Sedentary Lifestyle: Physical Activity Duration Versus Percentage of Energy Expenditure

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Introduction and objectives. To compare different definitions of a sedentary lifestyle and to determine which is the most appropriate for demonstrating its relationship with the metabolic syndrome and other cardiovascular risk factors.

Methods. A cross-sectional study of 5814 individuals was carried out. Comparisons were made between two definitions of a sedentary lifestyle: one based on active energy expenditure being less than 10% of total energy expenditure, and the other, on performing less than 25-30 minutes of physical activity per day. Reported levels of physical activity, anthropometric measurements, and biochemical markers of cardiovascular risk were recorded. The associations between a sedentary lifestyle and metabolic syndrome and other risk factors were adjusted for gender, age and tobacco use.

Results. The prevalence of a sedentary lifestyle was higher in women (70%) than in men (45%-60%, according to the definition used). The definitions based on physical activity duration and on energy expenditure were equally useful: there were direct associations between a sedentary lifestyle and metabolic syndrome, body mass index, abdominal and pelvic circumferences, systolic blood pressure, heart rate, apolipoprotein B, and triglycerides, and inverse associations with high-density lipoprotein cholesterol and paraoxonase activity, which demonstrated the greatest percentage difference between sedentary and active individuals. An incidental finding was that both definitions of a sedentary lifestyle were more strongly associated with the metabolic syndrome as defined by International Diabetes Federation criteria than by Adult Treatment Panel III criteria.

Conclusions. Given that it is relatively easy to determine whether a patient performs less than 25 minutes of physical activity per day, use of this definition of a sedentary lifestyle is recommended for clinical practice. The serum paraoxonase activity level could provide a useful marker for studying sedentary lifestyles.

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Key words: *Sedentary lifestyle. Physical activity duration. Active energy expenditure. Metabolic syndrome. Paraoxonase.*

Sedentarismo: tiempo de ocio activo frente a porcentaje del gasto energético

Introducción y objetivos. Comparar 2 definiciones diferentes de sedentarismo y averiguar cuál es más efectiva para detectar su relación con el síndrome metabólico (SM) y otros factores de riesgo cardiovascular.

Métodos. Estudio transversal de 5.814 individuos. Se compara el concepto de sedentarismo basado en consumir activamente menos del 10% del gasto energético total con el concepto basado en no realizar al menos 25-30 min diarios de ocio activo. Se analizan la actividad física declarada, la antropometría y los marcadores bioquímicos de riesgo cardiovascular. La relación del sedentarismo con el SM y los marcadores de riesgo se ajustó por el sexo, la edad y el tabaquismo.

Resultados. La prevalencia de sedentarismo en mujeres (70%) fue superior a la de los varones (un 45-60%, según el concepto empleado). El tiempo de ocio mostró la misma efectividad que la energía consumida: el sedentarismo se asoció directamente con el SM, el índice de masa corporal, las cinturas abdominal y pélvica, la presión arterial sistólica, la frecuencia cardiaca, la apolipoproteína B y los triglicéridos, e inversamente con el colesterol unido a lipoproteínas de alta densidad (cHDL) y la actividad de la paraoxonasa (ésta presentó el mayor porcentaje de variación entre sedentarios y activos). Como resultado colateral se obtuvo que la definición de SM propuesta por la Federación Internacional de Diabetes se asocia con mayor fuerza que la del ATP-III a cualquier concepto de sedentarismo.

Conclusiones. Dada su mayor facilidad de obtención, en la práctica clínica es recomendable el uso del concepto de sedentarismo basado en averiguar si el paciente realiza al menos 25 min diarios de ocio activo. La actividad de la paraoxonasa es un marcador de interés para el estudio del sedentarismo.

