Influence of the Self-Reported Skin Color on the Prevalence of Metabolic Syndrome in an Urban Brazilian Population

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Abstract

Background: The metabolic syndrome (MS) has a high prevalence in different parts of the world, with variations between different ethnic groups.

Objective: This study aims at exploring the influence of the self-reported skin color on the prevalence of MS

Methods: Cross-sectional study, carried out in a population subgroup (n=1,439 adults) in Salvador, Brazil. The self-reported skin color (white, mulatto or black) was used as well as the MS criterion of ATP-III. The Chi-square test for tendency was used to analyze the prevalence gradient between the groups and logistic regression, for association analysis.

Results: The general prevalence of MS, adjusted for potentially confounder variables, did not differ among whites (23.3%), mulattos (23.3%) and blacks (23.4%). The analysis by sex showed, among men, a reduction in the MS prevalence of whites (26.2%, 95%CI: 20.7–31.7), in comparison to blacks (17.5%, 95%CI: 12.3–22.8) and an intermediate prevalence among mulattos, 21.9%, 95%CI: 18.6–25.1, p tend. = 0.002. Among the women, the tendency was the opposite, being higher among the blacks, 27.0%, 95%CI: 22.2–31.8, and lower among the whites, 20.5%, 95%CI: 15.6–25.4, p tend. = 0.02. The multivariate analysis of the association between skin color and MS (white = group of reference) showed that the black color of the skin was a protective factor among black men, with a prevalence ratio (PR) = 0.60 (0.36–0.97), whereas it tended to be a risk factor among black women, with a PR = 1.33 (0.94–1.78).

Conclusion: The prevalence of MA presented an inverse variation according to the color of skin between men and women. To be black was a protective factor among men and a risk factor among women. (Arq Bras Cardiol 2010; 94(1) : 33-39)

Key-words: Metabolic syndrome; prevalence; color; skin; population; Salvador (BA); Brazil.

Introduction

The Metabolic Syndrome (MS) is characterized by a set of abnormalities (arterial hypertension and alterations in the lipid and glycidic metabolism) often correlated with insulin resistance[1] and central obesity and is strongly associated with the development of atherosclerosis. Currently, MS has been identified as one of the most potent and investigated determinant factors of cardiovascular diseases and of type 2 diabetes mellitus (DM2)[2-8].

The MS has high prevalence; however, the analyses of its associations with several variables have shown aspects that need to be clarified. Among these are the associations with distinct ethnic/racial groups and the identification of the sex variable as a modifier of the effect of this association[9-14]. In the United States, Ford et al[10], in 2001, verified that the MS prevalence among African descendants, when compared to Whites, was higher among women (25.7% *vs*. 22.8%) and lower among men (16.4% *vs*. 24.8%)[10]. It has also been observed that the prevalence of risk factors that characterize the MS substantially differ among distinct ethnic groups, with a different behavior between genders[9,10,15]. Considering, on the one hand, that the current different prevention strategies allow the early identification of populations and individuals, as well as intervention on those exposed to higher cardiovascular risk, and on the other hand, that the city of Salvador is the capital city with the highest degree of miscegenation of African descendants in the country, the aim of this study was to analyze the influence of the self-reported color of the skin on the prevalence of MS in men and women, in an attempt to find possible explanations for eventual differences between the analyzed groups.

Methods

This is a cross-sectional study, using the sample from the Cardiovascular Disease and Diabetes Mellitus Monitoring Project (MONIT)[16], carried out in the capital city of Salvador, state of Bahia, northeastern Brazil. In brief, for the MONIT, the sample size was initially estimated at 1,800 adults, aged ≥ 20 years, based on a prevalence of

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arterial hypertension of 25%, 95% confidence level and design error of 2%.

