116 patients responded (response rate 29%), and gave their written informed consent after receiving detailed information about the aims and study procedures. Participants were included in the study if: (i) they met the diagnosis of fibromyalgia according to the American College of Rheumatology criteria [22] (widespread pain for more than 3 months, and pain with 4 kg/cm^2 of pressure reported for 11 or more of 18 tender points), (ii) did not have other severe somatic or psychiatric disorders, or other diseases that prevent physical loading (answer "no" to all questions on the Physical Activity Readiness Questionnaire-PAR-Q [23] [24], (iii) were able to ambulate and to communicate, (iv) and were capable and willing to provide informed consent. Men were not included in the study (n=6), and women with incomplete physical activity data (n=5) or technical errors in the instrument (n=11) were excluded. A final sample of 94 women with fibromyalgia participated in the study. Age, weight and height, and fibromyalgia severity (assessed by the fibromyalgia impact questionnaire, FIQ) [25] [26] was similar between the included and excluded participants (all P>0.1). The study protocol was reviewed and approved by the Ethics Committee of the Hospital Virgen de las Nieves (Granada, Spain). The STROBE guidelines were followed during the course of the research [27].

Measurements

Women were interviewed in the Association of Fibromyalgia (Granada, Spain). They were asked to wear an accelerometer (Actigraph^{TM} GT1M, Pensacola, FL, USA) for 9 consecutive days starting the same day they received the monitor. The accelerometer was carried over the whole day (24 hrs) except during water-based activities such as bathing or swimming.

Accelerometers were initialized as described by the manufacturer, and data were recorded in 5 seconds epochs. Women wore the device on the lower back, secured with an elastic belt, underneath clothing, near to the center of gravity. The data were downloaded onto a computer using the manufacturer software. Data reduction, cleaning and analyses were performed using the MAHUffe program (see http://www.mrc-epid.cam.ac.uk/Research/Programmes/Programme_5/InDepth/Programme%205_Downloads.html).

Monitor wearing time was calculated by subtracting the sleeping reported time (recorded through a diary) from the total registered time for the entire day (i.e. 1440 minutes). Bouts of 60 continuous minutes of 0 activity intensity counts were also excluded from the analysis, considering these periods as non-wearing time [28]. There was no allowance for any minute with counts between 0-100 in the non-wear periods. A recording of more than 20,000 counts per minute (cpm) was considered as a potential malfunction of the accelerometer and the value was excluded from the analyses [28 29]. The first and last days of recording were not included in the analysis. A total of 7 days (full week) of recording with a minimum of 10 or more hours of registration per day was necessary to be included in the study analysis.

Sedentary time was estimated as the amount of time accumulated below 100 cpm during periods of wear time [30]. Time spent being sedentary was expressed as total duration (hours/day). Physical activity levels were estimated as follows: (i) Average physical activity intensity was expressed as mean cpm, and is a measure of overall physical activity. We calculated mean cpm as the sum of total counts per day divided by the number of minutes of wear time in that day; finally calculating the average of all valid days (n=7). (ii) Time engaged in moderate physical activity. We calculated the time engaged in moderate-intensity physical activity based upon a standardized cut-off of 1952-5724 cpm [29 31], where 1952 cpm corresponds to walking at 4 km/hour [31]. (iii) We also calculated the time engaged in MVPA as

the amount of time accumulated ≥1952 cpm. Sedentary time, as well as the study physical activity variables was calculated for weekdays and weekends. We calculated the proportion of women meeting the physical activity recommendations, that is 30 minutes/day of MVPA at least 5 of 7 days [20 21].

