1
2 **POST-PRINT**
3

4 Bernard, P., Hains-Monfette, G., Atoui, S., & Kingsbury, C. (2018). Differences in daily objective
5 physical activity and sedentary time between women with self-reported fibromyalgia and controls:
6 results from the Canadian health measures survey. *Clinical Rheumatology*, 1–6.

7 <https://doi.org/10.1007/s10067-018-4139-6>
8
9

10 **Differences in daily objective physical activity and sedentary time between women with**
11 **self-reported fibromyalgia and controls: results from the Canadian Health Measures**
12 **Survey**
13
14

15 **Bernard P^{*1,2}, Hains-Monfette G^{1,2}, Atoui S^{1,2}, Kingsbury C^{1,2}**
16

17 ¹Department of Physical Activity Sciences, Université du Québec à Montréal, Montréal, Québec ,
18 Canada
19

20 ² Research Center, University Institute of Mental Health at Montreal, Montréal, Québec, Canada
21
22
23
24

25 *Corresponding author: Paquito Bernard

26 Université du Québec à Montréal, Montréal, Canada

27 Faculté des sciences

28 Département des Sciences de l'Activité Physique

29 UQÀM, Complexe des Sciences

30 Pavillon des sciences biologiques (SB), Local: SB-4445

31 141, Avenue du Président Kennedy

32 Montréal, Québec, Canada, H2X 1Y4

33 bernard.paquito@uqam.ca

34 <https://orcid.org/0000-0003-2180-9135>
35
36

37 **Acknowledgments**

38 The authors would like to thank Noella Everard, the participants of the Canadian Health Measures Survey
39 as well as all staff at Statistics Canada involved in the operations of the survey. PB is supported by
40 Université du Québec à Montréal, Institut Universitaire de Santé Mentale de Montréal and by a salary award
41 from the Fonds de recherche du Québec - Santé. GHM and SA are supported by the Quebec Inter-
42 university Center for Social Statistics.

43
44 **Contributors**

45 PB conceived the study. PB provided statistical expertise in complex survey. GHM and SA conducted
46 the primary statistical analyses and wrote results section. PB and CK wrote introduction and discussion
47 sections. All authors contributed to refinement of the study protocol and approved the final manuscript

48
49 **Declaration of interest**

50 All authors declare that they have no competing interests for this work.

51

52

53

54

55

56 **Abstract**

57 **Introduction**

58 Physical activity and sedentary behaviors are important modifiable factors that influence health and
59 quality of life in women with fibromyalgia. The purpose of this study was to compare objectively
60 assessed physical activity and sedentary time in women self-reporting fibromyalgia with a control
61 group.

62 **Method**

63 Data were drawn from the Canadian Health Measures Survey cycle 1, 2 and 3 conducted by Statistics
64 Canada. We included women aged 18 to 79 years with complete accelerometer data. We performed
65 one-way analyses of covariance (adjusted-for socio-demographic and health factors) to determine
66 mean differences in physical activity and sedentary variables (minutes per day of moderate and
67 vigorous physical activity, light physical activity, sedentary and daily steps) between women with and
68 without fibromyalgia.

69 **Results**

70 In total, 4132 participants were included. A cross-sectional weighted analysis indicated that 3,1% of
71 participants self-reported a diagnosis of fibromyalgia. Participants with fibromyalgia spent less time than
72 controls engaged in moderate and vigorous physical activity ($M = 19.2 \text{ min/d}$ ($SE=0.7$) vs $M = 9.1 \text{ min/d}$
73 ($SE=1.2$), $p = 0.03$, $\eta^2 = 0.01$). No significant differences were found for daily time spent in light physical
74 activity, sedentary activities and number of steps.

75 **Conclusion**

76 Women participants with self-reported fibromyalgia spent significantly less time in moderate and
77 vigorous physical activity than control. Physical activity promotion interventions for women with self-
78 reported fibromyalgia should, as a priority, target physical activities with moderate to vigorous intensity.