As the project included several other objectives, the "n" was increased to approximately 2,500 people, estimating 1.7 eligible individuals per household. A 20% loss was predicted due to several reasons. The sampling was carried out at three stages: 1) the census sectors of 8 of the 10 hydrographic basins of the city, with similar sociodemographic characteristics, were grouped in 108 "Research Areas" and the latter were classified by socioeconomic level (SEL): high, mixed or low. The areas contained 16,592 households, with around 83,000 inhabitants aged ≥ 20 years. Proportionally to the number of sectors in each SEL, 37 were probabilistically drawn by lot; per systematic sample (interval = 10), 1,540 households were drawn by lot, with a loss of 18.3% and favorable response to participation of 1,258 families from 63 census sectors; 3) at the third stage, the participants were chosen by drawing lots, with a maximum of two participants per household, one of each sex, excluding pregnant women[16].

The project was submitted to and approved by the Medical Ethics Committee of the Regional Council of Medicine of the State of Bahia and all participants signed the Free and Informed Consent Form.

The global sample included 2,404 individuals, who answered questions about risk factors for cardiovascular disease (CVRF) and DM, had six blood pressure (BP) measurements and two measurements of the waist circumference (WC) at home. A total of 1,546 participants came in for blood collections as well as weight and height measurements (64.3% of the sample) and a final sample of 1,437 individuals were analyzed in this study (92.9% of those that completed the protocol).

The skin color was self-defined by the studied individuals as one of the following categories: white, mulatto and black, according to the definitions used in the demographic censuses of the Brazilian Institute of Geography and Statistics (IBGE)[17]. The use of the self-reported skin color sought to understand, particularly, aspects of the ethnic-social field and, implicitly, the cultural aspects of the studied population and thus considered in this study. The question of the skin color for the self-classification as white, mulatto or black, predicted to be closed, was not accepted by around 20% of the population, who self-classified using 18 other connotations of skin color/ethnicity. Some examples are fair, light-skinned, brunet, dark-skinned, negro, "cabo-verde", *sarara* (light-haired mulatto), light brunet, medium mulatto and dark mulatto, dark, colored, brown, etc.

These data were reclassified in the three predicted categories. The terms "fair", "light-skinned" and "light brunet" were considered equivalent to White (in Salvador, state of Bahia, people with white/fair skin and no facial characteristics that are typical of African-descendants receive this denomination), whereas the terms "black", "dark", "colored" and "negro" were classified as Black. The others were classified as Mulattos.

The socioeconomic level (SEL) was defined according to the criterion used in Brazil by IBGE[18], resulting from the sum of pre-established scores for availability and quantity of specified real estate and assets, availability of house employees and level of schooling of the head of the family. The original classification of the A to E strata was grouped in this study as A+B (high SEL), C (medium SLE) and D+E (low SEL).

The level of schooling was categorized in three strata: a) high (Complete High School, Complete or Incomplete College or University); b) medium (Complete Elementary School or Incomplete High School); c) low (illiterate or incomplete Elementary School).

Individuals that performed a mild physical activity (walking, swimming, cycling or dancing for ≥ 4 hours a week), moderate physical activity (running, gymnastics or soccer playing for ≥ 3 hours a week) or intense physical activities (training for competition) were considered as practicing physical activity in leisure time.

The following procedures were performed:

a) BP was measured in two blocks of three measurements (10-minute interval between the blocks); the mean of the five last measurements was obtained.

b) The waist circumference (WC) was measured as a whole unit in centimeters (cm) at the level of the natural waist (the narrowest part between the thorax and hips), with the individual breathing softly, in the standing position, feet placed side-by-side, with body weight distributed uniformly;

c) Height and weight were measured for the body mass index (BMI) calculation, using standardized equipment, sporadically verified by INMETRO (The National Institute of Metrology, Standardization and Industrial Quality);

d) After a 12-hour fast, biochemical analyses of glycemia (Labtest in fluorinated plasma), cholesterol (Tender enzymatic method), triglycerides (modified Soloni technique) and HDL cholesterol (Labtest) were performed.

