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ORIGINAL STUDY

Association of objectively measured sedentary behavior and physical activity levels with health-related quality of life in middle-aged women: The FLAMENCO project

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Abstract

Objective: The aim of the study was to analyze the association of objectively measured sedentary time and physical activity with health-related quality of life in middle-aged women.

Methods: The present cross-sectional analyses were performed in a total of 182 middle-aged women (52.6 ± 4.6 years old) from the Fitness League Against MENopause COst (FLAMENCO) project. Sedentary time and physical activity were objectively measured through accelerometry. Participants' health-related quality of life was assessed with the Short-Form Health Survey 36 (SF-36).

Results: Lower sedentary time was associated with a better SF-36 *emotional role* (B: −0.03; 95% confidence interval: −0.07 to −0.00). Greater light physical activity was associated with a better SF-36 *emotional role* (B: 0.04; 95% confidence interval: 0.00-0.08). Greater moderate-vigorous physical activity was associated with a greater SF-36 *physical function* (B: 0.01; 95% confidence interval: 0.00-0.02) and SF-36 *vitality* (B: 0.02; 95% confidence interval: 0.00-0.03). Greater vigorous physical activity was associated with a better SF-36 *physical function* (B: 0.34; 95% confidence interval: 0.02-0.66), SF-36-*bodily pain* (B: 0.63; 95% confidence interval: 0.02-1.25), and the SF-36 physical component scale (B: 0.20; 95% confidence interval: 0.00-0.39). Greater total physical activity was associated with a better SF-36 *emotional role* (B: 0.03; 95% confidence interval: 0.00-0.07). Moderate physical activity was not associated with any SF-36 dimension (all, $P > 0.05$).

Conclusions: Spending less time in sedentary behavior and greater physical activity levels, especially vigorous physical activity, are associated with better health-related quality of life in middle-aged women. Vigorous physical activity is associated with a better SF-36 physical component scale, which might mean a reduction in exercise time with similar improvements for women's quality of life.

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Key Words: Accelerometry – Climacteric – Primary care – Health-related quality of life – Sedentary behavior – Vigorous physical activity.

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Menopausal transition generally occurs between 45 and 60 years old and has a relevant impact on middle-aged women's lives, in which hormonal factors, family and personal relationships, work status, and self-concept may experience essential changes.[1] Consequently, during this period health-related quality of life (HRQoL) generally decreases.[2] The HRQoL is a multidimensional perspective of health, which includes not only physical, mental, and social well-being, but also the capacity to respond to stress, health perceptions, and physical functioning.[1] In this regard, during the menopausal transition women report incremental role limitations due to their physical or emotional health, poor perceived health, and high somatic symptoms (including pain).[1,3,4] In fact, some evidence showed that it is the most uncomfortable period for women's health and might affect not only their attitude toward menopause but also HRQoL.[5]

Women's attitude and perception about menopause might be influenced by several factors, including physical activity (PA).[6] A sedentary lifestyle is not only associated with an increasing risk of adverse health outcomes, including mortality,[7] but also with worse HRQoL in the general population.[8] Moreover, Spain is one of the countries with an unfavorably high prevalence of sedentary lifestyle (71%),[9] being especially higher among women, and increasing with age.[10] Furthermore, a reduction in the prevalence of physical inactivity may reduce direct healthcare expenditures.[11]

However, the effects that a sedentary lifestyle, as well as PA and its different intensities, has on HRQoL during this life stage were not yet studied. Analysis of these associations would be helpful to design specific interventions focused on improvement of HRQoL during this particular physiological stage. In fact, understanding which PA intensities are particularly correlated with improvements in HRQoL during these years may be useful to optimize adapted exercise-based interventions.

Therefore, the aim of the present study was to analyze the association of sedentary time (ST) and PA with HRQoL in middle-aged women.