79

80 **Keywords**

81 Exercise, Fibromyalgia, Canada, Sedentary, walking

82 **Introduction**

83 Fibromyalgia is a chronic disease defined by the American College of Rheumatology as generalized
84 pain lasting for longer than three months with tenderness on palpation at least four of five specific
85 tender points [1]. Individuals with fibromyalgia typically experience severe fatigue, sleep disturbances
86 and emotional disorders [2]. Taken together, these symptoms impair daily life activities and reduce
87 health related quality of life [3].

88 Physical activity and sedentary levels are major modifiable factors that influence fibromyalgia because
89 they are independently associated with less severe symptoms [4, 5], better sleep quality [6] and higher
90 quality of life [4]. A recent Cochrane review suggested that exercise interventions improve health
91 related quality of life and physical functions at short term. However, authors recommended further trials
92 to draw solid conclusions [7].

93 The assessment of physical activity and sedentary behaviors is challenging, particularly for adults with
94 fibromyalgia. Indeed, self-reported measures of physical activity were found to be poorly associated
95 with objective measures [8, 9]. Thus, it appears complicated to clearly understand the physical activity
96 and sedentary patterns based on self-reported measures.

97 Different levels of physical activity and sedentary have been previously objectively measured in women
98 diagnosed with fibromyalgia and compared to healthy controls. Three previous cross-sectional
99 investigations established that patients with fibromyalgia have a significantly reduced duration of
100 moderate and vigorous physical activity (MVPA) [9–11]. Contradictory findings were found about light
101 physical activity (LPA), number of steps and sedentary activities [9–11].

102 Another issue that needs to be investigated using objective measures is whether daily sedentary time is
103 higher in adults with fibromyalgia. Only one study investigated this question and suggested that
104 participants with fibromyalgia spent significantly more time than controls in sedentary activities [11]. The
105 purpose of this study was to compare objectively assessed physical activity and sedentary in a
106 representative sample of women self-reporting fibromyalgia with a control group.

107

108 **Methods**

109 **Participants and study background**

110 Data were drawn from the Canadian Health Measures Survey (CHMS) cycle 1, 2 and 3 conducted by
111 Statistics Canada between 2007 and 2013. The CHMS is a national survey representative of
112 approximately 96% of the Canadian population, aged 6 to 79 years [12]. Data were collected in 2
113 stages. First, sociodemographic and general health information were collected during an in-person
114 household interview at the participants' homes. Then, direct physical measurements were collected
115 during a subsequent visit to a mobile examination center. All respondents provided written informed
116 consent. Ethics approval to conduct the survey was obtained from Health Canada's Research Ethics
117 Board [13]. We included women aged 18 to 79 years with complete physical activity data. Participants
118 with functional limitation or pregnant women were excluded.

119 **Sociodemographic and clinical characteristics.**

120 We used data for age, level of education, household income, working status (yes/no for last 12-month),
121 marital status, smoking status, cotinine levels, and body mass index to describe the sample.

122 Women with self-reported fibromyalgia (SRF) was defined by the response to the following question
123 during the CHMS interview: "Has a health care provider ever diagnosed you that you had
124 fibromyalgia?". The other self-reported clinical characteristics measured were the following: subjective
125 health compared to previous year, mental health, diagnosis of mood disorder, quality of life, sleep
126 duration, sleep problems and restorative sleep.

127 **Objective measures of physical activity and sedentary**

128 Physical activity and sedentary behaviors were objectively measured using the Actical accelerometer
129 (Phillips -Respironics). Actical recorded time-stamped acceleration in all directions, thereby indicating
130 the intensity of physical activity [14]. Participants were instructed to wear an Actical accelerometer over
131 their right hip on an elasticized belt during their waking hours for seven consecutive days (weight: 17
132 grams). Accelerometer signals are also translated into steps accumulated per minute. The Actical has
133 been validated to measure physical activity in adults [14]. In order to be included in the analyses,
134 respondents had to have four or more valid days of actigraphic data (i.e., defined as 10 or more hours

of wear time) [15]. Accelerometer data were not included in the analyses if a participant had extreme counts (i.e., 20 000 cpm) [16]. The number of minutes per day spent in physical activity at different intensity levels was categorized using standard count value per minute (cpm) for adults: sedentary (<100 count value per minute [cpm]), light (100 to 1534 cpm), moderate and vigorous (≥ 1535 cpm) [17]. The following variables were separately used in analyses: average steps per day, average minutes per day of LPA and MVPA, and average minutes per day of sedentarity.