Weight and height were measured following standard procedures with a scale (InBody 720, Biospace, Seoul, Korea) and a stadiometer (Seca 22, Hamburg, Germany) respectively, and body mass index (BMI, weight in kg divided by height in m^2) was calculated. Percentage body fat was measured with bioelectrical impedance analysis (InBody R20; Biospace, Gateshead, UK). Waist circumference was measured at the level of the umbilicus with an anthropometric un-elastic tape (Harpenden anthropometric tape Holtain Ltd). Weight status groups were based on standard clinical definitions for BMI (normal weight: 18.5-24.9 kg/m^2, overweight: 25.0-29.9 kg/m^2, obese: 30.0 kg/m^2 or higher); percentage body fat (normal: <30%; obese: ≥30%); and waist circumference (normal: ≤ 80.0 cm; abdominal obesity: > 80 cm). One woman had a BMI below 18.5 kg/m^2 (18 kg/m^2) and was included in the normal weight group.

Fibromyalgia severity was assessed with the fibromyalgia impact questionnaire (FIQ) [25 26]. FIQ is composed of ten subscales: physical impairment, overall well-being, work missed, job difficulty, pain, fatigue, morning tiredness, stiffness, anxiety and depression. The score of each subscale was standardized from 0 to 10. We summed the score of all items, so that the total score ranged from 0 to 100, with a higher score indicating greater severity. Women were categorized into two groups based on the FIQ total score as FIQ <70 and FIQ ≥70. These thresholds corresponds with having moderate or severe fibromyalgia respectively [32].

Statistical analysis

All statistical analyses were performed with PASW (Predictive Analytics SoftWare, v. 18.0 SPSS Inc., Chicago, IL, USA), and the level of significance was set at $\alpha = 0.05$. Physical activity and sedentary outcome variables were logarithmically transformed to obtain a normal distribution.

We calculated the estimated means of sedentary time, average physical activity intensity, moderate physical activity and MVPA by age group, BMI and waist circumference categories, years since clinical diagnosis, fibromyalgia severity, marital status, educational level and occupational status, after adjusting for registered time. Linear regression analysis was conducted to examine the association of sedentary time, average physical activity intensity, moderate-intensity physical activity and MVPA (inserted as dependent variables) with age group, BMI, waist circumference and percentage body fat categories, years since clinical diagnosis, fibromyalgia severity and educational level (inserted as independent variables). Independent variables were inserted as ordinal variables. As marital status and occupational status categories were not ordinal variables, we conducted one-way analysis of covariance to determine mean differences in sedentary time and physical activity levels among marital status and occupational status categories. Separate analyses were conducted for each dependent and independent variable. Registered time was entered as confounder in all models. Mean differences of sedentary time, physical activity, moderate physical activity and MVPA levels on week days (Monday to Friday) vs. weekend (Saturday and Sunday) were estimated with one-way analysis of variance for repeated measures.

We analysed the association of meeting the physical activity recommendations (≥30 minutes/day of MVPA on 5 of 7 days a week) with age, waist circumference and percentage body fat, years since clinical diagnosis, fibromyalgia severity, marital status, educational level and using binary logistic regression analysis. Multinomial regression analysis was conducted

to examine the association of meeting the physical activity recommendations with BMI and occupational status categories.

RESULTS

All participants had 7 valid days of registration. Mean registered time during waking time was 842±108 minutes/day (~14±1.8 hours). There was no significant association of sedentary time and physical activity with age group, waist circumference and percentage body fat categories, years since clinical diagnosis, fibromyalgia severity, marital status, educational level and occupational status (all P>0.1, Table 1). Levels of moderate-intensity physical activity and MVPA were lower in women with greater BMI ($\hat{\beta}$ = -6.6±3.4 and -7±3.6 min respectively, per BMI category increase (i.e. 18.5-24.9 kg/m^2, 25.0-29.9 kg/m^2, and ≥30.0 kg/m^2; P values for trend were 0.056 and 0.051 respectively, Table 1). Mean estimates of sedentary time and physical activity intensity levels were similar in women with FIQ <70 compared with those with FIQ ≥70 (all P>0.5, Table 1). For sensitivity analyses, we explored whether the association between physical activity intensity levels and FIQ differ when a different FIQ threshold (FIQ ≥59) [33] was used, yet the findings persisted (data not shown).