Palabras clave: *Sedentarismo. Tiempo de ocio activo. Gasto energético activo. Síndrome metabólico. Paraoxonasa.*

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ABBREVIATIONS

MET: metabolic equivalent
MS: metabolic syndrome

IINTRODUCTION

The sedentary lifestyle is one of the principal risk factors in highly prevalent illnesses such as type 2 diabetes,[1] cardiovascular disease,[2] osteoporosis,[3] and some cancers.[4] The association between sedentary lifestyle and the current pandemia of obesity[5] and metabolic syndrome (MS) is clear.[6,7] Consequently, the sedentary lifestyle is associated with worse quality of life[8] and increased general mortality.[9] But, in spite of its intuitive simplicity, no consensus has been reached on the concept of sedentary lifestyle.[10] This suggests the value of further research into how best to measure it, and to increase our knowledge both of its prevalence in different populations and of associated factors.

Some authors take total daily energy expenditure and derive sedentary lifestyle as a function of the ratio between energy consumed in activities requiring ≥4 metabolic equivalents (MET) and total energy consumption.[11] Others focus on leisure-time expenditure, defining it as a function of the relation between physical activities with an expenditure of ≥4 MET and total energy consumption during activity time.[12] However, in clinical practice, concepts based on energy expenditure are difficult to apply because they require laborious calculations. The fight against the sedentary lifestyle calls for a concept that is easier to use; ideally one based on questions about the duration of daily physical activity.[13] One recent study classified individuals as sedentary or active solely on their response to the question: do you follow a regular program of physical training?[14] However, the authors provide no data to validate the method and classifying individuals as active or sedentary without knowing the frequency, duration and intensity of the physical exercise they undertake is unacceptable.

The objective of the present study is to determine whether the concept of sedentary lifestyle based on duration of leisure-time physical activity is equally or more effective than that based on percentage of energy expenditure, in detecting the relation between physical inactivity, MS and other cardiovascular risk factors. If this is the case, it would be more efficient in clinical practice, given it is easier to use.

METHODS

The data in this study come from the first 5814 individuals included in the "CDC de Canarias" cohort (CDC indicates cardiovascular, diabetes and cancer). Participants, aged 18 to 75, were randomly selected from the census. Enrolment took place between 2000 and 2004 through random sampling and the cohort selection strategy initially included proportionately more women. Participation surpassed 68% in both genders.[15] Specially trained interviewers questioned participants about lifestyle (physical activity, diet, tobacco use, alcohol use, sleep duration, etc.); tobacco use was defined as an affirmative response when asked "Do you smoke?"

Following informed consent, each participant underwent physical examination and blood samples were taken for analysis. Body mass index (BMI) was calculated as weight (in kg)/height (in m^2). Blood pressure was taken after 5 min seated rest and the mean of two measurements was recorded. Blood samples were obtained after overnight fasting, centrifuged at room temperature at 2000 rpm for 10 min, placed in ice in portable containers and transferred daily to the Hospital de La Candelaria, on the island of Tenerife. Glycemia and lipoproteins were measured with the Hitachi® 917 automatic analyzer within 24 hours of extraction and presented in mg/dL. Low-density lipoprotein cholesterol (LDL-C) was calculated as total cholesterol minus high-density lipoprotein cholesterol (HDL-C) minus triglycerides divided by 5. Leptin was quantified by ELISA (Biosource®, in ng/mL, with 3.6% intra- and 6.8% interassay coefficients of variation). Activity of paraoxonase versus paraoxon (PON) was determined by colorimetric techniques (U/L, 1.7% intra- and interassay coefficients of variation). To ensure efficiency, leptin and PON were only determined in the first 903 participants included. For MS, we used US National Cholesterol Education Program (ATP-III)[16] and International Diabetes Federation (IDF)[17] definitions.

