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Association of weight change with ethnicity and life course socioeconomic position among Brazilian civil servants

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Background Adult weight gain is generally associated with ethnicity of African descent, in addition to low socioeconomic position (SEP), but little information is available from the African diaspora in less-developed countries. We evaluated ethnic differences in adult weight change and the role of life course SEP in those differences.

Methods We conducted a cross-sectional analysis of baseline data (1999–2001) from 2594 non-faculty civil servants working at university campuses in Rio de Janeiro (Brazil) and participating in the longitudinal Pró-Saúde Study. Weight and height were measured at study entry whereas ethnicity, markers of SEP, and weight at age 20 were assessed through self-administered questionnaire.

Results Black and mulatto women gained, respectively, an excess of 1.6 kg and 1.2 kg per 10 years of adult life, compared with whites. After adjustment for markers of participants' early and later-life SEP, the estimates of excess weight gain for black and mulatto women decreased by about one-third, but a statistically significant estimate was still observed for black women. Among men, neither unadjusted nor adjusted ethnic gradients in weight gain were relevant.

Conclusions Only among women, black and mulatto ethnicity was associated with increased weight gain, which was partially explained through the association with their lower SEP.

Keywords Weight gain, obesity, ethnicity, socioeconomic factors, Brazil

The association of ethnicity and obesity has been documented in a number of studies mainly in the US and UK, with a higher risk of obesity being consistently reported among black women, compared with whites.[1–5]

Obesity is also associated with lower socioeconomic position (SEP) across more and less-developed societies;[6–8] this association is stronger and more consistently observed among women than among men.[3,7,9] Socioeconomic differences, however, did not completely explain the ethnic gradients in several studies.[10,11]

In Brazil, a marked increase in the prevalence of overweight and obesity has been detected since the mid-1970s.[12,13] During the 1990s, the social patterning of the obesity epidemic showed complex relationships: for example, the risk of obesity in men increased with income, but not with education; among women, those better-educated had a lower risk of being obese, and an inverse association of income with obesity was limited to the poorest region of the country.[14]

Despite the great burden of obesity, the determinants of adult weight change have not been fully characterized. Ethnicity, age, and initial degree of overweight are correlated with weight change over time.[1,2] To our knowledge, no published report has

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focused on the role of ethnicity on obesity or weight change in Brazil, notwithstanding the fact that it has the largest population of African descendants outside Africa, and that mounting empirical evidence indicates that this population is disproportionately situated in the poorer segments of Brazilian society.[15]

The Pró-Saúde Study aims at investigating the influence of the various dimensions of social position on health-related outcomes among university civil servants in Rio de Janeiro, Brazil. In this paper, we report gender-specific associations of ethnicity with weight change in adult life, and the roles of early and later-life socioeconomic disadvantage in those associations.

Methods

Participants

Our subjects were participants in two stages of baseline data collection (1999–2001) of a cohort study (the Pró-Saúde Study) of non-faculty civil servants at a university in Rio de Janeiro, Brazil. All 4428 employees were invited to participate; the response rate was 73% (3249). The current analyses are based on 2594 participants (1496 women), after exclusion of those with missing data (260) on weight or height measurements, reported weight at age 20, or ethnicity, and of those who were pregnant, reported ethnicity as Asian or Indigenous, or were outside the age range 30–70 years. In multivariate models of weight gain only those with complete data on all covariates were included in the models (2043/2594; 78%); compared with these participants, those with missing data in any covariate were similarly distributed by ethnicity, and had similar patterns of weight gain. Approval was obtained from the University ethics committee.

Measures

Weight (kg) and height (m) were measured with participants wearing light clothes and no shoes. Trained nutritionists used digital scales with 0.1 kg precision and 150 kg capacity, and a platform with an attached measuring bar with precision within 0.1 cm, according to standardized methods.