METHODS

Study design and participants

This cross-sectional study is part of the Fitness League Against MENopause COst (FLAMENCO) project, where an exercise intervention was conducted.[12] The complete methods of this study and the sample size calculation to detect clinically meaningful changes in that intervention were published elsewhere.[12] The participants were recruited through primary care centers from Granada (Southern Spain). Information about the aims and procedures of the study was published through leaflets, local newspapers, and social media. Moreover, medical staff helped recruit possible candidates during consultations. All interested participants signed a written informed consent after receiving detailed information about the study. From the 190 recruited women (age range 45-60 years old) that met the inclusion criteria,[12] the total sample size for the present analyses comprised 182 women who had valid data in accelerometry and questionnaires (Fig. 1). This study protocol was reviewed and approved by the Ethics Committee on Human Research of the University of Granada (no. 861).

Procedures

An initial anamnesis was performed, where sociodemographic data (marital status, educational level, number of children) and health information (smoking habits, history of illness, and menopause status) were compiled. Subsequently, the participants completed questionnaires assessing their quality of life. In addition, participants received an accelerometer, and it was arranged for them to be returned 8 days later.

Anthropometry and body composition

Weight (kg) was assessed with a scale (InBody R20, Biospace, Seoul, South Korea). Height (cm) was measured with a stadiometer (Seca 22, Hamburg, Germany). Body mass index was calculated as weight (kg) divided by height (m^2).

Objectively measured sedentary time and physical activity

Sedentary time and PA were objectively measured through accelerometry[13] (GT3X+, Pensacola, FL) for 9 consecutive days, starting the same day they received the monitor. The first and last day were excluded from the analyses, accounting for a total of 7 valid days of registering. Participants were instructed to wear the accelerometer during the whole day (24 h) on their waist, attached by an elastic belt. To prevent any damage to the devices, these were taken off during water-based activities (eg, bathing or swimming). ST, as well as time engaged in light, moderate, moderate-vigorous (MVPA), and vigorous PA, together with total PA time per day and per week were calculated. Bouted MVPA was defined as a period of 10 or more consecutive minutes of duration in MVPA. Percentage of participants who met the international PA recommendations of at least 150 minutes of MVPA per week was also calculated.[14]

Health-related quality of life

Participants' HRQoL was assessed with the Short-Form Health Survey 36 (SF-36).[15] This questionnaire contains 36 items grouped into eight dimensions: physical functioning, physical role, body pain, general health, vitality, social functioning, emotional role, and mental health. The scores range from 0 to 100 in every dimension, where higher scores indicate better health. These eight dimensions can be summarized into two global concepts: the physical component scale (covered by physical functioning, physical role, bodily pain, and general health) and the mental component scale (vitality, social functioning, emotional role, and mental health).

Statistical analysis

Descriptive statistics (mean [standard deviation] for quantitative variables and number of women [%] for categorical variables) were employed to describe sociodemographic and clinical characteristics of the participants. Partial correlations were employed to assess the association between ST and PA, and were adjusted for age, educational level, and marital