The metabolic syndrome was defined according to the revised criteria of ATP III[19], adjusting CC values for our population[20], characterizing the diagnosis of MS by the presence, in the same individual, of three or more of the following abnormalities: a) abdominal obesity determined by the WC (> 84 cm for women and > 88 for men); b) hypertriglyceridemia (≥ 150 mg/dl); low HDL-c (< 40 in men and < 50 in women); c) arterial hypertension (≥130/85 mmHg) or current drug treatment for arterial hypertension; d) hyperglycemia (fasting glycemia ≥ 100 mg/dl) or current drug treatment for diabetes mellitus (DM).

The MS was the dependent variable; the skin color, however, was the main independent variable. Age, level of schooling, SEL, smoking status, alcohol consumption and exercise practice were co-variables of interest. In all analyses, the gender variable was treated as a modifier of effect.

Statistical Analysis

Considering gender a modifier of effect in the association between MS and ethnicity[9-12], the association between MS and the self-reported skin color in men and women was analyzed separately. The prevalence and 95% confidence intervals (95%CI) of the co-variables of interest were measured in men and women, at the different strata of the skin color variable, to identify potential confounders of the main association.

The gross and adjusted prevalence and 95%CI of the MS and its components were measured separately, at the skin color variable strata between men and women.

The logistic regression model was used to analyze the association between MS and skin color in both sexes and the influence of the variables with a potential for confounding and interaction. The prevalence ratio (PR) with its 95%CI was the measurement of the used association, estimated based on the Odds Ratio (OR), relrisk procedure (STATA package). The confounding was defined as a difference ≥ 10% between the gross and adjusted PR. For the selection of the confounding variables, we also considered the current scientific knowledge in the literature. The interaction was evaluated through the maximum likelihood ratio test, considering a $p < 0.05$ as the level of statistical significance. The "White" color of skin was considered as the reference in the comparisons of MS prevalence among the skin color groups. The statistical package STATA[tm], version 7.0, was used for the statistical analysis.

Results

The studied subgroup was similar to the original sample, except for the higher frequency of individuals with low SEL (55.2% *vs*. 59.9%) and low level of schooling (43.2 *vs*. 47.5%), among women[20]. There was a loss of information on the skin color in 13 questionnaires. Of the 1,424 participants, 603 (42.3%) were males and 821 (57.7%) were females. The distribution of whites, mulattos and blacks in the male sex was 24,.9%, 46.8% and 28.3%, respectively and 26.6%, 45.3 and 28.1% in the female sex, respectively. The characteristics of the population at the different strata of skin color in the male sex had the following results: Whites tended to have the highest SEL; the physical activity in leisure time and higher alcohol consumption, however, were more frequent among the Blacks, who also tended to be younger; a lower SEL and the habit of smoking predominated among the mulattos (Table 1). In the female sex, a higher SEL and physical activity in leisure time were more frequent among the Whites, with a decreasing gradient towards the Blacks. Age, alcohol consumption and the habit of smoking showed an increasing gradient from the Whites to the Blacks; the level of schooling was similar among the three groups of women (Table 1).

Table 1 also shows more significant differences of white males in relation to women regarding physical activity, with a two-fold difference; 2.2-fold difference for alcohol consumption; and a 1.7-fold difference for smoking. Among the mulattos, it was observed that the differences were similar and among Blacks, it was verified that men presented a 1.2-fold higher SEL, developed physical activity in leisure time 3-fold more often and consumed 2.2-fold more alcohol, whereas the women predominated in the age range ≥ 40 years.

The prevalence of MS increases with age, doubling for each decade between 20 and 49 years (6.9% from 20 to 29 years; 14.3% from 30 to 39 years; 32.4 % from 40 to 49 years) and reaching 40.9% from the age of 50 years onward (similarly among whites, mulattos and blacks) (Figure 1).