Participants filled out a self-administered questionnaire, which included questions on weight at age 20 and on ethnic self-identification. The latter was assessed in two ways: first, participants could answer an open-ended item with any term they wished ('In your opinion, what is your colour or race?'); second, at the end of the questionnaire, participants were asked to choose among the Brazilian census ethnic categories (White, 'Pardo' [Mulatto], Black, Asian, and Indigenous). In the current analyses, we utilized the responses to this open-ended item. These responses were initially grouped into nine categories comprising 97% of the original responses. Subsequently, these categories were regrouped into three strata: white, mulatto (adding up mulatto, brown, mixed, *moreno*) and black (black, negro, African, dark), according to the published work.[16] Questions on other characteristics included: father's and mother's education, age started working, perceived family economic situation at age 12, own education, occupational class according to the Erikson-Goldthorpe-Portocarrero scheme,[17] household income and number of people living on that income, home and car ownership, and marital status. Women provided additional information on age at menarche, number of live births, history of breast-feeding, and menopausal status.

Statistical analysis

Body mass index (BMI) was calculated as weight (kg)/height $(m)^2$. BMI at age 20 was based on height at study entry and self-reported recall of weight at age 20.

Analyses were conducted separately for each gender. We calculated, for each ethnic group, the mean BMI and prevalence of obesity (BMI $\geqslant$30 kg/m^2)[6] at age 20, the mean weight change per year, and the age-adjusted mean BMI and obesity prevalence at study entry.

Annual average weight change since age 20 (measured weight at study entry minus reported weight at age 20/age at study entry minus 20) was analysed as a continuous variable. Associations of ethnicity with annual average weight change were analysed through multiple linear regression.

After initial adjustment for age and BMI at age 20, models sequentially included height and other markers of early socioeconomic characteristics, later-life socioeconomic characteristics, and marital status. For women, a final model included reproductive life characteristics. Statistical analyses were performed with SPSS for Windows version 10.

Results

On average, black men and women were older and reported lower levels of markers of early and later-life socioeconomic characteristics compared with white participants (Table 1). Mulattos tended to occupy an intermediate position in relation to these characteristics, with prevalence estimates in general closer to those of blacks than of whites. Regarding overweight or obesity, that same ethnic pattern was observed only among women; the prevalence of BMI $\geqslant$25 kg/m^2 was approximately 60% and 41% for white men and women, 61% and 54% for mulatto men and women, and 64% and 59% for black men and women, respectively.

Female participants at age 20 had a mean BMI of nearly 21 kg/m^2 across ethnic groups, and prevalence rates of obesity ranging from 0.7% (whites) to about 2% (blacks) (Table 2). Males had a similarly low prevalence of obesity at age 20. In spite of the very small numbers observed in each ethnic group, a higher proportion of white men was reportedly obese at early adulthood, in contrast to the opposite ethnic gradient among women.

At study entry, both black and mulatto women had higher age-adjusted mean BMI (nearly 27 kg/m^2) and obesity prevalence (about 25% and 20%, respectively) than whites (nearly 25 kg/m^2, 14%), and higher weight gain during adult life (0.72 kg/year and 0.66 kg/year versus 0.55 kg/year, respectively). Males' age-adjusted mean BMI (range about 26–27 kg/m^2), obesity prevalence (range about 15–19%), and weight gain during adult life (range 0.67–0.71 kg/year) tended to be more homogeneous across ethnic groups (Table 2).

Compared with white women, black and mulatto women gained, respectively, an average excess of 160 g ($P < 0.0010$) and 120 g ($P = 0.002$) per year during adult life, after adjusting for age and BMI at age 20 (Table 3, model 3). Among men, there was no statistically excess weight gain among blacks ($P = 0.22$) and mulattos ($P = 0.19$) compared with whites.

The estimates of excess weight gain for black and mulatto women decreased by about one-third after adjustment for markers of participants' early and later-life SEP (models 4, 5).