To collect data on physical activity at work we employed a questionnaire validated for the Canary Islands population (number of hours/day physical activity equivalent or greater in intensity than walking at a fast pace); leisure-time physical activity was elicited with the Minnesota Leisure Time Physical Activity Questionnaire.[18,19] Each activity reported was later assigned the corresponding MET number according to Ainsworth et al's Compendium of Physical Activities.[20] One MET is the energy consumption of an individual at rest, equivalent to approximately 1 kCal per kg of weight and hour, ie, 4184 kJ per kg of weight and hour.[21]

We employed two concepts of sedentary lifestyle. The first was that used by Bernstein et al, which defines the sedentary individual as one who invests <10% of daily energy expenditure in physical activities requiring ≥4 MET (physical activity equivalent or greater in energy expenditure than walking at a fast pace).[11] The second concept distinguishes between men and women and defines a sedentary individual as one who daily invests <n minutes in leisure activities consuming ≥4 MET. From the literature,[5,22,23] we determined n=25 minutes/day in women and 30 minutes/day in men.

In the statistical analysis we estimated the concordance between the two concepts of sedentary lifestyle using Cohen's kappa. We compared proportions of categorical variables (MS) with Pearson's χ^2 and correction for continuity. For continuous variables (anthropometric indices and biochemical markers) we analyzed the difference of means between sedentary and active individuals with Student's *t* test. To control for possible confounders such as gender, age and tobacco use in the association of sedentary lifestyle with continuous variables, we adjusted a multiple linear regression model for each anthropometric or biochemical variable; ie, we took each continuous variable as a dependent variable and in all the models introduced as independent predictor: sedentary lifestyle, gender, age and tobacco use. Similarly, we adjusted non-conditional binary logistical regression models for the dependent categorical variable (MS) to control for confounders. Continuous variables that did not fulfill normal frequency distribution criteria (triglycerides, PON, glycemia and leptin) were transformed logarithmically before applying statistical tests, but values are presented on the natural scale. Calculations were with SPSS 12.0 (Spanish).

RESULTS

Table 1 presents data on the 5814 individuals studied relating gender with prevalence of sedentary lifestyle, MS, tobacco use, age, BMI, and estimates of daily energy expenditure in different activities. Sedentary lifestyle in women is around 70% whichever definition is used. However, in men, sedentary lifestyle approached 60% when defined as duration of physical activity, and <50% with when defined as percentage of active energy expenditure. Concordance between the two concepts produced kappa 0.8 (P<.001) in women and 0.7 (P<.001) in men.

Table 2 presents results obtained on evaluating the differences in prevalence of MS, anthropometric and biochemical data of individuals classified as active or sedentary according to the percentage of energy expenditure in physical activities requiring ≥4 MET. In women, heart rate was the only variable not discriminated whereas in men no differences appeared for diastolic blood pressure (DBP), PON, and leptin.

Table 3 presents data based on analysis of individuals classified as sedentary or active according to duration in minutes of daily physical activity. Women present significant differences in all variables whereas in men differences are not statistically significant for pelvic circumference (P=.30), systolic blood pressure (SBP) (P=.14) and DBP (P=.09), HDL-C (P=.13), and PON (P=.07).

The use of different concepts of sedentary lifestyle to measure the same definition of MS did not generate significant differences in prevalence of MS detected.

TABLE 1. Prevalence (%) of Sedentary Lifestyle, Metabolic Syndrome and Tobacco Use in Women and Men*

	Women (n=3422)	Men (n=2392)
Prevalence of sedentary lifestyle 25†	68	53
Prevalence of sedentary lifestyle 30‡	73	59
Prevalence of sedentary lifestyle 10§	69	45
Prevalence of ATP-III metabolic syndrome	24	25
Prevalence of IDF metabolic syndrome	30	37
Prevalence of tobacco use	22	33
Age, y	43 (13)	43 (13)
BMI	27.4 (5.6)	27.5 (5.8)
Active work, MET/day	0.0 (0.0-1.5)	0.0 (0.0-20.0)
Passive work, MET/day	8.4 (8.4-8.5)	8.4 (1.5-9.0)
Physical activity, MET/day	1.7 (1.7-3.6)	2.4 (1.7-6.4)
Passive leisure, MET/day	4.6 (2.2-7.7)	0.9 (0.0-2.7)
Sleep duration, MET/day	6.2 (1.3)	6.2 (1.2)
"Napping", MET/day	0.0 (0.0-0.2)	0.0 (0.0-0.5)
Remaining activities in the day, MET/day	8.0 (2.5)	8.3 (2.7)
Total energy expenditure, MET/day	31.9 (6.0)	34.2 (10.9)