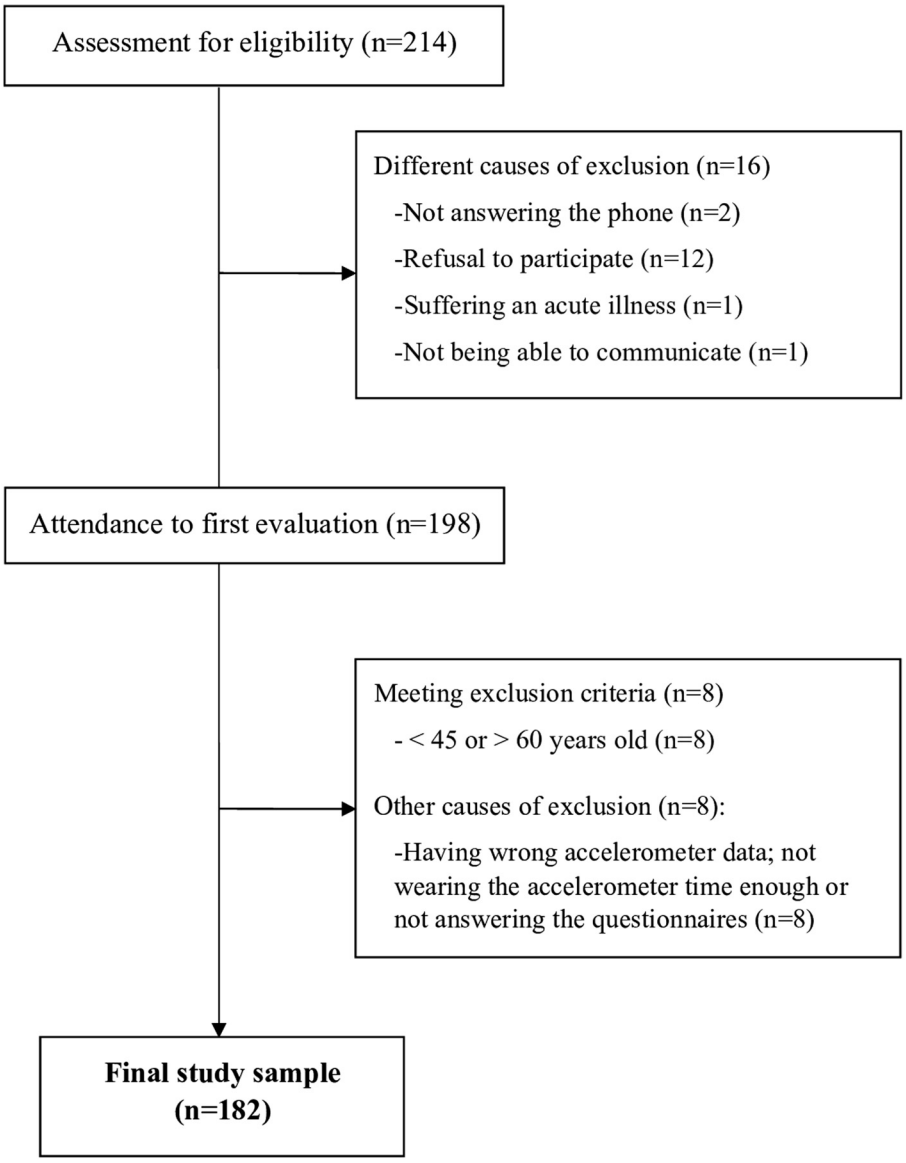

FIG. 1. Flow chart of the study sample.

status, as all of them were found to be associated with HRQoL.[3,8] Linear regression analyses and accelerometer wearing time were performed to explore the association of ST and PA with HRQoL. ST and PA were included as independent variables, whereas SF-36 dimensions were included as dependent variables. These analyses were adjusted for the aforementioned confounders. To assure that the total amount of time wearing the accelerometer was the same for the entire study sample, the total accelerometer time registered[8,16] was also used as covariate. Moreover, this allowed us to assess, in a more accurate way, the total ST and PA performed by each participant. All the analyses were performed using the Statistical Package for Social Sciences (IBM SPSS Statistics for Windows, version 22.0, Armonk, NY) and the level of significance was set at a P value less than 0.05.

RESULTS

The sociodemographic and clinical characteristics of the study sample and their objectively measured ST and PA levels are shown in Table 1. Most of the sample (mean age 52.6 ± 4.5 y) was overweight, had irregular menstruation (79%), and did not take hormone therapy (97%). Most of them were married (70%) and had finished secondary studies or a university degree (58%), whereas the minority were active smokers (23%). Half of the women met the PA recommendations (51%). Participants spent 8 h/d in sedentary behavior.

The highest values reported in SF-36 questionnaire were *physical function*, *emotional role*, *physical role*, and *social function* (all scores >80).

Partial correlations between ST and PA showed that ST was inversely associated with light PA ($r = -0.67$, $P < 0.01$),

TABLE 1. *Sociodemographic, anthropometric, and clinical characteristics of the participants (N = 182)*

