Waist Circumference and Waist-to-Hip Ratio as Indicators of Fat Location in Black, White, and Mulatto Brazilian Men

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Objective: To assess whether skin color classification as White, Mulatto, and Black is associated with abdominal fat location among healthy Brazilian men.

Design: Cross sectional study of men aged 20–59 years attending the Cuiabá Blood Center during August 1999 to January 2000. Skin color was defined by interviewer judgment. Body fat was estimated through electrical bioimpedance, and anthropometric measures were obtained by trained antropometrists.

Setting: Cuiabá, Brazil

Participants: Data refer to 1235 healthy men. Only 29 men refused to participate.

Main Outcome Measures: Waist circumference and waist-to-hip ratio (WHR).

Results: No differences were seen in body mass index according to race, but fat location was statistically smaller among Blacks and Mulattos compared to Whites, mainly among the middle aged. After adjustment for age, percent body fat, smoking, alcohol intake, physical activity, income, and schooling, Blacks compared to Whites had smaller waist (≈2 cm) and smaller WHR ($P<.01$ for waist for both age groups and $P=.05$ for WHR). Mulattos were in an intermediate position, but the association was statistically significant only among middle-aged men.

Conclusions: In this healthy population with high admixture of Blacks and Whites, abdominal adiposity was highly associated with race, and Whites had a greater risk of abdominal fat location. (*Ethn Dis*. 2007;17:256–261)

Key Words: Brazilian Men, Race, Waist Circumference, Waist-to-Hip Ratio

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Introduction

Visceral adipose tissue is the body fat depot most strongly related to the metabolic abnormalities of obesity.[1,2] Although waist circumference is commonly used as surrogate marker for intraabdominal fat, waist circumference was not a more suitable predictor of lipid profile in Brazilian men.[3] These inconsistent results may be partially explained by the race admixture that characterizes the Brazilian population.

Brazil has the largest population of African ancestry in all of South and North America.[4] Race in the Brazilian census refers to skin color. The 2004 census showed that, with a total population of 182 million, 51.4% Brazilians self-assessed themselves as "White," 42.1% as "Mulatto," 5,9% as "Black," and .6% as "Yellow" or "Indigenous" (http://www.ibge.com.br, last accessed on July 2006).

Much of the information regarding obesity has been derived from investigations of populations that are mainly of European descent. In recent years, many studies have shown that the World Health Organization cutoff values for the various indices of obesity and fat distribution vary according to race. As an example, a number of studies have reported that Asian descendants have a higher percentage of body fat at a similar or lower body mass index (BMI) than do Caucasians.[5–8]

In Brazil, despite the high admixture of the population, race has been related to health outcomes in many studies.[9–11] Studies conducted in other countries have also shown racial differences in the frequency of obesity-related health problems.[12–15] Among Blacks living in the United States a reduction in the abdominal fat location has been observed,[16–18] but we are not aware of such studies in Brazil. The aim of this study was to investigate the effect of race on fat distribution in Brazilian men, using skin color as a marker to race, after adjustment for relevant confounders.

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Methods

Study Population

All blood donors of the Blood Center Navantino Borba, in Cuiabá City, Brazil, from August 1999 to January 2000, were invited to participate ($n=2316$). Women were excluded ($n=249$) because most blood donors were men. Of the study population aged 20–59 years ($n=1485$), 250 men were excluded—12 were on medication, 15 were being treated for dyslipidemia, 15 reported weight loss in the last two months, 15 had BMI <18.5, 164 had BMI >30 kg/m^2, and 29 refused to participate—leaving 1235 men for study. The study was approved by the ethical committee of the Júlio Müller University Hospital, and informed consent was obtained from all participants.

Measurements

Waist and hip circumferences were measured in duplicate to the nearest .5 cm, with a flexible but inelastic measuring tape, while the subject was standing relaxed. A third measurement was taken if the first two measures differed by >1 cm. The mean of the two closest measurements was used for analysis. Circumferences were taken with the tape held snugly around the body part, but not tight enough to compress the subcutaneous adipose tissue.