The proportion of women meeting the physical activity recommendations by age group, BMI, waist circumference and percentage body fat categories, years since clinical diagnosis, fibromyalgia severity, marital status, educational level and occupational status are shown in Table 2. The proportion of women meeting the physical activity recommendations was 60.6% (n=57, 95%CI: 52.5-73.2%). The OR of meeting the physical activity recommendations were lower, yet not reaching statistical significance, in the oldest group (OR: 0.542, 95%CI: 0.231-1.237, P=0.160), in those with a high waist circumference (OR: 0.556, 95%CI: 0.235-1.312, P=0.180), and in those diagnosed with fibromyalgia more than 5 years ago (OR: 0.485, 95%CI: 0.206-1.142, P=0.098) (Table 3). The OR of meeting the physical activity recommendations was higher, yet not reaching statistical significance, in non-overweight (BMI <25kg/m^2) and in the overweight (BMI=25-30kg/m^2) group compared with the obese peers (OR: 2.046, 95%CI: 0.698-5.997, P=0.192; OR: 2.252, 95%CI: 0.794-

6.385, P=0.127) (Table 4). Unemployed women had also higher OR of meeting the recommendations (OR: 2.545, 95%CI: 0.902-7.187, P=0.078). The OR of meeting the physical activity recommendations was lower in women with FIQ ≥70 (OR: 0.690, 95%CI: 0.294-1.620, P=0.395). The findings persisted when another suggested FIQ threshold (>59 vs. ≥59) was used [33] (data not shown). Women spent on average 71% of their waking time (approximately 10 hours/day) in sedentary behaviours. The results did not change after adjusting for registered time (data not shown).

Sedentary time and physical activity levels during weekdays (Monday to Friday) and during weekend time (Saturday and Sunday) in women with fibromyalgia are shown in table 4. Mean levels of physical activity were lower during weekends compared with weekdays (mean difference: 24 cpm, 95%CI: 7.8-40.2, P=0.004). Likewise, registered time at moderate-intensity physical activity and MVPA was lower during weekends (mean difference: 10.5 min/day, 95%CI: 5.5-15.5, P<0.001; and 10.6 min/day, 95%CI: 5.5-15.6, P<0.001), respectively). Mean levels of sedentary time were also lower during weekends (mean difference: 22.6 min/day, 95%CI: 0-45.3, P=0.051). Figure 1 shows the sedentary time and physical activity mean time by week and weekend days.

DISCUSSION

The main purpose of the present study was to characterize levels of sedentary time and physical activity in women with diagnosed fibromyalgia as well as to describe the adherence to recommended levels of physical activity assessed by accelerometry. Over half of the women (60.6%) met the physical activity recommendations (30 min/day of MVPA on 5 or more days a week). These women spent on average 71% (approximately 10 hours/day) of their waking time in sedentary behaviours, that is, in activities that expend little energy. We observed that both sedentary behaviour and physical activity levels were similar across the study demographic factors as well as regardless the severity of the disease. Women spent on average 10 min less on MVPA and 22 min less on sedentary behaviours during weekends compared with weekdays.

The present study showed that 60.6% of women met the recommendation to accumulate 30 or more min/day of physical activity of MVPA on most days of the week. The variation in meeting the recommendations was not associated with the study demographic factors, and despite the prevalence of meeting the recommendations tend to be lower in the oldest group, in the overweight group and in those with a higher waist circumference, in those with fibromyalgia being diagnosed more than 5 years ago, and in the retired group, the associations were not statistically significant. Time spent at moderate-intensity physical activity and MVPA tended to be however lower in those with greater BMI (-6.6 min and -7 min, respectively, per BMI category increase, <25, 25-30, >30 kg/m^2), which concur with studies in healthy adults [29]. This may have important health implications since obese female fibromyalgia patients seem to have higher levels of pain, anxiety and depression and worse quality of life, as well as lower functional capacity than their normal weight peers [34].