Table 1 Social, demographic, and anthropometric characteristics by ethnicity. Pró-Saúde Study, Rio de Janeiro, Brazil, 1999–2001

	Men				Women			
	Whites	Mulattos	Blacks		Whites	Mulattos	Blacks	
Variable	No. (%)	No. (%)	No. (%)	***P***	No. (%)	No. (%)	No. (%)	***P***
Age (years)								
<35	134 (25.0)	65 (18.4)	34 (16.2)	0.05	151 (20.0)	59 (15.9)	55 (14.9)	0.01
35–44	251 (46.9)	184 (52.1)	114 (54.3)		407 (53.8)	195 (52.4)	178 (48.4)	
45–54	119 (22.2)	78 (22.1)	53 (25.2)		146 (19.3)	85 (22.8)	103 (28.0)	
>54	31 (5.8)	26 (7.4)	9 (4.3)		52 (6.9)	33 (8.9)	32 (8.7)	
Father's education								
Less than elementary	176 (34.2)	173 (52.4)	112 (58.9)	<0.001	271 (37.2)	167 (50.2)	192 (60.4)	<0.001
Elementary	149 (29.0)	92 (27.9)	51 (26.8)		191 (26.2)	85 (25.5)	82 (25.8)	
High school or more	189 (36.8)	65 (19.7)	27 (14.2)		266 (36.5)	81 (24.3)	44 (13.8)	
Mother's education								
Less than elementary	222 (41.4)	213 (62.1)	141 (69.5)	<0.001	327 (44.0)	221 (61.9)	244 (71.3)	<0.001
Elementary	146 (27.9)	89 (25.9)	50 (24.6)		200 (26.9)	92 (25.8)	77 (22.5)	
High school or more	156 (29.8)	41 (12.0)	12 (5.9)		217 (29.2)	44 (12.3)	21 (6.1)	
Perceived family economic situation at age 12								
Rich or middle class	283 (53.2)	114 (32.3)	50 (23.8)	<0.001	446 (59.2)	134 (36.1)	98 (26.8)	<0.001
Poor	223 (41.9)	198 (56.1)	135 (64.3)		263 (34.9)	193 (52.0)	211 (57.7)	
Very poor	26 (4.9)	41 (11.6)	25 (11.9)		45 (6.0)	44 (11.9)	57 (15.6)	
Age started working (years)								
≤12	47 (8.8)	81 (22.9)	34 (16.2)	<0.001	39 (5.2)	38 (10.2)	46 (12.5)	<0.001
13–17	201 (37.6)	148 (41.9)	108 (51.4)		167 (22.1)	115 (30.9)	127 (34.5)	
18+	287 (53.6)	124 (35.1)	68 (32.4)		550 (72.8)	219 (58.9)	195 (53.0)	
Education								
Elementary or less	106 (19.9)	137 (39.1)	87 (41.8)	<0.001	89 (11.8)	109 (29.7)	113 (31.0)	<0.001
High school	186 (35.0)	143 (40.9)	85 (40.9)		206 (27.4)	138 (37.6)	148 (40.5)	
College or more	240 (45.1)	70 (20.0)	36 (17.3)		457 (60.8)	120 (32.7)	104 (28.5)	
Occupation								
Manual	58 (10.9)	71 (20.3)	39 (19.2)	<0.001	13 (1.7)	14 (3.8)	18 (4.9)	<0.001
Non-manual routine	295 (55.5)	209 (59.7)	135 (66.5)		451 (59.7)	288 (77.8)	300 (82.0)	
Professional	179 (33.6)	70 (20.0)	29 (14.3)		292 (38.6)	68 (18.4)	48 (13.1)	
Household per capita income (tertiles)								
Lower	173 (34.1)	203 (61.1)	119 (59.8)	<0.001	159 (22.0)	155 (44.8)	178 (51.6)	<0.001
Intermediate	163 (32.1)	84 (24.7)	50 (25.1)		274 (37.8)	123 (35.5)	114 (33.0)	
Upper	171 (33.7)	47 (14.2)	30 (15.1)		291 (40.2)	68 (19.7)	53 (15.4)	
Home and car ownership								
None	103 (19.6)	102 (29.6)	74 (36.5)	<0.001	136 (18.4)	110 (30.0)	125 (35.3)	<0.001
House or car	220 (41.9)	163 (47.2)	86 (42.4)		313 (42.2)	153 (41.7)	155 (43.8)	
Both	202 (38.5)	80 (23.2)	43 (21.2)		292 (39.4)	104 (28.3)	74 (20.9)	
Marital status								
Married	394 (75.3)	270 (78.0)	141 (70.1)	0.008	438 (59.1)	191 (53.4)	165 (47.3)	<0.001
Divorced/widow	45 (8.6)	40 (11.6)	38 (18.9)		171 (23.1)	96 (26.8)	106 (30.4)	
Never married	84 (16.1)	36 (10.4)	22 (10.9)		132 (17.8)	71 (19.8)	78 (22.3)	
Body mass index at study entry (kg/m^2)								
Obese (≥30.0)	80 (15.0)	67 (19.0)	37 (17.6)	0.42	98 (13.0)	75 (20.2)	97 (26.4)	<0.001
Overweight (25.0–29.9)	243 (45.4)	147 (41.6)	97 (46.2)		211 (27.9)	124 (33.3)	120 (32.6)	
Normal (18.5–24.9)	206 (38.5)	134 (38.0)	76 (36.2)		443 (58.6)	164 (44.1)	144 (39.1)	
Underweight (<18.5)	6 (1.1)	5 (1.4)	–		4 (0.5)	9 (2.4)	7 (1.9)	