*BMI indicates body mass index; MET, metabolic equivalents.
†<25 minutes daily physical activity.
‡<30 minutes daily physical activity.
§<10% of daily energy expenditure employed in leisure or work activity. Work or physical activity was defined as requiring 4 MET.
Age, body mass index, and daily energy expenditure in different activities are summarized with mean (SD) or median (percentiles 25 and 75) depending on whether their distribution was normal or not.

With the ATP-III definition, in sedentary women we found 27% versus 26% of MS whereas sedentary men presented 30% versus 27% (Tables 2 and 3, respectively; P>.05). Similarly, with the IDF definition, prevalence was 34% and 33% in sedentary women and 45% and 41% in sedentary men (Tables 2 and 3, respectively; P>.05). In contrast, the use of the two definitions of MS did modify the capacity of sedentary lifestyle to detect presence of MS: specifically, on moving from the ATP-III definition to the IDF definition, prevalence of MS in sedentary women rises from 27% to 34% (Table 2; P<.001) and 26% to 33% (Table 3; P<.001) whereas in sedentary men prevalence of MS rises from 30% to 45% (Table 2; P<.001) and 27% to 41% (Table 3; P<.001).

Table 4 presents all statistics showing association of the different concepts of sedentary lifestyle with MS and the remaining variables studied after adjusting for gender, age, and tobacco use. In multivariate analysis, only DBP, glycemia, total cholesterol and LDL-C were not associated with sedentary lifestyle. The greatest percentage of variation between sedentary and active was presented by PON.

TABLE 2. Differences Between Active and Sedentary Individuals by Comparison With Prevalence of Metabolic Syndrome (% [95% CI]), Anthropometric, and Biochemical Marker Indices (Means [SD])*

	Women			Men		
	Sedentary 10 (n=2361)†	Active ≥ (n=1061)†	*P*	Sedentary 10 (n=1076)†	Active (n=1316)†	*P*
ATP-III metabolic syndrome	27 (25-29)	18 (16-20)	<.01	30 (27-33)	20 (18-22)	<.01
IDF metabolic syndrome	34 (32-36)	23 (20-26)	<.01	45 (42-48)	31 (29-33)	<.01
Body mass index	27.7 (5.8)	26.6 (5.1)	<.01	27.9 (4.4)	27.2 (6.9)	<.01
Abdominal circumference, cm	87.9 (14.4)	84.6 (13.3)	<.01	97.0 (12.5)	93.4 (12.6)	<.01
Pelvic circumference, cm	102.8 (21.2)	99.9 (12.0)	<.01	102.4 (9.8)	100.8 (9.7)	<.01
Systolic blood pressure, mm Hg	121.2 (19.8)	119.1 (18.6)	<.01	128.3 (18.5)	126.6 (17.2)	<.05
Diastolic blood pressure, mm Hg	76.3 (14.4)	75.0 (11.0)	<.01	81.0 (11.1)	80.3 (10.7)	NS
Heart rate, beats/min	75.2 (10.0)	74.9 (10.6)	NS	72.8 (10.9)	70.9 (10.8)	<.01
Glycemia, mg/dL	95.0 (25.4)	91.9 (19.0)	<.01	101.9 (29.1)	99.4 (32.9)	<.01
Total cholesterol, mg/dL	203.3 (41.0)	198.9 (40.9)	<.01	207.4 (41.0)	200.9 (43.4)	<.01
Triglycerides, mg/dL	110.9 (68.9)	97.8 (54.5)	<.01	147.0 (92.3)	132.6 (97.8)	<.01
LDL-C, mg/dL	127.0 (36.5)	123.1 (35.3)	<.01	132.2 (36.7)	127.4 (37.8)	<.01
Apolipoprotein B, mg/dL	106.1 (29.8)	99.7 (25.8)	<.01	112.3 (24.6)	106.2 (26.1)	<.01
HDL-C, mg/dL	54.0 (13.2)	56.3 (12.8)	<.01	45.7 (12.6)	46.9 (11.6)	<.05
PON, U/L	32.8 (22.7)	39.4 (25.8)	<.01	33.9 (23.8)	36.2 (23.8)	NS
Leptin, ng/mL	12.0 (9.3)	10.2 (7.7)	<.05	2.8 (3.1)	2.4 (2.4)	NS