Despite several attempts have been made to objectively quantify sedentary behaviours and physical activity levels in people with fibromyalgia [12 13 35-38], to our knowledge, there are

no previous studies showing the prevalence of meeting the physical activity recommendations in women with fibromyalgia, which hamper between study comparisons. Mcloughlin et al. [13] measured physical activity with accelerometry in 26 female fibromyalgia patients aged 42.7±12 years, yet they did not show the prevalence of meeting the recommendations. They showed however that time spent at moderate intensity using the same intensity threshold as used in the present study [31] was 15±8 minutes/day which is on average ~35 minutes lower (using the 51-75 years age group as a reference group) than the time observed in the present study. Kaleth et al. [12] also measured physical activity with accelerometry in 30 fibromyalgia patients (27 women), but unfortunately, they did not show physical activity estimates. Kashikar-Zuck et al. [38] measured physical activity with accelerometry in a juvenile primary fibromyalgia syndrome group of adolescents and showed that only 23% achieved 30 minutes/day of MVPA, and that only 1 patient achieved the recommended levels of physical activity for their age, that is 60 minutes/day of MVPA [20 21].

Data coming from apparently healthy women showed lower rates of meeting the recommendation than those observed in the present study [28 29 39 40]. Hagströmer et al. [29] reported that 48% of a representative sample of Swedish women accumulated 30 minutes/day of MVPA, and data from the Canadian Health Measures Survey [40] showed that less than 5% engaged in 30 minutes/day of MVPA at least 5 of 7 days. Similarly, findings from the National Health and Nutritional Examination Survey (NHANES) 2003–2004 indicated that less than 5% of a representative sample of women from U.S [28] met the physical activity recommendations, and 7% of U.S women met the physical activity recommendations in 2005–2006 (NHANES) [39]. Methodological procedures used to measure physical activity such as number of valid days included in the analysis, exclusion of the first recording day to avoid reactivity and criteria used to define compliance, may partially explain the observed differences among studies. Whereas in our study all women had 7 valid days with at least 10

hours of registered time during waking hours, in the other studies participants with 4 valid days were included in the study. Of note is that, for example, the NHANES 2003–2004 [28] study included participants with just with one or more valid days when calculated population adherence estimates. Besides the above-mentioned methodological difference, it cannot be discarded however that cultural differences might also explain the observed discrepancies.

Sedentary behaviours refer to those activities that do not increase resting energy expenditure substantially, that is, no more than 1.5 times resting energy expenditure [41]. These activities involved sitting, reclining and lying down such as watching television, studying, reading, etc. In the present study we observed that women spend on average 10 hours/day (~71%) of their waking time in sedentary activities, which is similar to that observed in Portuguese women [42], and slightly higher than American and Swedish women (about 7-8 hours) [29] . Mcloughlin et al. [13] also measured sedentary time with accelerometry, yet data are not comparable with our study because they included sleeping time as a sedentary activity. They reported that women with fibromyalgia spend 1,154±59 minutes/day at sedentary behaviours, which together with the registered time in other physical activity intensities summed ~1,440 min, which is a full day. We observed no association of sedentary time with any of the study demographic factors, which concur with the Swedish study by Hagströmer et al. [29]. Similarly, women with a higher severity of the disease (FIQ≥70) showed similar sedentary patterns as those with a FIQ<70, which concur with the findings reported by McLoughlin et al. [13].

In our study, women with fibromyalgia spend less time (~10 minutes/day) on MVPA and on sedentary time (~22 minutes/day) during weekends compared with weekdays. These findings are in agreement with the results reported by Cooper et al. [43]. The observed physical activity reduction during weekends could be partially explained by a reduced transport-related physical activity when commuting to or from work, whereas the reduction of sedentary time

could be due to a reduced work-related sitting time. More studies quantifying and characterizing physical activity and sedentary patterns during weekends and weekdays are needed.