Variable	Mean (SD)
Age, y	52.6 (4.5)
Weight, kg	69.5 (12.4)
Height, cm	159.8 (6.0)
Body mass index, kg/m^2	27.2 (4.6)
Physical activity, min/d	
Sedentary time	477.2 (90.2)
Light PA	421.9 (80.3)
Moderate PA	58.5 (28.1)
Vigorous PA	2.8 (5.7)
MVPA (min/wk, in bouts ≥10 min)	193.7 (161.1)
Total PA	483.3 (90.9)
Educational level	n (%)
No studies	6 (3.0)
Primary or professional training	76 (38.6)
High school	42 (21.3)
University degree	73 (37.1)
Marital status	
Single	25 (12.7)
Married	138 (70.1)
Separated/divorced/widow	34 (17.2)
SF-36 dimensions (0-100)	
Physical function	86.0 (13.2)
Emotional role	85.8 (18.4)
Physical role	80.4 (20.6)
Vitality	60.8 (17.8)
Mental health	70.1 (17.4)
Social function	79.8 (23.1)
Bodily pain	61.2 (23.8)
General health	66.7 (18.4)
Physical component scale	49.1 (7.6)
Mental component scale	48.4 (10.4)
Blatt-Kupperman Menopausal Index score (0-45)	14.7 (10.3)
Menopausal status (%; regular menstruation yes/no)	(27.9/72.1)
Irregular menstruation in the last 12 months (%; yes/no)	(21.3/78.7)
Hormone therapy (%; yes/no)	(2.6/97.4)
Smoking status (%; yes/no)	(22.7/77.2)
Meeting physical activity recommendations (%; yes/no)	(51.4/48.6)

MVPA, moderate-vigorous physical activity; PA, physical activity; SD, standard deviation; SF-36, Short-Form Health Survey 36.

moderate PA ($r = -0.43$, $P < 0.01$), MVPA ($r = -0.30$, $P < 0.01$), vigorous PA ($r = -0.19$, $P < 0.05$), and total PA ($r = -0.75$, $P < 0.01$) (see Supplemental Digital Content 1, http://links.lww.com/MENO/A526, which shows the association of ST with PA levels).

Linear regression analyses assessing the association of ST and PA with the SF-36 dimensions are shown in Table 2. Lower ST and greater light PA were associated with a better SF-36 emotional role (B: −0.03; 95% confidence interval (CI): −0.07 to −0.00; $P = 0.02$ and B: 0.04, 95% CI: 0.00-0.08; $P = 0.01$, respectively). Higher MVPA was associated with a better SF-36 *physical function* (B: 0.01, 95% CI: 0.00-0.02; $P = 0.05$) and SF-36 *vitality* (B: 0.02, 95% CI: 0.00-0.03; $P = 0.01$). Higher vigorous PA was associated with a better SF-36 *physical function* (B: 0.34, 95% CI: 0.0-0.66; $P = 0.03$), SF-36 *bodily pain* (B: 0.63, 95% CI: 0.02-1.25; $P = 0.04$), and the SF-36 physical component scale (B: 0.20, 95% CI: 0.00-0.39 $P = 0.04$). Higher total PA was associated with a better SF-36 *emotional role* (B: 0.03, 95% CI: 0.00-0.07: $P = 0.02$). Finally, moderate PA was not associated with any SF-36 dimension (all, $P > 0.05$).

DISCUSSION

The main findings of the present study indicate that greater PA levels, especially vigorous PA, were associated with overall better scores in most dimensions of HRQoL (as assessed through the SF-36 questionnaire). Moreover, lower time in sedentary behavior was associated with a better SF-36 *emotional role* in middle-aged women.

Spain has an outstandingly high prevalence of sedentary lifestyle,[9] which is even higher in the female population.[17] In fact, women in our study spent 8 h/d in sedentary behavior, which is consistent with the Eurobarometer results.[17] This epidemiological survey indicates that almost 40% of Spanish women spent more than 6 h/d in sedentary behavior (defined as the absence of movement, eg, sitting or lying). This fact is worrying, since a sedentary lifestyle leads to deterioration of health, increasing the risk of chronic illness, and all-cause mortality,[7,8,18] and may decrease HRQoL in the general population.[19] Moreover, it was suggested that menopausal women who spend a long time in sedentary behavior may present an increased risk of illness and higher menopausal symptoms,[20,21] which also can predispose them to worse HRQoL.[20] In fact, in the present study sample, those women who spent more time in sedentary behavior also showed less time in all PA levels. In this sense, reducing ST might improve the emotional health status during this time, since we found that less ST is associated with a better SF-36 *emotional role*. Interestingly, we found that the association of ST with the SF-36 *emotional role* was independent of any PA intensity (data not shown).