Pearson χ^2 test.

There was no further change with adjustment for marital status (model 6) and reproductive life characteristics (model 7). In our final models, a statistically significant excess weight gain was still observed among black women, and one of borderline significance among mulatto women, compared with whites.

Among men, there was some reduction in the regression coefficients with the inclusion of the same markers of later-life SEP; however, these coefficients were of small magnitude, and none was statistically significant.

There was no evidence of additive or multiplicative interactions between ethnicity and markers of SEP. The exclusion of 169 participants (6.5% of total) who lost weight during adult life from the multivariate analyses did not substantially change the above results.

Discussion

In this study of Brazilian civil servants, black and mulatto women gained an excess of 1.6 kg and 1.2 kg, respectively, per 10 years of adult life, after adjustment for age and BMI at age 20. The inclusion of markers of both early and later-life SEP in multivariate models reduced but did not eliminate these ethnic

Table 2 Mean body mass index (BMI) and prevalence of obesity at age 20, age-adjusted mean BMI and prevalence of obesity at study entry, and mean weight change since age 20, by gender and ethnicity

	At age 20		At study entry		
	BMI (kg/m^2)	Obesity (%)	BMI (kg/m^2)	Obesity (%)	**Weight change (kg/year)**
Ethnicity	(95% CI)	(95% CI)	(95% CI)	(95% CI)	(95% CI)
Women					
White	20.7	0.66	25.3	13.7	0.55
(N = 784)	(20.5, 20.9)	(0, 1.46)	(24.9, 25.6)	(11.1, 16.4)	(0.51, 0.58)
Mulatto	20.9	1.61	26.5	19.8	0.66
(N = 443)	(20.6, 21.1)	(0.47, 2.75)	(26.0, 27.0)	(16.0, 23.6)	(0.61, 0.71)
Black	20.9	2.17	26.9	25.2	0.72
(N = 275)	(20.6, 21.2)	(1.03, 3.32)	(26.4, 27.4)	(21.3, 29.0)	(0.67, 0.77)
Men					
White	21.8	0.93	26.2	15.0	0.67
(N = 555)	(21.5, 22.0)	(0.21, 1.66)	(25.9, 26.5)	(11.8, 18.2)	(0.62, 0.72)
Mulatto	21.7	0.57	26.4	18.9	0.70
(N = 389)	(21.4, 22.1)	(0, 1.46)	(26.0, 26.8)	(15.0, 22.8)	(0.64, 0.76)
Black	22.0	0.48	26.6	17.6	0.71
(N = 164)	(21.6, 22.4)	(0, 1.63)	(26.0, 27.1)	(12.5, 22.7)	(0.64, 0.79)

