Is practice rate rather than exercise intensity more important in health benefits of moderately obese postmenopausal women?


1. Introduction

Epidemiological evidence supports the notion that both sedentarity and obesity are associated with numerous risk factors for all causes of mortality and premature death, and more particularly, coronary heart disease (CHD) in women [30, 31]. As physical inactivity increases with advancing age [36], the World Health Organization (WHO) [38] has generally recommended a minimum of 150 minutes of moderate-intensity aerobic physical activity per week to maintain physical fitness and control for body weight and fatness, in adults and older adults. In this regard, walking was considered as the commonest and most feasible form of sustainable dynamic aerobic exercise for sedentary individuals [10]. Walking also had a large public health impact [29], as it is associated with lower risks of CHD and all-cause mortality in both genders [18].

However, the exercise dose required to lose weight and reduce the CHD risk profile is not well established, even if it can be summarized as “Even a little is good, more may be better!”. For patients and clinicians [28], the exercise dose needed to lead to health benefits generally depends on the frequency, duration, intensity, and type of activity [22]. Hamer and Chida [18] suggested that brisk walking pace (i.e., intensity) was a stronger independent predictor of overall risk when compared to walking...
volume. A cross-sectional study [30] reported that a high BMI was more strongly related to adverse cardiovascular biomarkers than physical inactivity. However, the risk for all-cause and CHD mortality was lower in individuals with a high physical fitness, regardless of BMI reductions [22]. In addition, associations between physical activity and either the CHD risk [35] or all-cause mortality risk [14,34] were stronger in women than in men. Another cross-sectional study revealed that the greatest reduction in the CHD risk profile was achieved by an exercise dose ranging from a low to a moderate level [1] and a curvilinear dose–response relationship has been reported between physical activity and physical fitness improvements [34]. A low to moderate cardiopulmonary exercise intensity was also shown to improve some components of the metabolic syndrome in postmenopausal women [9]. In our knowledge, no study has yet examined whether the frequency, intensity and/or duration of walking exerted the best health benefits in women with advancing age.

The primary aim of our study was thus to evaluate the efficiency of a 16-week walking program on body fatness and physical fitness of moderately obese and sedentary, postmenopausal women, once adherence or exercise intensity was taken into account. A secondary objective was to verify whether improvements in the fasting lipid-lipoprotein profile vary according to this important factor.

2. Methods

2.1. Participants

Healthy Caucasian postmenopausal women (amenorrhea for at least 12 months), 50 to 65 year-old who were moderately obese (BMI ranging from 29 to 35 kg/m²) [39] participated in our study. They had to be sedentary (exercising less than 30 minutes per week), non-smokers, and none or moderate consumers of alcohol and caffeine. Their body weight had to be stable (less than 2 kg weight change) in the year before the onset of the study. All participants were asked to maintain their current lifestyle habits during the study-period. Women had a physical examination by their personal physician, and none of them had any identified cardiomyopathy, endocrine disorders or orthopedic limitations that would limit their participation in physical activity.

2.2. Study design

The study design was approved by the institutional review board of the French Federation of Physical Education and Voluntary Gymnastic (FFEPGV) and the protocol was reviewed and approved by the local Research Ethics Board. All women gave their written informed consent to participate in this study in conformance with the Helsinki Declaration. All participants were asked to maintain their lifestyle habits constant, during the 16-week walking period. Although their daily energy intake remained unchanged, their energy expenditure was slightly increased by 151 ± 24 kcal/day (mean ± SD; P < 0.0001) at the end of our program [13]. Finally, all women were offered a Polar Heart Rate (HR) monitor (FS1 type, Finland) as an incentive to continue walking, and received a personal report on their physical (anthropometry and body composition, physical fitness) and biological (lipid-lipoprotein profile) changes, at the end of the study.

The walking program planned according to the ACSM/AHA guidelines for older adults [33] consisted in 3 non-consecutive sessions/week of 45 min, at approximately 60% of one’s HR reserve, HR (i.e., maximal HR minus resting HR), during 4 months. Maximal HR was calculated from the following equation: 220 – age, where age is expressed in years. HR walking was calculated as % HRR + resting HR [21]. Two weekly walking sessions were supervised by a trained exercise leader of the FFEPGV. The third weekly unsupervised session was performed according to participants’ preferences on sidewalks, streets, forest trails or in parks.