The amount of PA recommended to promote and maintain health in the adult population older than 18 years of age is at least 150 min/wk of MVPA in bouts of at least 10 minutes.[14] In the present study sample, 51% of the participants met these guidelines, achieving a mean of 194 min/wk of MVPA indicating that, overall, our study sample was active enough.

Middle-aged women are usually more likely to engage in light-to-moderate PA than vigorous PA,[22] and our results show a very similar tendency, because most women were engaged most of the time in light PA (7 h/d) than in vigorous PA (<30 min/d).

Our results are consistent with existing literature reporting positive associations between PA and better HRQoL in the general adult,[8,23] middle-aged,[24] and older populations.[24,25] Nonetheless, in most cases, PA was assessed through self-reported methods such as questionnaires,[8,23,24,26] whereas we employed the most widely reliable and objective method to assess ST and PA, if not the criterion standard (ie, accelerometry), which provides more reliable and valid results.[27] Regarding the middle-aged female population, Heesch et al[28] found greater HRQoL at low PA levels (walking) and continued up to higher PA levels, after which increases were less marked for some outcomes, like the SF-36 physical component scale and the SF-36 *physical function*. These findings are consistent with ours, where even light PA was associated with a better HRQoL. On the contrary, we observed that high-intensity PA is especially associated with better SF-36

TABLE 2. *Linear regression coefficients assessing the association of objectively measured sedentary time and physical activity with health-related quality of life (N = 182)*

