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Correlation between physical activity and cardiovascular risk factors in postmenopausal women from Colombia Caribbean

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Abstract

Postmenopausal period disturbances are more frequently observed in women with unhealthy lifestyles, insufficient physical activity is related to increased cardiovascular risk (CVR). There is a lack of evidence-based information on physical activity in postmenopausal women and its relationship with CVR factors, including D vitamin serum levels.

Objective: To determine the physical activity level in postmenopausal women from the Colombia Caribbean and establish relationships between the physical activity and biochemical and anthropometric CVR factors.

Methods: A correlational descriptive study in which 183 postmenopausal women were linked for convenience sampling. Level of physical activity (International Physical Activity Questionnaire) and their relationships with anthropometric variables, blood pressure, lipid profile, glycemic and serum vitamin D were evaluated.

Results: According to the physical activity, 82.5% of women were classified as inactive, 9.3% as insufficiently active and only 8.2% as physically active. Physical inactivity was significantly related to higher glucose, triglycerides, and total cholesterol serum levels ($P < .05$). The prevalence of the women with vitamin D levels less than 30 ng/mL were of 69.9%. The women physically active and with eutrophic nutritional condition had more high levels of vitamin D.

Conclusions: 82.5% of the postmenopausal women evaluated were physically inactive and this condition was associated with higher serum levels of glycemic, total cholesterol and triglycerides. Serum vitamin D concentrations were higher in traffic and physically active women.

Keywords: exercise, healthy lifestyle, postmenopause, risk factors, vitamin D

Introduction

Cardiovascular diseases (CVD) are the most common cause of death worldwide, the Global Burden of Disease study estimating that CVD caused 17.3 million deaths globally.[1] In the female population, the CVD represent the 23.0% of total deaths worldwide, and in postmenopausal women are the main cause of death, being the postmenopausal state classified as a risk factor for the development of atherosclerotic coronary artery disease.[2–4] As a consequence of the attenuation of the production of sex hormones since perimenopause, adult women undergo physiological and morphological changes that accentuate cardiovascular pathogenesis, such as: increased body mass index (BMI) with highly inflammatory central adipose tissue extension[5]; decreased muscle mass and functional capacity (sarcopenic)[6]; decreased basal metabolism and bone mineral density[7,8]; increased oxidative stress and inflammatory biomarkers.[9] These postmenopausal period disturbances are more frequently observed in women with unhealthy lifestyles, associated with increased intake of macronutrients and insufficient physical activity.[9] Physical inactivity is a world public health problem, associated with the increase of non-communicable chronic diseases (NCDs) and more mortality risk, observational data demonstrate an association between higher levels of physical activity and lower rates of many chronic diseases, including CVD.

Higher prevalence of deficiency in serum vitamin D concentrations, has been also observed in postmenopausal women, this deficiency increase in the same extent the incidence of metabolic syndrome and others disorders associated with mortality in this population.[10] The wide range of chronic non-musculoskeletal conditions that have been epidemiologically linked to deficiency of vitamin D include cancer, diabetes, multiple sclerosis, and immune diseases. However, CVD are the most prevalent conditions related to vitamin D deficiency, due to the vascular endothelium protection that this vitamin offers at normal levels (vasodilator, antioxidant, and antithrombotic activity).[10,11]

Vitamin D deficiency is currently considered a growing global public health problem, with more than 1 billion people estimated

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to have insufficient vitamin D levels.[12] There are few studies evaluating serum vitamin D levels in postmenopausal women of the Caribbean region and their association with physical inactivity and others CVR factors. This is a know relevant at the local and national level, taking into account that CVD constitute one of the main public health problem in Colombia.

The aim of this study is to determine the physical activity level (IPAQ, International Physical Activity Questionnaire) in postmenopausal women from the Atlántico department of Colombia Caribbean and establish relationships between the physical activity and anthropometric and biochemical cardiovascular risk factors, including deficient serum levels of vitamin D.