Subjects’ assiduity was registered in an exercise logbook, and adherence to the program was calculated from the following equation: % of adherence to the program = (number of sessions followed/total number of training sessions) × 100. HR was continuously recorded using a Polar HR monitor at each walking session (either supervised or not) to ensure compliance with the walking intensity. Monitoring HR allowed to control exercise intensity and to document the specific amount of exercise performed during each session. Effective exercise intensity was calculated from the following equation: % of HRR = (mean of exercise HR – resting HR)/(maximal HR – resting HR).

From the 200 postmenopausal women who began our walking program, 159 completed our study. Forty one subjects were not included in the study for the following reasons: injury (n = 2); illness (n = 5); did not complete the dietary and physical activity diaries at the end of the walking program as well the exercise log book (n = 26); and did not perform the 2-km walk test after our intervention (n = 8). Anthropometry and body composition, physical fitness and fasting lipid-lipoprotein profile were assessed at both the beginning and the end of the 16-week walking program by members of the research team.

2.3. Measurements

2.3.1. Anthropometry and body composition

Body weight and height were measured, while participants in light clothing without shoes and in standing position were looking straight ahead with their shoulders and buttocks against the wall, as well as joined feet and arms hanging on both sides. BMI was calculated as the ratio of weight (kg) to height² (m²). Waist girth was measured at the narrowest circumference of the trunk, using a graduated flexible tape when women were in standing position. Fat mass and fat-free mass were determined by a standard bioelectrical impedance technique (BodyStat 1500, Isle of Man, U.K.). All measurements were performed by the same operator, at rest, in the morning (after a 12-h overnight fast). Anthropometry and body composition measurements were performed in duplicate, and then averaged at both study-periods [12].

2.4. Physical fitness

Physical fitness was assessed by means of the 2-km walking test, which has been validated on moderately fit and obese but otherwise healthy, men and women aged 20–65 years [27]. Physical fitness was more accurately predicted in women than in men, as it underestimates O₂max by 3% in the former vs 12.4% in the latter individuals. The equation used to predict VO₂max in women was the following: VO₂max (mL O₂/kg/min) = 116.2 – 2.98 (time) – 0.11 (HR) – 0.14 (age) – 0.39 (BMI) where time is the elapsed time for a walk in min, HR is the value at the end of the walk (beats/min) and age is expressed in years and BMI in kg/m². Physical fitness measurements were performed by the same FFEPGV exercise leaders, at both study periods [27].

2.5. Lipid-lipoprotein profile

Blood samples were collected after a 12-h overnight fast, at both study periods. Fasting plasma triglyceride (TG), cholesterol, and High-Density Lipoprotein (HDL) cholesterol levels were routinely determined according to standardized laboratory procedures. Fasting plasma Low-Density Lipoprotein (LDL) cholesterol
concentrations were estimated by the Friedewald equation (1972) [11].

2.6. Statistical analyses

Results are given as means ± standard error (SE) in figures and as means ± standard deviation (SD) in tables. To analyze the impact of the inter-individual variability on the body composition and lipid-lipoprotein profile changes, tertiles of adherence and exercise intensity were performed a posteriori. The first tertile of adherence was lower than 71% (i.e., < 96 minutes of walking/week), while the second ranged between 71% and 87% (i.e., between 96 and 117 minutes of walking/week) and the third was higher than 87% (i.e., > 117 minutes of walking/week). On the other hand, the first tertile of walking intensity was lower than 56% of HRR, while the second ranged between 56% and 63% of HRR and the third one was higher than 63% of HRR. Basal values and mean changes (i.e., differences between post- and pre-training values) for the outcome variables of this study were compared between three groups of women categorized as having a low, medium vs high adherence, using an analysis of variance (ANOVA) with repeated measures on one factor (time). When ANOVA was significant, simple test effects were performed to detect which conditions were statistically different from each other. All analyses were conducted using the SAS statistical software (SAS Institute, version 9.1, Cary, NC, USA), and statistical significance was set at P ≤ 0.05.

3. Results

At baseline, there were no significant differences for the main variables of interest, between women who performed our study (n = 159) and those who did not complete the walking program (n = 41) for the reasons stated in the Methods section (not shown).

On the other hand, data revealed that women did not engage similarly in the walking program, as the mean exercise adherence (that reflects assiduity) was 77.3 ± 16.6% (i.e., 104 minutes of walking/week), while the mean exercise intensity was 57.8 ± 9.8% of HRR.