Statistical analyses

To account for the complex, multistage probability sampling design, weights (i.e., activity monitor subsample weights combining cycle 1, 2, 3) and bootstraps provided by the CHMS were used in the analyses. Differences in socio-demographic and physical activity/sedentary characteristics were assessed with t-test and chi-square test. The data on MVPA were not normally distributed and were therefore log transformed. We performed one-way analyses of covariance (ANCOVA) to determine mean differences in physical activity and sedentary variables between women with and without SRF. Age, body mass index, accelerometer wearing time, season, occupational status, smoking (cotinine), education level and income were included in all ANCOVA. All analyses were carried out using *survey* [18] package in R version 3.3.

Results

Data from 4132 participants were available for the analyses. Cross-sectional weighted analyses indicated that 3.1% of CHMS women self-reported a diagnosis of fibromyalgia. Women with SRF were significantly older, had a higher body mass index, and were less likely to be employed. They reported a significant deterioration of health during the last 12-month, a higher frequency of impaired mental health and sleep outcomes. On average, women with SRF spent 9.1 (SE = 1.2), 196.6 (SE = 8.6) and 546.8 (SE = 12.6) minutes per day of MVPA, LPA and sedentary behavior, respectively. They also performed 6084 (SE = 318) daily steps. Data from six univariate outliers were excluded because of extreme accelerometer data. Table 1 shows weighted characteristics of participants included in the analyses.

The participants with SRF spent less time than controls engaged in MVPA ($M = 9.1$ min/d (SE=1.2), $p = 0.03$ versus $M = 19.3$ min/d (SE=0.7), $\eta^2 = 0.01$). No significant differences were found for daily time

162 spent in light PA, sedentary activities and average step counts. Figure 1 shows the daily physical
163 activity and sedentary time in participants with and without SRF (see online for supplementary tables
164 and detailed results).

165

166 **Discussion**

167 The purpose of the present study was to compare physical activity and sedentary durations in women
168 with SRF with a control group in a representative national sample. The key finding of this study was that
169 only daily MVPA duration was significantly lower in women with SRF, whereas no significant
170 differences was found for time spent in LPA, sedentary and daily number of steps.

171 The weighted SRF prevalence (3.1%) in our sample was in accordance with international studies [19],
172 ranged from 2.4 to 6.8%. Participants with SRF had a deteriorated perceived health, mental health,
173 quality of life and sleep. In comparison to previous investigations including female with diagnosis of
174 fibromyalgia [9, 11], CHMS's women with SRF had similar time spent in daily physical activity and
175 sedentary activities.

176 The significant lower level of MVPA in women with SRF is consistent with previous findings including
177 participants with diagnosis of fibromyalgia [9–11]. However, the effect size was small compared to
178 those observed in these studies [9–11]. Regarding to daily LPA, no significant difference was also
179 observed in two previous investigations [9, 10]. However, it is inconsistent with a study showing that
180 women with fibromyalgia spent lower time in LPA [11]. Findings from daily step counts suggest that
181 women with or without SRF take similar steps per day. It differs from Segura-Jiménez et al. that found a
182 significant difference (with large effect) between fibromyalgia patients and controls [11]. In the current
183 study, participants with SRF spent ~7 hours per day being engaged in sedentary behaviors; it was not
184 significantly lower than control subjects. Segura-Jiménez et al. reported a significant difference
185 between females diagnosed with fibromyalgia and control subjects [11]. Our findings contrast with the
186 aforementioned study for time spent in LPA, sedentary activities and daily steps. These differences
187 might be attributable to recruitment strategies of participants (i.e., passive recruitment versus national

188 sampling strategy [12]), to determination of fibromyalgia status (i.e., self-reported versus diagnosed),
189 but also to the use of different accelerometers.