The prevalence of MS, with and without adjustment (by age, physical activity at leisure time, smoking status, SEL and level of schooling) was similar among whites (23.3%); mulattos

Table 1 - **Distribution of the metabolic syndrome covariables by skin color and sex.**

Covariables	Whites % (IC 95%)	Mulattos % (IC 95%)	Blacks % (IC 95%)
Males			
	(n= 150; 24.9%)	(n= 282; 46.8%)	(n= 171; 28.4%)
SEL*			
High/Medium	49.0 (40.8 - 57.2)	35.1 (29.5 - 40.8)	41.4 (33.9 - 48.9)
Low	51.0 (42.8 - 59.2)	64.9 (59. 2 - 70.5)	58.6 (51.1 - 66.1)
Level of Schooling			
High/Medium	53.3 (45.3 -61.4)	54.6 (48.8 - 60.5)	56.7 (49.2 - 64.2)
Low	46.7 (38.6 - 54.7)	45.4 (39.5 - 51.2)	43.3 (35.8 - 50.8)
Physical activity	37.8 (29.9 - 45.7)	36.5 (30.9 - 42.2)	40.3 (32.9 - 47.8)
Age ≥ 40 years	46.7 (38.6 - 54.7)	46.8 (40.9 - 52.7)	44.4 (36.9 - 52.0)
Frequent alcohol consumption	50.7 (42.6 - 58.8)	50.7 (44.8 - 56.6)	59.6 (52.2 - 67.1)
Smoker			
No	52.0 (43.9 - 60.1)	50.0 (44.1 - 55.9)	53.8 (46.2 - 61.3)
Yes	25.3 (18.3 - 32.4)	29.4 (24.1 - 34.8)	24.0 (17.5 - 30.4)
Ex-smoker	22.7 (15.9 - 29.4)	20.6 (15.8 - 25.3)	22.2 (15.9 -28.5)
Females			
	(n=218; 26.7%)	(n= 372; 45.3%)	(n= 231; 28.1%)
SEL*			
High/Medium	47.0 (40.2 - 53.7)	39.2 (34.2 - 44.3)	34.9 (28.7 - 41.2)
Low	53.0 (46.3 - 59.7)	60.8 (55.7 -65.8)	65.1 (58.8 - 71.3)
Level of Schooling			
High/Medium	50.0 (43.3 - 56.7)	52.4 (47.3 - 57.5)	49.8 (43.3 - 56.3)
Low	50.0 (43.3 - 56.7)	47.6 (42.5 – 52.7)	50.2 (43.7 - 56.7)
Physical activity	19.3 (14.0 - 24.5)	16.7 (12.9 - 20.5)	13.5 (9.0 - 17.9)
Age ≥ 40 years	43.6 (36.9 - 50.2)	47.6 (42.5 - 52.7)	52.8 (46.3 - 59.3)
Frequent alcohol consumption	23.0 (17.4 - 28.7)	25.0 (20.6 - 29.4)	27.7 (21.9 - 33.5)
Smoker			
No	65.1 (58.8 - 71.5)	63.4 (58.5 - 68.4)	62.3(56.0 - 68.6)
Yes	15.1 (10.3 - 19.9)	18.3 (14.3 - 22.2)	19.5 (14.3 - 24.6)
Ex-smoker	19.7 (14.4 - 25.0)	18.3 (14.3 - 22.2)	18.2 (13.2 - 23.2)