As exercise dose represents one of the most important criteria of training, statistical analysis taking into account different adherence levels (< 71%, 71%–87%, > 87%) was performed. As shown in Table 1, body composition, CRF and fasting lipid-lipoprotein profile assessed at baseline were similar, irrespective of the adherence to the training program. In addition, neither age, nor exercise intensity differed between groups.

As illustrated in Fig. 1, body weight, fat mass and waist girth decreases in all groups after walking (0.0001 < P < 0.05). The greatest body weight loss was, however, found in women with the highest adherence (0.01 < P < 0.05). Fat mass and waist girth reductions were highest in women who had the highest adherence, when compared to participants with the lowest one (P < 0.05). Also, BMI decrease was significant in women characterized by the greatest adherence, exclusively (P < 0.0001), while fat-free mass remained unchanged, irrespective of the group (not shown). Although estimated VO2 max was improved in all groups after the intervention (P < 0.0001), its highest increase was observed in women with the greatest adherence, compared to those who had the lowest one (P < 0.05).

As shown in Fig. 2, decreases in fasting plasma triglyceride levels and increases in HDL cholesterol concentrations (0.0001 < P < 0.001) were not significantly different between groups. Reductions in plasma cholesterol and LDL cholesterol levels (0.0001 < P < 0.05) also did not vary according to participants’ adherence. Finally, significant decreases in the plasma cholesterol/HDL cholesterol ratio of –0.88 ± 0.11, –0.74 ± 0.13, –0.55 ± 0.16 (mean ± SD) (P < 0.0001) did not differ between women having a low, medium, or high adherence, respectively (not shown).

On the other hand, as exercise intensity is another important issue to be considered in the context of training, statistical analysis taking into account tertiles of walking intensity expressed as percent of HRR (< 56%, 56–63%, > 63%) was also performed. Table 2 shows that body composition, physical fitness and the fasting lipid-lipoprotein profile at baseline were comparable, regardless of the exercise intensity. In addition, neither age, nor adherence differed between groups.

As shown in Fig. 3, body weight (0.0001 < P < 0.001) and fat mass (P < 0.0001) losses as well as estimated VO2 max increases (P < 0.0001) were similar, irrespective of the exercise intensity. Although waist girth was reduced in all groups (P < 0.0001), the greatest decrease was found between women with the medium and highest walking intensity (P < 0.01). Also, BMI decreases were comparable, regardless of the group (P < 0.05) (not shown). Fat-free mass was not strikingly modified in response to the intervention, irrespective of walking intensity (not shown). As illustrated in Fig. 4, the fasting lipid-lipoprotein profile was improved, regardless of the exercise intensity. Indeed, reductions in fasting triglyceride levels and increases in plasma HDL cholesterol concentrations (0.0001 < P < 0.001) did not differ between groups. Reductions in plasma cholesterol (0.0001 < P < 0.05) and LDL cholesterol levels (0.0001 < P < 0.001) also did not vary according to the exercise intensity. Once again, significant decreases in the plasma cholesterol/HDL cholesterol ratio of –0.83 ± 0.14, –0.68 ± 0.12, –0.65 ± 0.14 (mean ± SE) (P < 0.0001) were not significantly different among women walking at a low, medium, or high intensity, respectively (not shown).

4. Discussion

The major finding of this study was the strong relationship observed between adherence to the walking program and increase in physical fitness (i.e., estimated VO2 max) and decrease in body weight, fat mass and waist girth.

Our results showed clear benefits in the physical fitness, body fatness and fasting lipid-lipoprotein profile at a target of 78 minutes walking/week (lowest adherence < 71%). Although additional health benefits appear in the two other subgroups (adherence ranging from 71% to 87% and adherence > 87%), our data are in good accordance with those of Lee [28] who claimed