190 The main strengths of this study include the use of objective data of physical activity and sedentary
191 behaviors from a nationally representative sample. Thus, our findings are generalizable to the
192 Canadian women population. The major limitation was that fibromyalgia diagnosis was self-reported
193 and not provided by medical records or checked by a doctor. This study is also limited by its cross-
194 sectional design restricting the ability to make causal inferences.

195 Taken together, our results support that only MVPA duration is significantly lower in women with SRF.
196 Thus, physical activity promotion interventions for women with fibromyalgia should, as a priority, target
197 physical activities with moderate to vigorous intensity [20, 21]. It is important to note that physical
198 activities with moderate intensity are more readily adopted and maintained than vigorous physical
199 activity [21]. Even if the fibromyalgia was not associated with higher time spent in sedentary,
200 researchers and clinicians should be not discouraged to develop intervention to reduce the sedentary
201 activities among their patients. Indeed, the sedentary behavior has deleterious effects on pain for
202 women with fibromyalgia [5].

203 **Table 1**
204 Weighted women characteristics of the Canadian Health Measures Survey (cycle 1,2,3)
205

	Control	Fibromyalgia	Univariate test	p
Age (years) M(Se)	45.3 (0.4)	53.7 (1.2)	t = 6.6	0.0004E-07
BMI M(Se)	25.8 (0.1)	27.9 (0.7)	t = 2.7	0.006
Worked at job last year %(N)	73.2 (8 690 005)	56.5 (219 611)	F = 6.8	0.009
Marital status (alone) %(N)	36.2 (4 398 513)	27.3 (106 656)	F = 1.7	0.19
Income %(N)				
<\$20k	7.9 (959 712)	16.5 (64 350)	F = 2.1	0.06
\$20k-\$29,99k	8.4 (1 018 836)	9.9 (38 744)		
\$30k-\$39,99k	11.2 (1 360 983)	6.2 (24 422)		
\$40k-\$49,99k	10.2 (1 243 557)	4.6 (18 119)		
\$50k-\$59,99k	9.4 (1 139 840)	13.3 (51 909)		
\$60k-\$69,99k	15.6 (1899 393)	23.7 (92 739)		
\$70k-\$79,99k	11.5 (1 403 111)	10.5 (41 084)		
>=\$80k	26 (3 165 686)	15.3 (59 819)		
Education %(N)				
Highschool or lower	15.2 (1 855 470)	10.8 (42 484)	F = 2.5	0.06
College	28.7 (3 498 369)	36.4 (144 143)		
University	28.7 (3 492 245)	11.4 (44 963)		
Missing	27.4 (3 340 848)	41.4 (163 783)		
Self reported symptoms and disease				
Self-rated health compared to 1 year ago %(N)				
Much-somewhat better/about the same	86 (10 486 224)	66.4 (259 676)	F = 15.5	0.0009E-01
Somewhat-much worse	14 (1 704 894)	33.6 (131 511)		
Self reported mood disorder %(N)	12 (1 465 261)	40.8 (159 722)	F = 28.5	0.0001E-03
Psychosocial outcomes				
Self-perceived quality of life %(N)				
fair/poor	5.3 (641 309)	21.7 (85 383)	F = 29	0.0001E-03
(very)good/excellent	94.7 (11 547 982)	78.3 (307 631)		
Self-rated mental health %(N)				
fair/poor	5.6 (687 791)	19.9 (78 003)	F = 26.2	0.0004E-03
(very)good/excellent	94.4 (11 501 649)	80.1 (314 861)		
Sleep outcomes				
Sleep duration (hr) M(Se)	7.2 (0.04)	6.6 (0.2)	t = -3.5	0.0004
Frequency of sleep problems %(N)				
Never/rarely/sometimes	76.4 (9 316 384)	45.6 (178 502)	F = 37.8	0.0002E-05
Most of /all the time	23.6 (2 874 098)	54.4 (213 322)		
Restorative sleep %(N)				
Most of /all the time	55.8 (6 797 406)	34.5 (134 978)	F = 7.4	0.007
Never/rarely/sometimes	44.2 (5 393 139)	65.5 (256 782)		
Smoking variables				
Smoking %(N)	18 (2 192 101)	18.4 (72 016)	F = 0.005	0.94
Levels of cotinine M(Se)	196.6 (16.6)	263.0 (90)	t = 0.7	0.46
Season				
Autumn %(N)	31.7 (3 867 069)	43.5 (170 123)	F = 2.7	0.04
Spring %(N)	25.4 (3 099 844)	31 (121 110)		
Summer %(N)	22 (2 680 042)	7.6 (29 798)		
Winter %(N)	20.8 (2 534 208)	17.8 (69 836)		
Characteristics of physical activity and sedentary				