Waist was taken at the level of the natural waist (the narrowest part of the torso). When it was difficult to identify a waist narrowing, the smallest horizontal circumference was taken in the area between the last rib and iliac crest. The hip circumference was taken at the maximum circumference of the buttocks posteriorly and the symphysis pubis anteriorly, on a horizontal plane.[19]

Body mass was evaluated with an electronic scale, which is a part of the body composition analyzer, model Tanita TBF-305, with a variation of 200 g. Stature was measured to the nearest centimeter by using a stadiometer with a variation of .1 cm. Body mass index (BMI) was calculated as weight (kg) divided by squared height (m^2). Electrical bioimpedance was used to estimate percentage of body fat that was analyzed as a continuous variable.

Smoking habits, alcohol intake, leisure physical activity, income, and schooling were obtained through interview. A detailed description of the survey methods and procedures has been given in a previous publication.[3] In short, schooling was measured as years of study. Income was analyzed as minimum wage. Smoking was measured as number of cigarettes per day, and individuals were classified as: 1) never smokers (those who were not current smokers and had never smoked cigarettes daily); 2) ex-smokers (those who reported having smoked cigarettes daily in the past but not currently); 3) smokers who smoked one to nine cigarettes per day; 4) smokers who smoked >10 cigarettes per day. Alcohol consumption was measured from subjects' reports of wine, beer, and spirits per week, expressed as grams of ethanol per day in the previous two weeks. Physical activity was measured by questionnaire, which included the main leisure activities for the previous month.

Racial classification was based on skin color, defined by the judgment of the trained interviewer as Black, White, or Mulatto. Mulatto is the term used to designate the mix of Black-White ancestry.

Statistical Analysis

Analyses were conducted with SPSS version 9.0 software and were stratified by two age groups because associations between race and fat location were strongly modified by age. Age 30 was chosen as cutoff since this is the mean age in the three racial groups. Differences among races were tested by using analysis of variance (ANOVA) and Spearman correlation coefficient.

Associations of race with fat location were analyzed through multiple linear regression. Dummy variables were used for racial classification (White as the reference category). Anthropometric variables were log-transformed to normalize distribution. Multivariate adjustment took into account potentially confounding factors: age, percentage of body fat, smoking habits, alcohol intake, physical activity, income, and schooling.

RESULTS

As expected for the Brazilian population, the study sample had a high percentage of Mulattos (55.2%). No significant differences were seen in anthropometric measures according to race in the young group, but for middle-aged men, measures were higher among Whites, and Mulattos were in an intermediate position. Whites had the highest values except for waist-to-hip ratio (WHR), which showed almost similar values for Whites and Mulattos (Table 1).

Correlation coefficients between percentage of body fat and BMI with measures of fat location were analyzed. Measures of fatness (BMI and percentage of body fat) had similar correlation among the youngest ethnic groups, but Blacks had a much higher correlation of BMI with percentage of body fat in the middle-aged group (Table 2). In the youngest group, the correlation between measures of fatness with waist circumference was similar, but for WHR the correlation was higher for Whites, and Blacks had correlation coefficients of .40 against .48 among Whites. For the older group (31–59 years), all correlations were reduced when compared to the youngest group. Correlation between measures of fatness and fat location between Mulattos and Blacks was similar, but BMI did not correlate with WHR for Blacks (Table 2).

Correlation coefficient between age and BMI according to race was higher for Whites (r=.39; P value<.001) and intermediate for Mulattos (r=.29; P value<.01). For Blacks, correlation was not statistically significant (r=.18). Correlations for percentage of body fat showed similar trends and almost the same values observed for BMI. Correlation coefficients between age and measures of fat location (waist and WHR) according to race were higher than correlations with fatness, and they were statistically significant for all racial groups. These values for waist circumference were .52, .41, and .38 for Whites, Mulattos, and Blacks, respectively.

Possible confounders of the association between race and fat location are shown in Table 3. Blacks had a lower socioeconomic level, a higher prevalence of heavy smoking, and more alcohol intake. Whites were more sedentary.