The present study has several limitations. The cross-sectional design of our study does not allow establishing any causal relationship. The sample is of convenience and includes the known limitations of all non-probability samples, including less representativeness and unknown levels of sampling error. Further studies involving randomly recruited patients with fibromyalgia are needed. Of note is also the relatively low response rate (29%). We cannot discard that women who accepted to participate in this study are those more aware of the importance of having an active lifestyle, which may have influenced the results. It should also be mentioned that the accelerometer underestimates physical activities that involve upper body movement, those with minimal vertical displacement such as cycling, water-based activities such as swimming, and it does not capture well the extra energy cost of load-bearing activities, such as walking while carrying a backpack. Nevertheless, walking is the most prevalent leisure-time physical activity among women with fibromyalgia [15], and is likely the type of activity they do at work and for transportation. We used the same cut-points for all ages and BMI levels as has been done in previous studies [28 29]. Use of a single cut point for all ages and BMI levels may however lead to an underestimate of moderate-intensity activity for the older and heavier group by not accounting for the decline in exercise capacity with age and weight. We do not present data on vigorous physical activity because the time spent at this intensity ranged from 0 to 2 min (see table 1, subtract moderate intensity to MVPA). On average, ~98% of the time spend at MVPA is moderate-intensity physical activity. This is consistent with the available clinical knowledge on this population, and concur with data from apparently healthy women from Sweden [29]. The observed low levels of vigorous physical activity could also suggest that the cut point for this intensity was too high, thereby missing

many minutes of activity in our population that should have been classified as vigorous physical activity. Unfortunately, we have no data on an age- and culturally-matched group of healthy women, so that direct comparison cannot be made. Mcloughlin et al. [13] observed that female fibromyalgia patients (n=26) were less active than a group of healthy women (n=26), yet the healthy group was younger and had higher level of education than the patients group. Despite the number of participants in the present study is relatively small, to date, this is the largest series described in adults. We do not know whether these findings apply to men, therefore, future studies should quantify both sedentary time and physical activity in this group of patients. We [44] and others [45] observed gender differences in patients with fibromyalgia, therefore studies focused on examining gender differences on sedentary time and physical activity will provide further insights on whether preventive and interventions strategies should be gender-specific.

One of the strengths of the present study was however the strict standardization of methodology used to measure physical activity, and the fact that all women were compliant with the measurements procedures. All women had 7 valid days with at least 10 hours of registered time during waking hours. Indeed, the mean daily accelerometer wear time was 14±1.8 hours/day. We do not know whether women modified their habitual sedentary behavior or physical activity during the days they were monitored despite they were advised to keep on with their normal life. To avoid any kind of immediate reactivity, we removed from the analysis the first day of monitoring.

Modifiable lifestyle factors, such as physical activity, may have a great potential as a public health instrument to prevent and contribute to the treatment of fibromyalgia. Longitudinal studies are also needed to further understand the predictive value of sedentary behaviours and physical activity over the course of the disease, and whether preventive strategies should start at the early stages of the disease development. To have an objective

estimate of the patient's sedentary behaviour as well as the engagement in physical activity could be used as a potential tool to increase the effectiveness of treatment approaches as well as to reduce disability and enhance quality of life in people with fibromyalgia. Indeed, Fontaine et al. [46] observed that accumulating 30 minutes of moderate-intensity physical activity throughout the day produces clinically relevant changes in perceived physical function and pain in previously minimally active adults with fibromyalgia.

In summary, these data provide an objective measure of amount of time spent in sedentary activities and in physical activity in women with fibromyalgia. These estimates can be used for comparisons with other rheumatologic diseases, as baseline reference levels for monitoring, and to assess the effectiveness of intervention strategies promoting physical activity in women with fibromyalgia.