** SEL- Socioeconomic level*

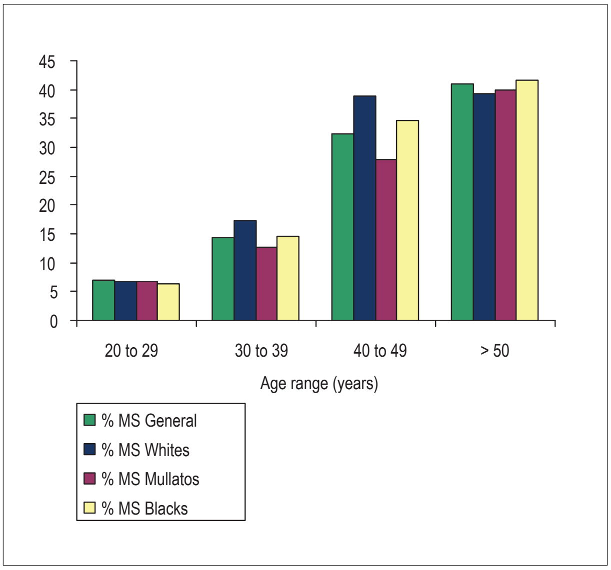

Figure 1 - Prevalence of metabolic syndrome (MS) related to age and skin color.

(23.3%) and blacks (23.4%); p = ns (Table 2). However, when analyzed by sex, there was a decrease of 37% in the gross prevalence of MS in white males toward the blacks (p tend. = 0.02). At the adjusted analysis, the prevalence gradient was maintained: 26.2, 95%CI (20,7–31,7) among the whites; 21.9%, 95%CI (18.60–25.1) among the mulattos and 17.5%, 95%CI (12.3–22.8) among the blacks. The trend is inverted among women, for both the gross and adjusted rates (Table 2). The prevalence of MS (adjusted by age, physical activity at leisure time, smoking status, SEL and level of schooling) was higher among black women, 27.0%, 95%CI (22.2–31.8), when compared to white women, 20.5%, 95%CI (15.6–25.4), with an intermediate prevalence among the women that self-reported being mulatto, 23.8%, 95%CI (20.8-26.8). When the data are plotted in a chart, the behavior of the MS prevalence in the skin color strata in the general population, between men and women, clearly identifies the modification of the sex variable effect on this association (Figure 2).

Table 3 shows the prevalence of factors that constitute the MS. There was a higher prevalence of abdominal obesity, DMms and SAHms among the black women, whereas the white women presented a higher prevalence of low HDL-c. Among men, central obesity (CO), HDL-c < 40mg/dl and hypertriglyceridemia were more prevalent among the Whites, whereas arterial hypertension predominated among Blacks.

Taking the white skin color as reference, the PR of the metabolic syndrome was calculated by skin color (Table 4). Among the men, after adjusted by age, physical activity at leisure time, smoking status, SEL and level of schooling, the black skin color behaved as a protective factor, in a statistically significant fashion, 0.60, 95%CI (0.36-0.97). Among the women, the black skin color behaved as a risk factor, reaching an almost statistical significance level, 1.33, 95%CI (0.94-1.78).

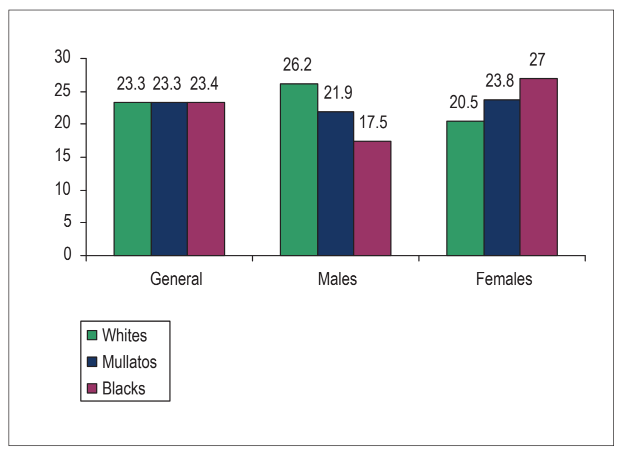

Figure 2 – Prevalence of metabolic syndrome adjusted for Age, physical activity in leisure time, smoking status, socioeconomic level and level of schooling.