*HDL-C indicates high-density lipoprotein cholesterol; LDL-C, low-density lipoprotein cholesterol; PON, paraoxon.
†For PON and leptin: n=342 sedentary women, 139 active women, 207 sedentary men and 215 active men.
Concept of sedentary lifestyle: consumption in leisure or active work of <10% of daily energy expenditure (sedentary 10).

DISCUSSION

In the always limited time available during a clinical examination it is easier for patient and physician to estimate minutes of daily physical activity (any exercise of an intensity equal to or greater than walking at a fast pace) than laboriously calculate energy expenditure during a day or part of one. Our results show the good concordance[24] of the concept of sedentary lifestyle based on duration of active leisure[13] with that based on energy actively consumed[11] and its similar capacity to detect greater cardiovascular risk associated with physical inactivity. This equals out both concepts when used in research, but gives an advantage to the use of duration of physical activity in clinical practice as it is easier to use. Some authors have compared leisure-time energy expenditure with total energy expenditure[25]; others have compared leisure-time energy expenditure with absence of physical activity plus number of hours seated.[12] However, we have found no prior studies that directly compare leisure time with expenditure in terms of the association with MS and other cardiovascular risk factors. The World Health Organization (WHO) considers that a sedentary adult obtains health benefits if they perform 30 minutes moderately-intense physical activity every, or almost every day.[22] The present study demonstrates that in both women and men, even 25 minutes per day produces benefits similar to those attained when a specific percentage of active energy consumption is estimated.

The relation between sedentary lifestyle and MS has been widely commented,[6,7,26,27] but to our knowledge, this is the first study that compares the association of the sedentary lifestyle with two definitions of MS: that of the ATP-III[16] and that of the IDF.[17] We conclude that whichever concepts of sedentary lifestyle and MS are used, MS is less frequent among active individuals. However, prevalence of MS in sedentary individuals is greater if we apply the IDF definition; this is only to be expected as it defines abdominal obesity in terms of a smaller abdominal circumference.

To compare the definitions of sedentary lifestyle we used a raft of anthropometric indices[28,29] and biochemical markers[30-33] previously proven to associate with physical activity. Differences in leptin and PON between active and sedentary men did not prove significant in bivariate analysis due to the smaller initial sample size and loss in statistical power as a consequence of sample stratification. However, multivariate analysis enabled us to see that the concentration of both serum markers is significantly different in active and sedentary individuals regardless of gender. Values of PON fell among sedentary individuals. This enzyme is associated with HDL-C, as it stimulates hydrolysis of lipid peroxides and confers protection against atherosclerosis,[34] so its values are low in MS.[35,36] The reduction of up to 20% in sedentary lifestyle makes it an interesting marker. There

TABLE 3. Differences Between Active and Sedentary Individuals by Comparison With Prevalence of Metabolic Syndrome (% [95% CI]), Anthropometric and Biochemical Marker Indices (Means [SD])*