Table 1. Mean and standard error (SE) of age and anthropometric indices and percentage body fat by race and age among Brazilian blood donors

	20–30 Years							31–59 Years						
	White (*n*=258)		Mulatto (*n*=419)		Black (*n*=67)			White (*n*=183)		Mulatto (*n*=263)		Black (*n*=45)		
	Mean	SE	Mean	SE	Mean	SE	*P**	Mean	SE	Mean	SE	Mean	SE	*P**
Age	24.2	.14	24.7	.15	24.6	.35	.22	38.2	.46	38.6	.41	38.5	1.01	.83
BMI (kg/m^2)	23.5	.17	23.7	.14	23.8	.32	.67	25.5	.19	25.1	.17	24.7	.51	.12
Percentage (%) body fat	17.0	.34	17.6	.28	17.8	.65	.34	21.2	.40	20.3	.35	19.5	1.03	.10
Waist circumference (cm)	78.4	.43	78.4	.35	77.6	.85	.66	85.8	.53	83.9	.46	82.4	1.22	.005
Hip circumference (cm)	90.8	.38	91.3	.31	90.1	.72	.27	94.9	.40	92.9	.39	92.8	1.01	.002
Waist-to-hip ratio	.863	.003	.859	.002	.861	.005	.51	.903	.004	.902	.003	.888	.009	.17

* *P* value of ANOVA.
BMI=body mass index.

Multiple linear regression analyses were performed to determine whether race was an independent predictor of fat location when all possible confounders (age, percentage body fat, smoking habits, alcohol intake, physical activity, income, and schooling) were controlled for. Percentage of body fat was chosen instead of BMI because percentage of body fat was a better marker for fatness.[3] Compared to Whites, Blacks had a significantly negative association with fat location in all age groups, even after adjustment for confounding variables. Mulattos had an intermediate position, but significant association independent of fatness and other confounders only remained with waist circumference in the older group (Table 4).

DISCUSSION

This study showed an association between race and fat location mainly for Blacks. After adjusting for potential confounders, including socioeconomic status (SES), race itself was a significant predictor of waist circumference and WHR. Also, blood donors are healthier than the overall population, which reduces race disparities due to previous diseases.

Ethnicity incorporates a concept that is not easy to measure with accuracy or validity.[20,21] In this study, race/ethnicity was described based on the

After adjusting for potential confounders, including socioeconomic status (SES), race itself was a significant predictor of waist circumference and WHR.

Table 2. Spearman correlation coefficients between measures of fatness and fat location by race and age among Brazilian blood donors

	20–30 Years			31–59 Years		
	% Body Fat	Waist Circumference	Waist-to-Hip Ratio	% Body Fat	Waist Circumference	Waist-to-Hip Ratio
			White			
		(*n*=258)			(*n*=183)	
BMI	.94*	.85*	.47*	.89*	.77*	.45*
% body fat	-	.85*	.48*	-	.73*	.41*
			Mulatto			
		(*n*=419)			(*n*=263)	
BMI	.95*	.85*	.45*	.91*	.83*	.36*
% body fat	-	.84*	.46*	-	.82*	.39*
			Black			
		(*n*=67)			(*n*=45)	
BMI	.95*	.86*	.42*	.94*	.82*	.29
% body fat	-	.84*	.40*	-	.83*	.39*

BMI=body mass index.
* *P* value<.01.

Table 3. Prevalence of socioeconomic factors and lifestyle risk factors associated to fat location by race among Brazilian blood donors

	White (n=441)		Mulatto (n=682)		Black (n=112)	
	%	CI 95%	%	CI 95%	%	CI 95%
Income below median (1.3=minimum wage)	42.6	38.0–47.4	54.5	50.7–58.3	56.3	46.6–65.6
Schooling (≤8 years)	44.2	39.5–49.0	55.4	51.6–59.2	56.3	46.6–65.6
Smoking habits (cigarettes/day)						
None	62.4	57.6–66.9	61.9	58.1–65.5	57.1	47.4–66.5
Ex-smokers	16.1	12.9–19.9	16.6	13.9–19.6	15.2	9.1–23.2
1–9	4.8	3.0–7.3	6.9	5.2–9.1	6.3	2.5–12.5
≥10	16.8	13.5–20.7	14.7	12.1–17.6	21.4	14.2–30.2
Alcohol intake (g/day)						
None	48.3	43.6–53.1	47.9	44.1–51.8	48.2	38.7–57.9
≤20	39.5	34.9–44.2	38.3	34.6–42.0	34.8	26.1–44.4
>20	12.2	9.4–15.8	13.8	11.3–16.7	17.0	10.5–25.2
Leisure physical activity						
Never	46.5	41.8–51.3	43.8	40.1–47.7	39.3	30.2–49.0