Table 2 – **Prevalence of metabolic syndrome by skin color and sex.**

	General % (95%CI)		Males % (95%CI)		Females % (95%CI)	
	Gross	Adjust.*	Gross	Adjust.*	Gross	Adjust.*
Caucasians	25.0 (20.5 – 29.4)	23.3 (19.6 – 26.9)	28.7 (21.3 – 36.0)	26.2 (20.7 – 31.7)	22.5 (16.9 – 28.1)	20.5 (15.6 - 25.4)
Mulattos	21.9 (18.7 – 25.0)	23.3 (21.2 – 25.4)	19.9 (15.2 – 24.5)	21.9 (18.6 – 25.1)	23.4 (19.1 – 27.7)	23.8 (20.8 – 26.8)
Blacks	25.1 (20.9 – 29.4)	23.4 (19.9 – 26.9)	18.1 (12.3 – 24.0)	17.5 (12.3 – 22.8)	30.3 (24.3 – 36.2)	27.0 (22.2 – 31.8)
p Tend.†	0.93		0.02		0.05	

**Adjusted for age, physical activity in leisure time, smoking status, socioeconomic level and level of schooling. † = Chi-square p value for tendency*

Table 3 – **Distribution of factors that constitute the metabolic syndrome by skin color and sex.**

	Males			Females		
	Whites n=150	Mulattos n=282	Blacks n=171	Whites n=218	Mulattos n=372	Blacks n=231
WC	40.0 (32.1 - 47.9)	31.9 (26.4 - 37.4)	30.4 (23.4 - 37.4)	32.1 (25.9 - 38.4)	36.0 (31.1 - 40.9)	39.4 (33.0 - 45.7)
FG	12.0 (6.7 – 17.3)	14.2 (10.1 – 18.3)	12.3 (7.3 - 17.2)	12.4 (8.0 – 16.8)	16.1 (12.4 – 19.9)	19.5 (14.3 – 24.6)
SAH	40.0 (32.1 - 47.9)	40.4 (34.7 - 46.2)	45.6 (38.1 - 53.1)	32.1 (25.9 - 38.4)	37.1 (32.2 - 42.0)	46.3 (39.8 - 52.8)
HDL-c ↓	40.0 (32.1 - 47.9)	30.8 (25.4 - 36.3)	15.2 (9.8 - 20.6)	58.7 (52.1 - 65.3)	48.7 (43.5 - 53.7)	46.7 (40.3 - 53.2)
TG ↑	37.3 (29.5 - 45.2)	32.6 (27.1 - 38.1)	33.9 (26.7 - 41.1)	26.6 (20.7 - 32.5)	25.3 (20.8 - 29.7)	26.8 (21.1 - 32.6)

WC =waist circumference ≥ 84 cm for females and ≥ 88 cm for males; FG= Fasting glycemia ≥ 100 mg/dl and/or hypoglycemiant drug use for DM; SAH= BP ≥ 130/85mmHg and/or anti-hypertensive drug use; *HDL ↓=HDL-c < 40 mg/dl in males and < 50 mg/dl in females; TG ↑= triglycerides ≥ 150 mg/dl.*

Discussion

In the present study, the sex variable confirmed its status as a modifier of the association effect between skin color and MS. When the prevalence of MS is analyzed at the different strata of skin color, there was no statistically significant difference. However, when the association was analyzed separately by sex, it was observed that whereas among men, the highest prevalence was observed in whites and the lowest in blacks, the gradient was inverted among women, with a higher prevalence of MS among blacks (Figure 2).

Ford et al[10], in 2001, found a MS prevalence of 21.8% of the adult population of the USA, with no significant difference between the sexes[10]. However, when the authors analyzed the prevalence of MS by gender and ethnic group, they found a higher prevalence among the African-descendants (25.7%) when compared to white women (22.8%), and a lower prevalence among African-American men (16.4%) when compared to white men (24.8%).