### Table 1

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Low adherence (n=52)</th>
<th>Medium adherence (n=55)</th>
<th>High adherence (n=52)</th>
</tr>
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<tbody>
<tr>
<td>Adherence (%)</td>
<td>57.4 ± 11.3</td>
<td>80.9 ± 5.2</td>
<td>93.3 ± 3.8</td>
</tr>
<tr>
<td>Brisk walking duration (min/week)</td>
<td>78 ± 15</td>
<td>109 ± 7</td>
<td>126 ± 14</td>
</tr>
<tr>
<td>Heart rate reserve (%)</td>
<td>56.9 ± 9.9</td>
<td>56.9 ± 10.5</td>
<td>59.7 ± 8.8</td>
</tr>
<tr>
<td>Age (years)</td>
<td>61 ± 5</td>
<td>60 ± 6</td>
<td>60 ± 6</td>
</tr>
<tr>
<td>Body weight (kg)</td>
<td>73.9 ± 10.3</td>
<td>75.0 ± 12.2</td>
<td>73.5 ± 13.2</td>
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<tr>
<td>Body mass index (kg/m²)</td>
<td>29.9 ± 3.8</td>
<td>29.9 ± 4.3</td>
<td>29.9 ± 5.0</td>
</tr>
<tr>
<td>Fat mass (kg)</td>
<td>32.9 ± 7.3</td>
<td>33.7 ± 8.4</td>
<td>32.5 ± 9.0</td>
</tr>
<tr>
<td>Fat-free mass (kg)</td>
<td>40.9 ± 4.5</td>
<td>41.1 ± 5.3</td>
<td>41.0 ± 5.7</td>
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<tr>
<td>Waist girth (cm)</td>
<td>91.4 ± 11.5</td>
<td>92.6 ± 9.6</td>
<td>89.3 ± 11.0</td>
</tr>
<tr>
<td>Total cholesterol (mg/dL)</td>
<td>234.3 ± 4.2</td>
<td>233.3 ± 3.6</td>
<td>229.3 ± 0.31</td>
</tr>
<tr>
<td>LDL cholesterol (mg/dL)</td>
<td>121.2 ± 33.3</td>
<td>118.8 ± 39.3</td>
<td>117.3 ± 0.12</td>
</tr>
<tr>
<td>HDL cholesterol (mg/dL)</td>
<td>60.3 ± 18</td>
<td>60.1 ± 17</td>
<td>60.3 ± 0.15</td>
</tr>
<tr>
<td>Triglycerides (mg/dL)</td>
<td>1.05 ± 0.32</td>
<td>1.06 ± 0.37</td>
<td>1.57 ± 0.61</td>
</tr>
<tr>
<td>VO2 max (mL O2/kg/min)</td>
<td>18.1 ± 6.4</td>
<td>19.6 ± 6.2</td>
<td>19.0 ± 6.2</td>
</tr>
</tbody>
</table>

Values are means ± SD.
“Even a little is good; more is better.” A moderate physical activity program is thus likely to yield some important health benefits. Interestingly, 126 minutes walking per week (highest adherence > 87%) led to the greatest increase in VO2max (Fig. 1). The exercise volume of our study was lower than the minimal dose recommended by the WHO (2010), [38] i.e., 150 min per week of moderate-intensity aerobic physical activity.

Fig. 1. Changes in body composition and cardiorespiratory fitness after the 16-week walking program, according to exercise adherence. Values presented are means ± SE. P values indicated on the figure stand for differences between women with low (< 71%), medium (71–87%) or high (> 87%) adherence. Differences between before and after the 16-week walking program, in each group at *P < 0.0001, **P < 0.001 and ***P < 0.05.

Fig. 2. Changes in fasting lipid-lipoprotein profile after the 16-week walking program, according to exercise adherence. Values presented are means ± SE. For other details, see legends to Fig. 1. Differences between before and after the 16-week walking program, in each group at *P < 0.0001, **P < 0.001 and ***P < 0.05.
Table 2
Characteristics at baseline of women with low, medium or high exercise intensity.