Methods

In this descriptive correlational study, 183 postmenopausal women who were attending habitually to the internal medicine consult in health institutions from the Department of the Atlantic of Colombia, were linked for convenience sampling. Level of physical activity using the IPAQ questionnaire and their relationships with cardiovascular risk associated variables as anthropometric status, blood pressure, lipid profile, glycemic and serum vitamin D were evaluated. The sampling was done between the month of September and October of the year 2017. The inclusion criteria were postmenopausal women (at least 1 year after the last menstruation period), with ages between 50 and 80 years old, who does not consume replacement hormonal therapy or nutritional supplements or another vitamin D source additional to the diet, who had a stable health status, according to the medical assessment performed by an internal medicine resident under the supervision by an internist, without being exclusion criterion the control of pathologies such as the hypertension and the diabetes through use of medicament. The medical assessment included the taking of the blood pressure with an automatic arm pressure monitor (Elite Omron HEM-7130) and recorded the participant health history.

Physical activity evaluation: The level of physical activity was assessed by a physiotherapist using the IPAQ questionnaire long version, in order to determine the level of physical activity of postmenopausal women and to classify the population in 3 categories: inactive (<1000 METs), insufficiently active (1000–1500 METs) and active (>1500 METs), depending on their total physical activity (METs min/week) and frequency of activities. The IPAQ is used as a standardized measure to estimate habitual practice of physical activities of populations from different countries and sociocultural contexts, the long form of IPAQ examines the habitual physical activity in daily life, using 27 items about 4 domains, leisure time, domestic, occupational and transport-related activities.[13]

The METs energy expenditure values (3.5 mL O_2/kg × min −0.0175 kcal) and the level of physical activity were calculated according to the IPAQ data processing and analysis guidelines, for to categorize the individual woman according to the indirect analysis provided by the questionnaire, associated with the energy expenditure used for physical activity in 1 week.[14]

Biochemical evaluation: The women were summoned to the morning in fasting condition (12-hour fast) in the health promoting entity, where a bacteriologist performed the extraction of 10 mL of blood without anticoagulant, for the estimation of lipid profile, basal glycemic and vitamin D serum levels. The blood samples were immediately transported in refrigeration to the Metropolitan University Hospital Foundation for processing. Serum extracted by centrifugation of the blood sample was used to determine the levels of total cholesterol, triglycerides, high density lipoproteins (HDL), and basal glycemic, the values for low density lipoproteins (LDL) were calculated with the Friedewald formula.[15] The serum vitamin D levels, were determined using the LIAISON XL immunochemiluminescence analyzer and the LIAISON-25 OH total vitamin D kit, according to the manufacturer instructions; this kit evaluated serum levels of 25-hydroxy total vitamin D (25-OH-D2 and 25-OH-D3 fractions). The serum vitamin D analysis of results included the absolute and relative frequency of states of sufficiency, insufficiency and deficiency according to the criteria accepted by ISE (International Society of Endocrinology), which define as sufficiency the serum levels of 25-OH-D >30 ng/mL (75 nmol/L), insufficiency between 21 and 29 ng/mL and deficiency <20 ng/mL (50 nmol/L).[16]

Anthropometric evaluation: Body weight in kilograms (electronic balance OMRON HN-289, Tokyo, Japan), height in centimeters (Perspective Enterprises, Portage, USA) and abdominal perimeter in centimeters (performed at half-distance between the iliac crest and the last palpable rib) (Gulick anthropometric tape CM-150 cm), was assessed by expert nutritionists, following the national guidelines described in the 2465 resolution of Colombia of 2016.[17]

Data processing and information analysis was carried out using the statistical package SPSS software version 24.0. The categorical variables were analyzed using absolute frequencies and percentages and the average quantitative and standard deviation. For quantitative variables, the normality of the data of each variable was initially tested using the Q-Q charts and the Kolmogorov-Smirnov normality test. Dispersion measurements were standard deviation (SD) and differences in quantitative variables were calculated with the ANOVA test. A value of $P < .05$ was considered statistically significant for all tests.

The study was endorsed by the institution ethics committee, it respected the Declaration of Helsinki, and it was classified in the research category minimum risk, according to article 11 of resolution 8430 of 1993 of the Ministry of Health,[18] All patients or their relatives signed the informed consent. The management of the data and the medical records was carried out in accordance with the provisions of Law 23 of 1981 of the Colombian Congress and resolution 1995 of 1999 of the Ministry of Health.