The Salvador data are similar to those of the aforementioned authors. Considering Ford's results and also our results, a lower prevalence of MS occurred among black men (or African descendants) occurred because, in spite of presenting a higher prevalence of SAHms, this ethnic group presented a lower prevalence of abdominal obesity, low HDL-c and hypertriglyceridemia (Table IV). The authors did not describe characteristics such as level of schooling, SEL, dietary habits and physical activity practice in the studied population. Such fact limits the interpretation of the differences in prevalence observed among the ethnic-racial groups studied.

In Brazil, although there was no statistically significant difference between the SM prevalence among "distinct" racial groups, Salaroli and cols., in a population-based study in the city of Vitoria, state of Espirito Santo, southeastern Brazil, found, similar to our study, a higher prevalence of MS among black women, as well as a lower prevalence among black men[21].

It has been demonstrated that black men present lower triglyceride and higher HDL-c levels than white men[9,22-26], whereas, among adult women, these differences are lower or nonexistent[22,26]. The finding of higher levels of HDL_2-cholesterol subfraction (the more protective fraction of HDL-c) among black children constitutes evidence that can suggest some influence of genetic factors. However, it is mainly considered that the factors related to lifestyle can explain the differences in lipid profiles between blacks and whites at the adult age. Hence, black women, similarly to black men, in childhood and adolescence, present lower triglyceride and higher HDL-c levels than white women[27-30], but these disappear throughout time.

Some authors have demonstrated that central obesity is associated with the onset of alterations in the glycidic metabolism, increase in triglyceride and decrease in HDL-c levels, regardless of ethnicity[9,23,24,31]. Based on this evidence and on our results, we believe that the lower prevalence of central obesity among black men has a central role to explain the findings of lower triglycerides and higher HDL-c levels found in this subgroup, as well as the higher prevalence of central obesity among white men helps to broaden the differences in lipid profiles between blacks and whites. Therefore, the higher proportion of black women with CO helps to explain why they present similar triglyceride and a lower difference in HDL-c

Table 4 – **Association between skin color and metabolic syndrome at the multivariate analysis***

	Whites	Mulattos	Blacks
Males	1(reference)	0.76 (0.50 – 1.12)	0.60 (0.36 – 0.97)
Females	1(reference)	1.00 (0.71 – 1.36)	1.33 (0.94 – 1.78)

**Adjusted for age, physical activity in leisure time, smoking status, socioeconomic level and level of schooling.*

levels, when compared to white women, than that observed in the male sex[31].

Regarding the population of this study, we observed a higher proportion of black women with a low level of schooling that did not practice physical activity in leisure time (Table I). Supposedly, this would explain, in part, the higher prevalence CO and MS in this subgroup. Moreover, a higher proportion of individuals that practice physical activity in leisure time among the black men would help explain the lower prevalence of these conditions among them (Table I). However, the distribution of thee variables does not seem to be enough to explain the higher prevalence of CO and MS among white men.

The low birth weight would be another factor that could help to explain the association between skin color and MS[32-34]. Thus, malnutrition during intrauterine life seems to cause metabolic alterations that have as priority the supply of nutrients to the brain to the detriment of the striated musculature and pancreas, resulting in insulin resistance[35]. In the present study, we do not have data on birth weight of the analyzed individuals.

The non-inclusion in the present study of the analysis of dietary habits and psychosocial factors of individuals might have resulted in limitations for a better understanding of the association between skin color and MS. Moreover, considering that the prevalence of MS increases with age and this is a cross-sectional study, the survival bias can influence the finding of differences in the prevalence of MS among whites, mulattos and blacks. Among the men, the proportion of individuals aged ≥ 40 years was very similar in the three groups, and among the women, this proportion tended to be higher among blacks.

Thus, we do not believe that this type of bias can fully explain the different prevalence rates found, but it might have contributed, together with dietary habits and psychosocial factors, to explain the different MS rates among whites, mulattos and blacks, in men and women.

Potential Conflict of Interest

No potential conflict of interest relevant to this article was reported.

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Study Association

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