<table>
<thead>
<tr>
<th></th>
<th>Low exercise intensity</th>
<th>Medium exercise intensity</th>
<th>High exercise intensity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&lt; 56% HRR (n = 53)</td>
<td>56–63% HRR (n = 53)</td>
<td>&gt; 63% HRR (n = 53)</td>
</tr>
<tr>
<td>Adherence (%)</td>
<td>76.5 ± 17.1</td>
<td>78.4 ± 15.2</td>
<td>76.9 ± 17.5</td>
</tr>
<tr>
<td>Heart rate reserve (%)</td>
<td>46.7 ± 7.3</td>
<td>59.6 ± 3.8</td>
<td>67.2 ± 4.3</td>
</tr>
<tr>
<td>Age (years)</td>
<td>60 ± 6</td>
<td>61 ± 5</td>
<td>61 ± 6</td>
</tr>
<tr>
<td>Body weight (kg)</td>
<td>74.5 ± 10.8</td>
<td>73.9 ± 11.6</td>
<td>74.1 ± 13.4</td>
</tr>
<tr>
<td>Body mass index (kg/m²)</td>
<td>30.0 ± 4.2</td>
<td>29.7 ± 4.0</td>
<td>30.1 ± 5.0</td>
</tr>
<tr>
<td>Fat mass (kg)</td>
<td>32.8 ± 7.5</td>
<td>33.4 ± 8.1</td>
<td>33.0 ± 9.1</td>
</tr>
<tr>
<td>Fat-free mass (kg)</td>
<td>41.6 ± 4.6</td>
<td>40.3 ± 5.2</td>
<td>41.1 ± 5.6</td>
</tr>
<tr>
<td>Waist girth (cm)</td>
<td>90.8 ± 9.5</td>
<td>91.9 ± 10.6</td>
<td>90.7 ± 12.2</td>
</tr>
<tr>
<td>Total cholesterol (g/L)</td>
<td>2.31 ± 0.34</td>
<td>2.29 ± 0.36</td>
<td>2.37 ± 0.40</td>
</tr>
<tr>
<td>LDL cholesterol (g/L)</td>
<td>1.15 ± 0.35</td>
<td>1.20 ± 0.33</td>
<td>1.21 ± 0.37</td>
</tr>
<tr>
<td>HDL cholesterol (g/L)</td>
<td>0.62 ± 0.13</td>
<td>0.60 ± 0.15</td>
<td>0.65 ± 0.21</td>
</tr>
<tr>
<td>Triglycerides (g/L)</td>
<td>1.05 ± 0.32</td>
<td>1.06 ± 0.37</td>
<td>1.57 ± 0.61</td>
</tr>
<tr>
<td>VO₂max (mLO₂/kg/min)</td>
<td>19.2 ± 6.6</td>
<td>18.4 ± 5.8</td>
<td>19.1 ± 6.5</td>
</tr>
</tbody>
</table>

Values are means ± SD. HRR: heart rate reserve.

Our results are concordant with those of Church et al. [4] who showed an improvement in individuals’ physical fitness from 4 to 8 mL/min/kg according to the exercise dose, at an intensity of 50% VO₂ peak, although they are in contrast with those of Doury-Panchout et al. [7] who reported a slight improvement of 1 mL/min/kg in VO₂max after a 4-week rehabilitation program. Our data, however, fit well with those of King et al. [23] who reported a close relationship between adherence to exercise and VO₂max increase. The decrease in fat mass and more particularly in abdominal fat reflected by the waist girth measurement observed in our study is in good accordance with the one found in walking trials performed on similar populations [3,20] but not in a laboratory study where exercise was performed on cycloergometers or treadmills [4]. In this regard, body composition seems to be influenced by the type of exercise, as outdoor walking was shown to reduce body weight and waist girth [3] in contrast to an indoor program that did not change body weight (and thus BMI) or fat mass, but surprisingly decreased waist circumference [4]. Reasons for these discrepancies could be due to the beneficial effects of performing physical activity in a natural environment [37]. On the other hand, improvements in the CHD risk profile did not seem to depend on the adherence, as ameliorations in the fasting lipid-lipoprotein profile were not significantly different between groups (Fig. 2). This observation is in agreement with the 6-month study of Church et al., [4] although it contrasts with the 2-year study of King et al. [23] who showed that exercise duration was more important than its frequency and/or intensity to increase plasma HDL cholesterol levels in middle-aged individuals. In this regard, a meta-analysis [24] estimated 120 minutes as the minimal weekly exercise volume necessary to increase plasma HDL cholesterol concentrations, in both genders. Although such exercise volume was reached in women characterized by the highest adherence (i.e., 126 minutes) in our study, ameliorations in plasma HDL levels were found in the 3 groups investigated (Fig. 2).