	Sedentary time and physical activity				
	β	B	SE	*P*	95% CI
SF-36 dimensions			Sedentary time		
Physical function	−0.05	−0.00	0.01	0.46	(−0.03 to 0.01)
Emotional role	−0.18	−0.03	0.01	**0.02**	(−0.07 to −0.00)
Physical role	−0.11	−0.02	0.01	0.16	(−0.06 to 0.01)
Vitality	−0.05	−0.01	0.01	0.48	(−0.04 to 0.02)
Mental health	−0.10	−0.02	0.01	0.19	(−0.05 to 0.01)
Social function	−0.09	−0.02	0.02	0.22	(−0.06 to 0.01)
Bodily pain	−0.11	−0.03	0.02	0.16	(−0.07 to 0.01)
General health	−0.06	−0.01	0.01	0.40	(−0.04 to 0.01)
Physical component scale	−0.05	−0.00	0.00	0.49	(−0.01 to 0.00)
Mental component scale	−0.12	−0.01	0.01	0.12	(−0.03 to 0.00)
			Light PA		
Physical function	0.05	0.00	0.01	0.48	(−0.01 to 0.03)
Emotional role	0.19	0.04	0.01	**0.01**	(0.00-0.08)
Physical role	0.13	0.03	0.02	0.09	(−0.00 to 0.07)
Vitality	0.01	0.00	0.01	0.84	(−0.03 to 0.04)
Mental health	0.10	0.02	0.01	0.22	(−0.01 to 0.05)
Social function	0.11	0.03	0.02	0.18	(−0.01 to 0.07)
Bodily pain	0.13	0.04	0.02	0.11	(−0.00 to 0.08)
General health	0.07	0.01	0.01	0.36	(−0.02 to 0.05)
Physical component scale	0.07	0.00	0.00	0.36	(−0.00 to 0.02)
Mental component scale	0.11	0.01	0.01	0.16	(−0.00 to 0.03)
			Moderate PA		
Physical function	−0.01	−0.00	0.03	0.89	(−0.07 to 0.06)
Emotional role	0.03	0.02	0.05	0.66	(−0.07 to 0.12)
Physical role	−0.03	−0.02	0.05	0.59	(−0.13 to 0.07)
Vitality	0.09	0.06	0.04	0.20	(−0.03 to 0.15)
Mental health	0.05	0.03	0.04	0.51	(−0.06 to 0.12)
Social function	−0.01	−0.01	0.06	0.87	(−0.13 to 0.11)
Bodily pain	−0.04	−0.03	0.06	0.60	(−0.16 to 0.09)
General health	−0.02	−0.01	0.05	0.78	(−0.11 to 0.08)
Physical component scale	−0.05	−0.01	0.02	0.43	(−0.05 to 0.02)
Mental component scale	0.06	0.02	0.02	0.43	(−0.03 to 0.07)
			MVPA (min/wk, in bouts ≥10 min)		
Physical function	0.13	0.01	0.00	**0.05**	(0.00-0.02)
Emotional role	0.08	0.00	0.00	0.28	(−0.00 to 0.02)
Physical role	0.05	0.00	0.00	0.46	(−0.01 to 0.02)
Vitality	0.18	0.02	0.00	**0.01**	(0.00-0.03)
Mental health	0.10	0.01	0.00	0.15	(−0.00 to 0.02)
Social function	0.05	0.00	0.01	0.43	(−0.01 to 0.03)
Bodily pain	−0.00	−0.00	0.01	0.96	(−0.02 to 0.02)
General health	0.03	0.00	0.00	0.66	(−0.01 to 0.02)
Physical component scale	0.02	0.00	0.00	0.72	(−0.00 to 0.00)
Mental component scale	0.10	0.00	0.00	0.15	(−0.00 to 0.01)
			Vigorous PA		
Physical function	0.15	0.34	0.16	**0.03**	(0.02-0.66)
Emotional role	0.08	0.27	0.24	0.25	(−0.20 to 0.75)
Physical role	0.07	0.25	0.26	0.33	(−0.26 to 0.77)
Vitality	0.09	0.30	0.23	0.19	(−0.16 to 0.77)
Mental health	0.01	0.05	0.23	0.81	(−0.40 to 0.51)
Social function	0.10	0.41	0.30	0.16	(−0.18 to 1.01)
Bodily pain	0.15	0.63	0.31	**0.04**	(0.02-1.25)
General health	0.12	0.39	0.24	0.10	(−0.08 to 0.87)
Physical component scale	0.15	0.20	0.09	**0.04**	(0.00-0.39)
Mental component scale	0.04	0.08	0.13	0.55	(−0.19 to 0.35)
			Total PA		
Physical function	0.05	0.00	0.01	0.46	(−0.01 to 0.30)
Emotional role	0.19	0.03	0.01	**0.02**	(0.00-0.07)
Physical role	0.11	0.02	0.01	0.16	(−0.01 to 0.06)
Vitality	0.05	0.01	0.01	0.48	(−0.02 to 0.04)
Mental health	0.10	0.02	0.01	0.19	(−0.01 to 0.05)
Social function	0.10	0.02	0.02	0.22	(−0.01 to 0.06)
Bodily pain	0.11	0.03	0.02	0.16	(−0.01 to 0.07)
General health	0.06	0.01	0.01	0.40	(−0.01 to 0.04)
Physical component scale	0.05	0.00	0.00	0.49	(−0.00 to 0.01)
Mental component scale	0.12	0.01	0.01	0.12	(−0.00 to 0.03)

Model adjusted for age, educational level, marital status, and accelerometer wearing time.
β, standardized regression coefficient; B, nonstandardized regression coefficient; CI, confidence interval; MVPA, moderate-vigorous physical activity; PA, physical activity; SE, standard error; SF-36, Short-Form Health Survey 36.
Bold values indicates $P < 0.05$ or $P < 0.01$.

dimensions, since vigorous PA showed a positive association with *physical function* and *bodily pain* and the SF-36 physical component scale.

The physiological impact of perimenopause may promote a decrease in their perceived well-being.[6] Estrogen loss may decrease the opioid effect of endorphins and alter dopamine and serotonin metabolism.[29] On the contrary, PA releases an opioid and endocannabinoid effect, which promotes a sense of euphoria and well-being and decreases pain sensitivity.[30] These mechanisms could partially explain our results that women who break the sedentary behavior and start engaging PA at any intensity could improve some SF-36 psychological components, such as emotional role and vitality. Therefore, our findings might indicate a positive association between less ST and higher PA levels with better HRQoL,[31] despite the fact that a direct causal pathway cannot be clearly established due to this cross-sectional study design.