Results

In this study we evaluated the levels of physical activity in 183 postmenopausal women from the department of Atlántico-Colombia, with average age of 64.2 ± 6.1 years. The results show that 82.5% of women (n = 151) were classified as inactive, 9.3% as insufficiently active (n = 17) and only 8.2% (n = 15) as physically active. Nutritional status by anthropometry was altered in the 81.4% of the subjects including overweight (BMI >25 to <30) 41.0% and obesity 40.4% (obesity I (BMI 30 to <35) 27.3%, obesity II (BMI 35 to <40) 8.2% and obesity III (BMI 40) 4.9%), without presence of low weight; the women with abdominal circumference above of 88 cm were of 94.0%. The prevalence of high blood pressure was 78.7% determined according ATP III criteria (systolic blood pressure (SBP) greater than or equal to 130 mm Hg and/or diastolic blood pressure (DBP) greater than or equal to 85 mm Hg or in antihypertensive treatment).[19] The frequency of postmenopausal women with serum vitamin D levels below the recommended (>30 ng/mL) were of 69.9%, to doing deficiency (25-OH-D <20 ng/mL) the

Table 1

Comparison of means of the characteristics studied in the population grouped according to their level of physical activity

Variables evaluated	Physical activity (METs)			P^*
	Active 2252.9 ± 689.8 (n = 15)	Insufficiently active 1231.6 ± 129.1 (n = 17)	Inactive 379.8 ± 145.3 (n = 151)	
Age (yr)	64.3 ± 3.8	63.2 ± 4.9	64.3 ± 6.5	.842
BMI (kg/m^2)	28.0 ± 3.3	28.8 ± 3.5	30.2 ± 6.2	.271
Ab. perimeter (cm)	100.2 ± 9.2	97.2 ± 9.5	101.3 ± 9.4	.564
SBP (mm Hg)	123.7 ± 9.3	125.0 ± 12.4	126.1 ± 12.6	.797
DBP (mm Hg)	77.7 ± 7.7	78.7 ± 5.3	78.1 ± 7.4	.928
Glycemic (mg/dL)	83.4 ± 16.0^a	80.3 ± 14.6^a	94.2 ± 30.7^b	.041
Total cholesterol (mg/dL)	163.8 ± 47.3^a	177.9 ± 39.9^{a,b}	186.1 ± 49.5^b	.049
Triglycerides	154.9 ± 56.6^a	174.1 ± 83.6^{a,b}	186.4 ± 71.1^b	.035
LDL (mg/dL)	95.8 ± 35.3	80.6 ± 30.9	96.8 ± 41.9	.057
HDL (mg/dL)	51.1 ± 10.0	48.4 ± 11.4	52.0 ± 11.7	.812
Vitamin D (ng/mL)	27.7 ± 6.8	23.6 ± 6.6	22.060 ± 9.4	.089

The data that do not share the same letters a, b or c are statistically different. $^*P$ value $<.05$ is considered significant. Value correspond to mean ± standard deviation.
BMI = body mass index, DBP = diastolic blood pressure, HDL = high density lipoprotein, LDL = low density lipoprotein, METs = unit of measurement of the metabolic index (3.5 mL O_2/kg × min − 0.0175 kcal), SBP = systolic blood pressure.

26.2% (n = 48) and insufficiency (25-OH-D between 21 and 29 ng/mL) the 43.7% (n = 80).

The relationship between the levels of physical activity and the averages values of the evaluated variables (Table 1) showed statistical differences between the active and inactive women groups in relation to fasting serum glucose concentrations, total cholesterol and triglycerides, where the average value was significantly higher in inactive women compared to active ($P < .05$ ANOVA test). Physical activity and serum vitamin D levels showed a direct but not statistically significant relationship. The comparisons of the average values to age, anthropometric parameters, systolic and diastolic arterial pressures were similar in all 3 groups ($P > .05$).

The relationship between the nutritional status determined according to the BMI and the average value of the abdominal perimeter was directly proportional. The average values of the amount of energy expended through weekly physical activity in METs showed an inverse and statistically significant relationship ($P = .047$ ANOVA) with nutritional status. The age of the women was significantly related to the BMI, being greater and associated with obesity and overweight significantly in the younger women in the evaluated group. The mean values of biochemical glycemic and lipid profile variables showed no relation to nutritional status, but serum vitamin D levels were higher in eutrophic women in relation to overweight and obesity (Table 2).