Fig. 3. Changes in the body composition and physical fitness after the 16-week walking program, according to the exercise intensity. Values presented are means ± SE. P-values indicated on the figure stand for differences between women with low (< 56% HRR), medium (56–63% HRR) or high (> 63% HRR) exercise intensity. Differences between before and after the 16-week walking program, in each group at *P < 0.001 and **P < 0.001. HRR: heart rate reserve.
In contrast, ameliorations in both physical fitness and body fatness as well as in the CHD risk profile were independent of the exercise intensity (Figs. 3 and 4). The average program intensity reached in our study (i.e., 57 ± 10% HRR) (mean ± SD) was close to the one we planned, i.e., 60% HRR, and corresponded to a moderate-intensity physical activity, as defined by Nelson et al. (2007) [33]. Improvements in both physical fitness and body fatness, as well as in the fasting lipid-lipoprotein profile fitted well with the data reported by Asikainen et al. (2003) [3], thus suggesting that frequency, duration and compliance to physical activity are more important than intensity to improve different health indicators, in sedentary and moderately obese postmenopausal women. Although we noticed comparable reductions in body weight and fat mass regardless of the walking intensity, the greatest decrease in waist circumference observed at 56–63% HRR was in agreement with data reported by Irwin et al. (2003) [20]. Once again, ameliorations in the fasting lipid-lipoprotein profile did not appear to depend on exercise intensity (Fig. 4). However, the increase in plasma HDL cholesterol levels we observed in 2 of the 3 groups studied (i.e., < 56% HRR and 56–63% HRR) was concordant with the favorable changes noted by Dalleck et al. (2009) [5], but clearly contrasts with the unchanged HDL cholesterol concentrations found by Asikainen et al. (2003) [3]. Our data emphasized the fact that a low to moderate exercise intensity is sufficient to improve individuals’ lipid-lipoprotein profile. The lack of ameliorations in HDL cholesterol level noted at exercise intensity greater than 63% HRR (Fig. 4) and the lower reduction in waist girth (Fig. 3) emphasized the fact that high exercise intensity does not seem to be necessary to improve some cardiovascular risk factors.

Some limits may, however, deserve further attention. First, the lack of a control group could be questioned although unchanged body weight, fat mass, lean mass and physical fitness have already been reported in women remaining physically inactive during the 16-week study period, by our group [12]. Second, as the weight reducing program we used only referred to aerobic physical activity, women recruited needed to be in good physical condition to perform regular walking, 3 days/week, during 16 weeks. The fact that women selected for the objective of our study were thus rather healthy and probably represented a group of volunteers more health-conscious and motivated in losing weight, could be questioned. Although consequences of possible or even likely sampling bias on results obtained are difficult to estimate, it seems realistic to consider that our data could not be extended to the overall population. As suggested by Labrune et al. [25] our approach combined with an educational program would have been more effective. Moreover, we could imagine even better results using an exercise program based on high-intensity interval training [6,8,16,17]. Also, it would have been interesting to include measurements of energy expenditure by accelerometers or podometers, since such measures were shown to improve observance to physical activity (PA) in different populations [2,15] at high risk of non-observance of regular PA [26]. Finally, it would have been useful to perform a follow-up study that examined the duration of health benefits due to this walking program.

Our study also has several strengths such as its large sample size which allows us to perform adequate statistical analyses, control of physical activity through the supervision of 2 on the 3 exercise sessions planned, completion of dietary diaries to verify participants’ compliance from a nutritional standpoint [13], continuous HR monitoring during exercise and registration of the mean HR at each session in an exercise log book, as well as the small drop out probably due to the type and location of exercise. In this regard, our training program took place outdoors, on sidewalks, streets, forest trails or parks, and, nearby participants’ home, emphasizing the fact that adults living in more walkable neighborhoods would engage in more physical activity [19]. Indeed, Murtagh et al. [32] have already suggested that “neighborhood and workplace amenities and programs may be important supports for walking behaviors”. This issue needs to be more extensively investigated, as a recent review pointed out the importance of considering social and physical environment as potential contributors to physical inactivity. Finally, all measurements were carried out by the same operators and in strictly controlled similar conditions.

5. Conclusion

A high adherence appears to be an important factor to reduce body fatness and improve physical fitness, as well as some
components of the lipid-lipoprotein profile and thus CHD risk. Furthermore, health benefits appear as early as 78 minutes of brisk walking per week, in moderately obese and initially sedentary postmenopausal women. Finally, these findings might contribute to increase engagement of our study population in regular physical activity and, thereby, facilitate its promotion as part of health education.

Disclosure of interest

The authors have not supplied their declaration of conflict of interest.

Acknowledgments

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1 Deceased November 2013.