Acc wearing time (hr/day) M(Se)	13.1 (0.06)	12.5 (0.2)	t = -2.7	0.006
MVPA (min/day) M (Se)	19.2 (0.7)	9.1 (1.2)	t = -7.0	0.0002E-08
LPA (min/day) M (Se)	209.5 (2.0)	196.6 (8.6)	t = -1.4	0.14
Steps (steps/day) M (Se)	7360.4 (92)	6084.5 (318)	t = -3.8	0.0001
Sed (min/day) M (Se)	557.7 (3.0)	546.8 (12.6)	t = -0.9	0.38

Notes. BMI = Body Mass Index, Acc = Accelerometer, LPA = Light Physical Activity, MVPA = Moderate and Vigorous Physical Activity, Sed = Sedentary behavior, min = minutes, hr = hours

213 **Figure 1** Daily physical activity and sedentary time (weighted) in participants with and without self-
214 reported fibromyalgia.
215

216
217
218
219 Notes. MVPA = Moderate and Vigorous Physical Activity, LPA = Light Physical Activity. The whiskers are
220 voluntary missing because Statistic Canada does not allow figures with individual representation.

References

1. Wolfe F, Clauw DJ, Fitzcharles M-A, et al (2016) 2016 Revisions to the 2010/2011 fibromyalgia diagnostic criteria. *Semin Arthritis Rheum* 46:319–329 . doi: 10.1016/j.semarthrit.2016.08.012
2. Malin K, Littlejohn GO (2016) Psychological factors mediate key symptoms of fibromyalgia through their influence on stress. *Clin Rheumatol* 35:2353–2357 . doi: 10.1007/s10067-016-3315-9
3. Isomeri R, Mikkelsen M, Partinen M, Kauppi MJ (2018) Severity of symptoms persists for decades in fibromyalgia—a 26-year follow-up study. *Clin Rheumatol* 1–6 . doi: 10.1007/s10067-017-3967-0
4. Bidonde J, Busch AJ, Schachter CL, et al (2017) Aerobic exercise training for adults with fibromyalgia. *Cochrane Database Syst Rev* 6:CD012700 . doi: 10.1002/14651858.CD012700
5. Segura-Jiménez V, Borges-Cosic M, Soriano-Maldonado A, et al (2017) Association of sedentary time and physical activity with pain, fatigue, and impact of fibromyalgia: the al-Ándalus study. *Scand J Med Sci Sports* 27:83–92 . doi: 10.1111/sms.12630
6. Munguía-Izquierdo D, Legaz-Arrese A (2012) Determinants of sleep quality in middle-aged women with fibromyalgia syndrome: Sleep quality in fibromyalgia. *J Sleep Res* 21:73–79 . doi: 10.1111/j.1365-2869.2011.00929.x
7. Bidonde J, Busch AJ, Schachter CL, et al (2017) Aerobic exercise training for adults with fibromyalgia. *Cochrane Database Syst Rev* 6:CD012700 . doi: 10.1002/14651858.CD012700
8. Benítez-Porres J, Delgado M, Ruiz JR (2013) Comparison of physical activity estimates using International Physical Activity Questionnaire (IPAQ) and accelerometry in fibromyalgia patients: The Al-Andalus study. *J Sports Sci* 31:1741–1752 . doi: 10.1080/02640414.2013.803594
9. Mcloughlin MJ, Colbert LH, Stegner AJ, Cook DB (2011) Are Women with Fibromyalgia Less Physically Active than Healthy Women?: *Med Sci Sports Exerc* 43:905–912 . doi: 10.1249/MSS.0b013e3181fca1ea
10. Kop WJ, Lyden A, Berlin AA, et al (2005) Ambulatory monitoring of physical activity and symptoms in fibromyalgia and chronic fatigue syndrome. *Arthritis Rheum* 52:296–303 . doi: 10.1002/art.20779
11. Segura-Jiménez V, Álvarez-Gallardo IC, Estévez-López F, et al (2015) Differences in Sedentary Time and Physical Activity Between Female Patients With Fibromyalgia and Healthy Controls: The al-Ándalus Project. *Arthritis Rheumatol* 67:3047–3057 . doi: 10.1002/art.39252