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Author contributions

JRR: Conception and design of the study, data collection, statistical analysis and interpretation of data, drafting the article

VSJ: Data collection, interpretation of data, and revising the article critically for important intellectual content

FOP: Conception and design of the study, interpretation of data, and revising the article critically for important intellectual content

IAG: Data collection, interpretation of data, and revising the article critically for important intellectual content

DCM: Data collection, interpretation of data, and revising the article critically for important intellectual content

VAA: Conception and design of the study, data collection, interpretation of data, and revising the article critically for important intellectual content

ACB: Conception and design of the study, data collection, interpretation of data, and revising the article critically for important intellectual content

PF: Statistical analysis, interpretation of data, and revising the article critically for important intellectual content

DMI: Interpretation of data, and revising the article critically for important intellectual content

MDF: Conception and design of the study, data collection, interpretation of data, and revising the article critically for important intellectual content

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Table 1. Sedentary time and physical activity levels in women with fibromyalgia, by age group, body mass index, waist circumference and percentage body fat category, years since clinical diagnosis, fibromyalgia impact, marital status, educational level and occupational status[a].

		Sedentary (hours/day)			Average PA (counts/minutes)			Moderate PA (min/day)			MVPA (min/day)		
	N	Mean	95% CI		Mean	95% CI		Mean	95% CI		Mean	95% CI	
Age groups (years)													
18-50	41	10.0	9.6	10.5	222	196	248	51	43	59	52	44	60
51-75	52	9.9	9.5	10.3	219	195	242	50	43	58	52	44	59
P value			0.65			0.86			0.96			0.98	
Body mass index[b] category (kg/m^2)													
< 25	29	10.3	9.7	10.8	229	199	260	56	47	65	58	48	67
25-30	34	9.5	9.0	10.0	235	207	263	53	44	61	54	45	63
> 30	27	10.1	9.6	10.7	195	162	227	42	32	52	43	33	54
P for trend			0.63			0.14			0.056			0.051	
Waist circumference category (cm)													
≤80	44	10.2	9.7	10.6	233	208	257	54	47	62	56	48	64
>80	46	9.7	9.3	10.2	209	185	234	47	39	54	48	40	56
P value			0.157			0.187			0.155			0.139	
Body fat (%)													
< 30	13	10.6	9.8	11.4	210	164	256	48	34	63	50	35	65
≥ 30	76	9.8	9.5	10.2	223	204	242	51	45	57	52	46	58
P value			0.93			0.605			0.709			0.774	
Years since clinical diagnosis													
≤ 5 years	47	9.9	9.5	10.3	224	200	248	53	46	61	54	47	62
> 5 years	45	9.8	9.3	10.2	219	194	244	49	41	56	50	43	58
P value			0.650			0.765			0.420			0.489	
Fibromyalgia severity (score)[c]													
< 70	42	9.9	9.4	10.3	226	200	251	51	43	60	53	45	61
≥ 70	50	10.0	9.6	10.5	215	191	238	49	42	57	50	43	58
P value			0.632			0.546			0.725			0.636	
Marital status													

Married	72	9.9	9.6	10.3	217	198	237	50	43	56	51	44 57
Unmarried	22	10.0	9.4	10.7	229	194	264	54	43	65	56	44 67
P value			0.710			0.564			0.510			0.436
Educational level												
Below university degree	71	9.9	9.6	10.3	222	203	242	51	45	57	53	46 59
University degree	22	10.2	9.5	10.8	218	182	253	50	39	61	51	40 63
P value			0.519			0.814			0.791			0.830
Occupational status												
Working	29	9.8	9.3	10.3	222	196	247	51	43	59	52	44 60
Unemployed	41	10.1	9.6	10.7	236	205	266	55	45	64	57	47 66
Retired	24	10.0	9.3	10.6	197	163	232	45	34	56	46	35 57
P value			0.619			0.107			0.187			0.159

Abbreviations: CI, confidence interval; PA, physical activity; MVPA, moderate- to vigorous-intensity physical activity.

[a] Estimates and P values were adjusted for registered time.

[b] Weight (kg)/height $(m)^2$.

[c] Assessed with the Fibromyalgia Impact Questionnaire.

Analyses were conducted with physical activity and sedentary outcome variables logarithmically transformed to obtain a normal distribution, yet crude values are presented in the table for easier interpretation.

Table 2. Prevalence of meeting the physical activity recommendations (30 min/day of moderate-to-vigorous-intensity physical activity) on at least 5 days a week.