	Women			Men		
	Sedentary <25 min (n=2327)†	Active ≥25 min (n=1095)†	*P*	Sedentary <30 min (n=1411)†	Active ≥30 min (n=981)†	*P*
ATP-III metabolic syndrome	26 (24-28)	20 (18-22)	<.01	27 (25-29)	21 (18-24)	<.01
IDF metabolic syndrome	33 (31-35)	24 (21-27)	<.01	41 (38-44)	31 (28-34)	<.01
Body mass index	27.7 (5.7)	26.7 (5.4)	<.01	27.7 (4.4)	27.2 (7.6)	<.05
Abdominal circumference, cm	87.8 (14.3)	84.8 (13.6)	<.01	96.3 (12.5)	93.0±12.7	<.01
Pelvic circumference, cm	102.7 (21.2)	100.2 (12.4)	<.01	101.7 (0.18)	101.2±0.12	NS
Systolic blood pressure, mm Hg	121.0 (19.6)	119.6 (19.0)	<.05	127.7 (18.2)	126.9±17.2	NS
Diastolic blood pressure, mm Hg	76.2 (14.4)	75.2 (11.1)	<.05	80.9 (11.0)	80.1 (10.7)	NS
Heart rate, lat/min	75.4 (10.1)	74.4 (10.3)	<.01	72.7 (10.9)	70.5 (10.8)	<.01
Glycemia, mg/dL	94.5 (24.9)	92.8 (20.8)	<.05	101.2 (28.1)	99.6±35.4	.01
Total cholesterol, mg/dL	203.0 (41.0)	199.6 (40.9)	<.05	206.6 (41.3)	199.8 (43.8)	<.01
Triglycerides, mg/dL	110.9 (69.6)	98.0 (53.0)	<.01	145.5 (98.3)	129.6 (90.8)	<.01
LDL-C, mg/dL	126.8 (36.4)	123.7 (35.8)	<.05	131.3 (36.7)	127.1 (38.3)	.01
Apolipoprotein B, mg/dL	106.0 (29.9)	100.5 (26.1)	<.01	112.0 (25.3)	104.4 (25.4)	<.01
HDL-C, mg/dL	53.9 (13.2)	56.3 (12.7)	<.01	46.2 (13)	46.7 (11)	NS
PON, U/L	32.2 (22.5)	39.7 (25.4)	<.01	33.5 (22.8)	38.4 (25.5)	NS
Leptin, ng/mL	12.2 (9.4)	10.2 (7.8)	<.05	2.7 (3.6)	2.1 (2.3)	<.01

*HDL-C indicates high-density lipoprotein cholesterol; LDL-C, low-density lipoprotein cholesterol; PON, paraoxon.
†For PON and leptin: n=320 sedentary women, 161 active women, 284 sedentary men and 138 active men.
Concept of sedentary lifestyle based on minutes of daily physical activity.

were markers that associated with sedentarism only in bivariate analysis. DBP, serum glucose concentration, total cholesterol and LDL-C, but this is commonly found in other studies[30,37,38] and depends on the quantity and intensity of the physical activity studied and the way it is measured.

A further important aspect of our results is the fact that the prevalence of sedentary lifestyle reported by

TABLE 4. Relationship of Sedentary Lifestyle With Metabolic Syndrome, Anthropometric, and Biochemical Marker Indices Following Adjustment for Gender, Age, and Tobacco Use*