Bernard P, Hains-Monfette G, Atoui S, Kingsbury C. Differences in daily objective physical activity and sedentary time between women with self-reported fibromyalgia and controls: results from the Canadian health measures survey. *Clin Rheumatol*. 2018, 2;1–6. DOI: 10.1007/s10067-018-4139-6

- 258 12. Tremblay MS, Connor GS (2007) Canadian health measures survey: Brief overview. Can
259 J Public Health 98:453–56
- 260 13. Day B, Langlois R, Tremblay M, Knoppers B-M (2007) Canadian Health Measures
261 Survey: ethical, legal and social issues. Health Rep 18 Suppl:37–51
- 262 14. Heil DP (2006) Predicting activity energy expenditure using the Actical activity monitor.
263 Res Q Exerc Sport 77:64–80 . doi: 10.1080/02701367.2006.10599333
- 264 15. Colley RC, Garriguet D, Janssen I, et al (2011) Physical activity of Canadian adults:
265 accelerometer results from the 2007 to 2009 Canadian Health Measures Survey. Health
266 Rep 22:7–14
- 267 16. Troiano RP, Berrigan D, Dodd KW, et al (2008) Physical activity in the United States
268 measured by accelerometer. Med Sci Sports Exerc 40:181–188 . doi:
269 10.1249/mss.0b013e31815a51b3
- 270 17. Colley RC, Tremblay MS (2011) Moderate and vigorous physical activity intensity cut-
271 points for the Actical accelerometer. J Sports Sci 29:783–789 . doi:
272 10.1080/02640414.2011.557744
- 273 18. Lumley T (2010) Complex surveys: a guide to analysis using R. John Wiley, Hoboken, N.J
- 274 19. Marques AP, Santo A de S do E, Berssaneti AA, et al (2017) Prevalence of fibromyalgia:
275 literature review update. Rev Bras Reumatol 57:356–363 . doi: 10.1016/j.rbre.2017.01.005
- 276 20. Beltrán-Carrillo VJ, Tortosa-Martínez J, Jennings G, Sánchez ES (2013) Contributions of
277 a group-based exercise program for coping with fibromyalgia: a qualitative study giving
278 voice to female patients. Women Health 53:612–629 . doi:
279 10.1080/03630242.2013.819399
- 280 21. Sanz-Baños Y, Pastor M-Á, Velasco L, et al (2016) To walk or not to walk: insights from a
281 qualitative description study with women suffering from fibromyalgia. Rheumatol Int
282 36:1135–1143 . doi: 10.1007/s00296-016-3459-6

283