Discussion

Physical activity has been recognized as the backbone to healthy living, contribute to the prevention of CVD, decrease the incidence of NCDs and is supporting people to enjoy a good quality of life. For postmenopausal women the physical activity is an essential way to limit the consequences of the menopause with positive impact on body function, psychological wellbeing and general health status. This study gives new information on physical activity profiles in postmenopausal women from the department of Atlántico-Colombia, showered that there is a large proportion of women (82.5%) with an inactive or insufficiently active lifestyle, these results are higher than those found in Brazil where 189 postmenopausal women were evaluated finding that only 4.2% were sedentary and 35.5% insufficiently active,[20] but similar to those found by Mattioli et al in 425 Italian women (age 48.9 years) where 47.3% were inactive and the 33.6% insufficiently active.[21] The IPAQ instrument utilized in this study, evaluates the frequency and duration of activities performed at work or at home over the course of a normal

Table 2

Comparison of nutritional status by anthropometry with the physical activity and biochemical variables in the analyzed population

Variables	Nutritional status according to BMI (kg/m^2)			P^*
	Normal IBM 23.6 ± 1.1 (n = 34)	Overweight 27.8 ± 1.4 (n = 75)	Obesity 34.8 ± 5.9 (n = 74)	
Age (yr)	67.7 ± 6.5^b	63.9 ± 5.6^a	62.9^a	.000
Ab. perimeter (cm)	97.3 ± 8.4^a	97.36 ± 7.5^a	106.3 ± 9.2^b	.000
Physical activity (METs)	681.2 ± 272.1^a	677.1 ± 156.4^{a,b}	524.4 ± 118.7^b	.047
SBP (mm Hg)	129.3 ± 15.7^a	123.1 ± 11.7^b	126.7 ± 10.4^{a,b}	.033
DBP (mm Hg)	79.6 ± 8.6^a	76.6 ± 7.2^b	79.0 ± 6.6^a	.046
Glycemic (mg/dL)	99.8 ± 37.6	93.6 ± 32.5	92.3 ± 32.6	.544
Total cholesterol (mg/dL)	188.6 ± 41.8	182.7 ± 49.1	182.5 ± 51.2	.811
Triglycerides	192.1 ± 65.2	186.4 ± 76.5	173.3 ± 67.2	.351
LDL (mg/dL)	97.4 ± 36.7	94.6 ± 40.9	95.8 ± 42.4	.944
HDL (mg/dL)	52.7 ± 12.1	50.8 ± 11.4	52.1 ± 11.4	.659
Vitamin D (ng/mL)	29.3 ± 9.6^a	24.3 ± 8.0^b	27.0 ± 9.5^{a,b}	.024

The data that do not share the same letters a, b or c are statistically different. $^*P$ value $<.05$ is considered significant (ANOVA test). Value correspond to mean ± standard deviation.
BMI = body mass index, DBP = diastolic blood pressure, HDL = high density lipoprotein, LDL = low density lipoprotein, METs = unit of measurement of the metabolic index (3.5 mL O_2/kg × min −0.0175 kcal), SBP = systolic blood pressure.

week, this standardized questionnaire, translated into different languages, permit comparisons between different studies and populations.[22]

Different studies relate physical activity in postmenopausal women with representative improvements in health status, mainly associated with reduction of BMI, increase in muscle mass and reduction of fatty tissue, prevention of osteoporosis and reduction of menopausal symptoms, among others.[20,23] However, the direct effect of the physical activity on CVR factors is poorly studied. Fan et al, in 2019, observed that decreased levels of physical activity and low musculoskeletal activation in postmenopausal women, increased the cardiovascular risk associated with the reduction of leptin and adiponectin plasma concentrations, increased insulin resistance and body weight gain by the extent of adipose tissue.[24] These findings are associated with those found in this study, where obese women spend less average energy on physical activity compared to women with normal BMI.