Dependent Variables	Sedentary Lifestyle 25 (n=5814)§	Sedentary Lifestyle 30 (n=5814)§	Sedentary Lifestyle 10 (n=5814)§
ATP-III metabolic syndrome	1.29 (1.12-1.48)‡	1.30 (1.12-1.51)tt	1.46 (1.27-1.68)‡
IDF metabolic syndrome	1.41 (1.24-1.61)‡	1.40 (1.22-1.61)‡	1.53 (1.34-1.75)‡
Body mass index	0.59 (0.19)‡	0.61 (0.20)‡	0.59 (0.20)‡
Abdominal circumference, cm	1.91 0.35)‡	1.90 (0.36)‡	1.89 (0.35)‡
Pelvic circumference, cm	1.21 (0.44)‡	1.09 (0.46)†	1.76 (0.45)‡
Systolic blood pressure, mm Hg	0.98 (0.44)†	1.02 (0.46)†	0.96 (0.45)†
Diastolic blood pressure, mm Hg	0.21 (0.33)	0.10 (0.34)	0.05 (0.39)
Heart rate, beats/min	1.49 (0.30)‡	1.73 (0.31)‡	1.36 (0.34)‡
Glycemia, mg/dL	0.01 (0.72)	0.28 (0.75)	0.47 (0.73)
Total cholesterol, mg/dL	1.02 (1.09)	0.82 (1.13)	0.73 (1.10)
Triglycerides, mg/dL	8.47 (2.16)‡	8.42 (2.25)‡	8.46 (2.18)‡
LDL-C, mg/dL	0.94 (0.98)	0.35 (1.01)	0.13 (1.03)
Apolipoprotein B, mg/dL	3.01 (1.37)†	3.31 (1.42)†	2.15 (1.40)
HDL-C, mg/dL	–1.30 (0.36)‡	–1.29 (0.37)‡	–1.65 (0.36)‡
PON, U/L	–6.26 (1.81)‡	–6.95 (1.89)‡	–5.25 (1.84)‡
Leptin, ng/mL	1.20 (0.50)†	1.13 (0.52)‡	1.02 (0.50)†

*HDLC indicates high-density lipoprotein cholesterol; LDL-C, low-density lipoprotein cholesterol; PON, paraoxon.
Sedentary lifestyle 25: <25 min daily physical activity. Sedentary lifestyle 30: <30 min daily physical activity. Sedentary lifestyle 10: <10% daily energy expenditure used in leisure or work active.
†*P*<.05
‡*P*<.01
§For PON and leptin: n=903
For dependent categorical variables (metabolic syndrome) values correspond to odds ratio (confidence interval 95%) for sedentary lifestyle. For dependent continuous variables values express the regression coefficients for sedentary lifestyle±SE.

women in the Canary Islands is similar to that described in mainland Spain, Germany, or France, but the difference by comparison with men (15%) is greater than that described in any other European country.[12,25]

Given we have measured sedentary lifestyle through duration of physical activity in active leisure, this great difference is not attributable to differences in physical activity at work but, rather, to social inequalities between the genders. When we measured sedentary lifestyle defined as total energy expenditure, the difference between the genders increased by 10% to 25%, and this can be attributed to the greater physical activity of men at work. This large difference between men and women may be associated with the outstanding position that women of the Canary Islands present in Spanish statistics for mortality due to ischemic heart disease and diabetes mellitus,[39] but we will need more studies on this point to be able to demonstrate this. We would suggest that the difference will tend to diminish because levels of physical activity at work in Spain seem to be diminishing in women and men.[40]

The principal limitation of our study is probably the measurement of physical activity through self-reporting. This problem is common to most epidemiologic studies including large population samples as questionnaires are the most efficient instrument. Wide-ranging questionnaires have previously been employed in research into physical activity and their validity and reproducibility demonstrated in Spanish populations.[18,19] We know there is a tendency to overestimate activity in self-reporting[41] but this would only mean that our study has classified as active some sedentary individuals, which would attenuate differences detected anyway. In any case, among men in the Canary Islands, prevalence of sedentary lifestyle may be greater than individuals have reported. Participation is acceptable (68%) for this type of study in the general population when individuals are asked to travel to attend clinic, fast prior to giving blood samples, and make time available to attend clinical examinations and a lengthy interview. However, the possibility of some participation bias has been discussed earlier.[15]

CONCLUSIONS

To summarize, we have proved that to detect metabolic and anthropometric effects of physical inactivity, the concept of sedentary lifestyle based on duration of physical activity is not significantly inferior to that based on active energy consumption. We have also proved that the IDF definition of MS associates more strongly than the ATP-III definition with either concept of sedentary lifestyle, and that PON activity is a useful biochemical marker in studying this problem. We recommend using the definition of sedentary lifestyle as 25-30 minutes of daily physical activity, given its greater efficiency in clinical practice.

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