On the contrary, vigorous PA could have a more protective cardiometabolic health effect than MVPA[32-36] and middle-aged women should also engage in higher PA intensities without health risk nor side effects.[14,37] The mechanisms through which vigorous PA produces additional benefits in health remain unclear[38-40] and might be partially explained by an intensity-response relationship.[36,38-40] Moreover, high-intensity interval training was shown to activate mitochondrial capacity, antioxidant defense, glucose uptake, and anti-inflammatory pathways,[36] also increasing cardiorespiratory capacity.[36] Indeed, recent evidence found that vigorous PA is an excellent alternative to classical PA recommendations,[14] because it is a potent and time-efficient training method for inducing both central (cardiovascular) and peripheral (skeletal muscle) adaptations, even in populations at risk for cardiovascular disease[36] such as menopausal women.[12] Moreover, vigorous PA is associated with better mental and physical health (including less pain) in young adults[32] and less incidence of cardiovascular events among postmenopausal women.[35] Consequently, it seems that vigorous PA may not only involve benefits for cardiovascular disease health, but also for general HRQoL in this population.

It is also noteworthy that no association was found between moderate PA and any variable studied. This can be justified by the proven positive association of light, MVPA, and vigorous PA in detriment of moderate PA. Indeed, a systematic review conducted in an adult population[8] found differences in HRQoL between light PA (leisure PA) and vigorous PA, but less so with moderate PA. In most of these studies, PA levels were measured with a self-reported method, where moderate PA intensity could be interpreted as MVPA, explaining our lack of association between moderate PA and HRQoL outcomes.

Note that our study sample was relatively healthy. Other studies showed that other variables, such as social and life-style factors, may affect HRQoL.[41,42] Practicing PA, not-smoking, higher education level, and being married are related to a better overall HRQoL.[6,42] In this regard, as mentioned above, women in our study were active enough,[14] most of them were nonsmokers (77%), had high educational level (58%), and were married (70%). Altogether, these factors could be associated with higher scores in the SF-36 questionnaire[42] and greater PA levels.[42]

From a public health perspective, it would be particularly useful if research focused on the effect of vigorous PA on women's health during this relevant stage. Moreover, to study how vigorous PA may have additional benefits for middle-aged women is also noteworthy. Vigorous PA may be implemented in PA guidelines. In fact, ''the lack of time'' remains one of the most commonly cited barriers to practice regular exercise and it was found that high-intensity interval training is perceived to be more enjoyable than moderate-intensity continuous exercise.[36]

The present study has limitations that must be underlined. First, the present cross-sectional design precludes determination of causality. We cannot conclude whether the cross-sectional association between PA and HRQoL can be explained via a causal pathway (ie, higher HRQoL leading to higher levels of PA or vice versa). Second, the women in the sample included in the present study showed mild-severity menopause symptomatology and moderate-high PA levels and were active enough (meeting PA recommendations), which may stymie the extrapolation to women suffering from severe menopausal symptoms or with poor PA levels. Third, all participants were overall healthy and with high educational levels, having, in general, a relatively good HRQoL. Finally, the results should be interpreted cautiously considering that no correction for multiple comparisons was made. Some strengths also need to be highlighted. First, the scarcity of studies on objectively measured ST and PA levels with HRQoL conducted among middle-aged women. Therefore, this study provides a comprehensive examination of the association of two important, potentially modifiable, factors (ie, ST and PA) that were associated with better HRQoL in middle-aged women. In addition, the valid and reliable tools employed to assess PA (ie, accelerometry) and HRQoL (ie, SF-36 questionnaire), as well as the robust protocol for data collection and the relatively large participant sample size add to the strength of the study. Finally, the fact that there are no previous studies reporting any association between objectively measured vigorous PA and greater HRQoL is also noteworthy.

CONCLUSION

Spending less time in sedentary behavior and increasing PA levels, especially vigorous PA, showed a strong relationship with better HRQoL in middle-aged women. Future research is necessary to clarify the relationship of objectively measured ST and PA with HRQoL in this population. Furthermore, these data provide some support for current recommendations that emphasize enhancing vigorous PA during this stage, which may mean spending less time practicing PA or exercise with the same or even more benefits for health.

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