In Colombia, There are few studies about the physical activity in postmenopausal women and its relationship with CVR factors, between these, Suárez-Ortegón et al in 2014, evaluated the relationship of the levels of physical activity (IPAQ short version) and variables related to metabolic syndrome and cardiovascular risk in 89 women between 25 and 64 years age, they found a high prevalence of insufficient physical activity (74.2%) not associated with metabolic syndrome, and 1 Inverse correlation between physical activity of moderate-intensity and anthropometric markers related to cardiovascular risk as increase of body index and waist circumference.[25] As in this study, their findings show insufficient physical activity in women, even from an early age, and a relationship between BIM and physical inactivity.

The typical gynoid distribution of body fat of young women is change gradually for the android distribution type in postmenopausal women, characterized by the accumulation of abdominal fat, this phenomenon leads to inflammatory states and oxidative stress that promotes the development of CVD.[4] Although the composition and distribution of body fat was not examined in this study, the abdominal perimeter measurement was used as a factor associated with visceral fat increase, finding that the most women presented abdominal perimeters above the recommended; results similar were found by Zając-Gawlak et al in a sample of Polish postmenopausal women found abdominal perimeters higher than recommended, being especially high in women with diagnosed metabolic syndrome.[26]

In this study, the physically inactive condition of the postmenopausal women, were associated with more high serum levels of glycemic, total cholesterol and triglycerides. Similar results were described by Barua et al, in their study with 265 Indian postmenopausal women, they found hypercholesterolemia and hypertriglyceridemia in women with low level of physical activity.[27] Energy expenditure associated with physical activities for transport, leisure or household tasks directly influences the use of glucose as a primary energy source for moderate long-term activities.[28] Lwow et al studied in 343 postmenopausal Poland women the associations between physical activity and CVD risk factors, they found what low level of physical activity increase significantly the BMI, total body fat, total cholesterol, LDL cholesterol and insulin resistance (HOMA IR index).[29]

Active women showed higher values of serum vitamin D in relation to inactive women, but this was not statistically significant in this study. Increased sun exposure during the performance of the physical activity could be associated with increase in the skin synthesis of vitamin D, however, recent studies have shown that physical activity is associated with high serum levels of vitamin D, regardless of indoor or outdoor practice and due to factors unrelated to solar exposure that need to be studied.[30,31] Observational data support the link between vitamin D status and CVD, and vitamin D deficiency can be considered a cardiovascular risk marker. Postmenopausal women with vitamin D deficiency are especially susceptible to cardiovascular and metabolic complications.[32] Pinkas et al, in 2017 showed that women with greater deficiencies of vitamin D had higher BMI averages,[33] data that are consistent with those found in the present study, where obese and overweight women showed lower levels of vitamin D than women with BMI normal. Vitamin D sequestration in subcutaneous fat and making stores less available to become biologically activated and minor serum levels also are possible.[34]

The potential Scientific relevance of this study in the public health context of regional level, is to permit elucidate existing relationships between biological parameters that together can exponentially increase the risk of deaths from chronic diseases in women. The present study showed a high prevalence of physical inactivity in postmenopausal women from the Department of the Atlantic of Colombia, associate with alterations in nutritional status by anthropometry such as overweight, obesity and altered abdominal perimeter. Significant statistical differences in the comparison between groups according the level of physical activity were observed, showed higher levels of glycemic, cholesterol and triglycerides in physically inactive women. High prevalence of insufficiency or deficiency of serum vitamin D was found in the studied population, being this an additional factor in cardiovascular risk. Overall, the findings of this study suggest that postmenopausal women health status is closely related with cardiovascular risk and metabolic diseases.

The positive effects of exercise in postmenopausal women have previously been shown in different studies. Likewise, is necessary to generate new evidence to determine the impact of physical activity on cardiovascular health and establish the correct physical activity requirements for postmenopausal women that allow to obtain the maximum benefits in body composition, functional performance, prevention of chronic non-communicable diseases and cardiovascular health. The authors recommend the education and continue adoption of healthy lifestyles, including outdoor training with regular sun exposure as the most natural way to get enough vitamin D. Actions with the aim of decelerating the negative impact of physical and nutritional alterations of postmenopausal status on the cardiovascular and metabolic health of the woman.

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Conflicts of interest

The authors declare no conflicts of interest.

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