	N	%	95%CI		Frequency
Age groups (years)					
18-50	41	68.3	51.9	81.9	28
51-75	52	53.8	39.5	67.8	28
Body mass index category (kg/m^2)					
< 25	29	65.5	45.7	82.1	19
25-30	34	67.6	49.5	82.6	23
> 30	27	48.1	28.7	68.1	13
Waist circumference category (cm)					
≤80	44	68.2	52.4	81.4	30
>80	46	54.3	39.0	69.1	25
Body fat (%)					
< 30	13	61.5	31.6	86.1	8
≥ 30	76	61.8	50.0	72.8	47
Years since clinical diagnosis					
≤ 5 years	47	70.2	55.1	82.7	33
> 5 years	45	53.3	37.9	68.3	24
Fibromyalgia severity					
< 70	42	66.7	50.5	80.4	28
≥ 70	50	58	43.2	71.8	29
Marital status					
Married	72	61.1	48.9	72.4	44
Unmarried	22	59.1	36.4	79.3	13
Educational level					
Below university degree	71	62.0	49.7	73.2	44
University degree	22	59.1	0.0	0.0	13
Occupational status					
Working	29	62.1	42.3	79.3	18
Unemployed	41	68.3	51.9	81.9	28
Retired	24	45.8	25.6	67.2	11
All	94	60.6	52.5	73.2	57

Abbreviations: CI, confidence interval (expressed in %).

[a] Assessed with the Fibromyalgia Impact Questionnaire.

Table 3. Odds ratio (OR) and 95% confidence interval (CI) of meeting the physical activity recommendations (30 min/day of moderate-to-vigorous-intensity physical activity, 5 of 7 days) by age group, body mass index, waist circumference and percentage body fat category, years since clinical diagnosis, marital status, educational level and occupational status.

	OR	95% CI		P value
Age groups (years)				
18-50	Ref.			
51-75	0.542	0.231	1.273	0.160
Body mass index category (kg/m^2)				
> 30	Ref.			
25-30	2.252	0.794	6.385	0.127
< 25	2.046	0.698	5.997	0.192
Waist circumference category (cm)				
≤80	Ref.			
>80	0.556	0.235	1.312	0.180
Body fat category (%)				
< 30	Ref.			
≥ 30	0.987	0.297	3.309	0.983
Years since clinical diagnosis				
≤ 5 years	Ref.			
> 5 years	0.485	0.206	1.142	0.098
Fibromyalgia severity (score)*				
< 70	Ref.			
≥ 70	0.690	0.294	1.620	0.395
Marital status				
Married	Ref.			
Unmarried	0.919	0.347	2.432	0.865
Educational level				
Below university degree	Ref.			
University degree	0.886	0.334	2.351	0.809
Occupational status				
Retired	Ref.			
Unemployed	2.545	0.902	7.187	0.078
Working	1.934	0.645	5.803	0.239

Abbreviations: Ref., Reference group.

* Assessed with the Fibromyalgia Impact Questionnaire.

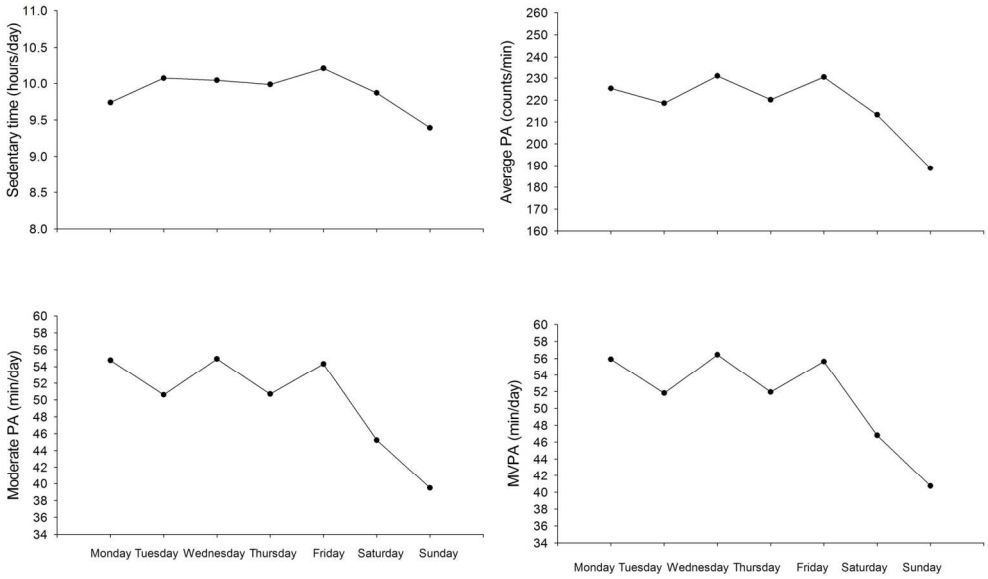
Table 4. Sedentary time and physical activity levels during weekdays (Monday to Friday) and during weekends (Saturday and Sunday) in women with fibromyalgia.