phenotypic characteristic "skin color." Reliability of this measure in the Brazilian population was studied by Sichieri et al[10] and Fuchs et al.[22] Both studies showed strong agreement on the skin color classification according to the interviewer's observation[10,22] and on self-assessment,[22] Mulattos expressed moderate agreement.

There is a vast amount of literature that relates race to disparities in health outcomes, showing Blacks at a disadvantage compared to Whites. Biological differences have also been reported by ethnic groups.[23] Brazil is a country with a large racial admixture and social disparities, but race and SES are not equivalent.[21] Therefore, an independent role of race in health outcomes after adjustment for SES has been shown.[10,11,24]

In accordance to our findings, Blacks have lower visceral fat compared to Whites when assessed by accurate methods.[17,18,25] We measured only waist circumference and WHR, but these indirect and less accurate methods indicated that Black people had waist circumferences nearly 2 cm less than those of Whites of similar fatness. We also showed that WHR was more independent of overall fatness in Blacks than in Whites, with correlation coefficients of .40 vs. .48 in the younger group and no correlation of BMI with WHR in the older group of Blacks. Any misclassification associated with our measurements would probably be nondifferential with a tendency toward reduction of the magnitude of associations mainly among the Mulatto classification. As a consequence, for both measures of fat location, major differences were observed between Whites and Blacks, and Mulattos had less consistent associations.

Mulattos make up most of the Brazilian population in most states. Reliability studies in Brazil have shown that Mulattos are most difficult to characterize in terms of skin color.[10] Therefore, for Mulattos, an attenuation of the association was expected.

Abdominal fat location has been associated with the worst lipid profile,[26–28] and we tested if race in this sample would be related to triglyceride and cholesterol levels. Lipid profile was available only in a subsample of 416 subjects, and our analysis showed that Blacks and Mulattos had lower triglyceride levels (P=.02), but our results did not show significant differences for

Table 4. Regression coefficients,* associated P value, and R^2 between waist circumference, waist-to-hip ratio, and race among 1235 Brazilian blood donors

	Waist Circumference			Waist-to-Hip Ratio		
	β	P	R^2	β	P	R^2
			20–30 years			
Mulatto/White	−.35	.23	.75	−.006	.06	.40
Black/White	−1.77	<.001	.75	−.010	.05	.40
			31–59 years			
Mulatto/White	−1.27	.02	.70	−.003	.46	.47
Black/White	−1.78	.01	.70	−.01	.05	.47

* Models adjusted for age, percentage body fat, physical activity, alcohol intake, smoking habits, income, and schooling.

high-density lipoprotien cholesterol and total cholesterol by race, probably because of the small sample of Blacks (data not shown).

Further studies should explore the Brazilian Mulatto group with more reliable measures of fat distribution. A better fat distribution in Brazilian Blacks as suggested in the present study may help explain the lack of association of fatness measurements with healthy outcomes found in several Brazilian studies. For example, hypertension[29] and blood lipids[3,30] were not correlated with waist circumference. The high admixture in the Brazilian population may explain these inconsistent findings.

In conclusion, our data suggest that abdominal adiposity, whether measured by WHR or by waist circumference, is associated with race in adult Brazilian men; Whites have higher values for these measures, and Mulattos are intermediate between Whites and Blacks. This association appeared to be independent of known risk factors for fat location. A better understanding of fat location according to skin color would help define the best indicators and the appropriate cutoffs for fatness and fat location in a population with high admixture such as the Brazilian one.

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