	Week		Weekend		Difference			
	mean	sd	mean	sd	mean	95% CI		P value
Sedentary (hours/day)	10.0	2.2	9.6	2.5	0.4	0.0	0.8	0.051
Average PA (counts/min)	225.1	88.5	201.0	98.0	24.0	7.8	40.2	0.004
Moderate PA (min/day)	53.1	28.4	42.6	28.0	10.5	5.5	15.5	<0.001
MVPA (min/day)	54.3	29.1	43.8	29.7	10.6	5.5	15.6	<0.001

Abbreviations: CI, confidence interval; PA, physical activity; MVPA, moderate-to-vigorous-intensity physical activity; sd, Standard deviation.
Analyses were conducted with physical activity and sedentary outcome variables logarithmically transformed to obtain a normal distribution, yet crude values are presented in the table for easier interpretation.

Figure legend

Figure 1. Sedentary time and physical activity (PA) mean time by week and weekend days.



146x90mm (300 x 300 DPI)

STROBE 2007 (v4) checklist of items to be included in reports of observational studies in epidemiology*

Checklist for cohort, case-control, and cross-sectional studies (combined)

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3
Objectives	3	State specific objectives, including any pre-specified hypotheses	4
Methods			
Study design	4	Present key elements of study design early in the paper	6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6
Participants	6	(*a*) *Cohort study*—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up *Case-control study*—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls *Cross-sectional study*—Give the eligibility criteria, and the sources and methods of selection of participants	6
		(*b*) *Cohort study*—For matched studies, give matching criteria and number of exposed and unexposed *Case-control study*—For matched studies, give matching criteria and the number of controls per case	6
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6-9
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	*6-9*
Bias	9	Describe any efforts to address potential sources of bias	6
Study size	10	Explain how the study size was arrived at	6
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	9
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	9
		(*b*) Describe any methods used to examine subgroups and interactions	9
		(*c*) Explain how missing data were addressed	9
		(*d*) *Cohort study*—If applicable, explain how loss to follow-up was addressed *Case-control study*—If applicable, explain how matching of cases and controls was addressed	9

		Cross-sectional study—If applicable, describe analytical methods taking account of sampling strategy	
		(*e*) Describe any sensitivity analyses	9
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	10-11
		(b) Give reasons for non-participation at each stage	
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	10-11
		(b) Indicate number of participants with missing data for each variable of interest	
		(c) *Cohort study*—Summarise follow-up time (eg, average and total amount)	
Outcome data	15*	*Cohort study*—Report numbers of outcome events or summary measures over time	10-11
		Case-control study—Report numbers in each exposure category, or summary measures of exposure	
		Cross-sectional study—Report numbers of outcome events or summary measures	
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	
		(*b*) Report category boundaries when continuous variables were categorized	
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	
Discussion			
Key results	18	Summarise key results with reference to study objectives	12
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	15-16
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	15-16
Generalisability	21	Discuss the generalisability (external validity) of the study results	15-16
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	17

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.