Table 3 Multiple linear regression analysis of the effect of ethnicity on weight change (kg) since age 20. Pró-Saúde Study, Rio de Janeiro, Brazil, 1999–2001

		Beta	SE Beta	*P*
Women (N = 1129)				
Model 1—Unadjusted	Black	0.15	(0.04)	< 0.001
	Mulatto	0.12	(0.04)	0.004
Model 2—Model 1 + age	Black	0.16	(0.04)	< 0.001
	Mulatto	0.12	(0.04)	0.002
Model 3—Model 2 + BMI at age 20	Black	0.16	(0.04)	< 0.001
	Mulatto	0.12	(0.04)	0.002
Model 4—Model 3 + height, father's education and mother's education, age started working, and perceived family economic situation at age 12	Black	0.14	(0.04)	0.001
	Mulatto	0.12	(0.04)	0.004
Model 5—Model 4 + education, occupation, income, car, and home ownership	Black	0.11	(0.04)	0.013
	Mulatto	0.07	(0.04)	0.076
Model 6—Model 5 + marital status	Black	0.11	(0.04)	0.009
	Mulatto	0.07	(0.04)	0.064
Model 7—Model 6 + age at menarche, number of live births, history of breastfeeding, and menopausal status	Black	0.11	(0.04)	0.013
	Mulatto	0.07	(0.04)	0.064
Men (N = 914)				
Model 1—Unadjusted	Black	0.05	(0.05)	0.37
	Mulatto	0.04	(0.04)	0.42
Model 2—Model 1 + Age	Black	0.06	(0.05)	0.23
	Mulatto	0.06	(0.04)	0.16
Model 3—Model 2 + BMI at age 20	Black	0.06	(0.05)	0.22
	Mulatto	0.05	(0.04)	0.19
Model 4—Model 3 + height, father's education and mother's education, age started working, and perceived family economic situation at age 12	Black	0.05	(0.06)	0.34
	Mulatto	0.07	(0.04)	0.11
Model 5—Model 4 + education, occupation, income, and car and home ownership	Black	0.02	(0.05)	0.66
	Mulatto	0.04	(0.04)	0.39
Model 6—Model 5 + marital status	Black	0.03	(0.05)	0.57
	Mulatto	0.04	(0.04)	0.36

gradients. In contrast, among men, there was no statistically significant association between ethnicity and weight change.

One source of concern is the possibility that some misclassification of ethnicity might have occurred because of the tendency of Brazilians of African descent to 'whiten' their self-report, as was observed during the 1960s and 1970s.[18] However, according to recent studies this behaviour is not as frequent as it might have been in the past especially in the most developed regions of the country (such as Rio) and among younger birth cohorts (such as our study participants).[16,19] In addition, it has been shown that existing fluidity in self-reported ethnicity in Brazil is contextual, as opposed to more fixed

concepts observed in the US.[20] Thus, it is likely that in a health survey the misreporting of ethnicity would be negligible when compared, for example, with the context of a job application.[21]

It should be noted that although our data originated from a specific population of civil servants, its ethnic distribution (blacks, 16%; mulattos, 30%; whites, 54%) was very similar to that of the general population in the State of Rio de Janeiro (blacks, 12%; mulattos, 27%; whites, 61%).[22] It is possible, however, that the association of weight change and ethnicity differs in the poorest segments of the population, which are not included among these civil servants.

Because of the cross-sectional nature of the data, our estimates of participants' weight change included retrospectively reported weight at age 20. Although the ethnic gradients might have been affected by differential reporting error, two indirect sources of evidence suggest that this is unlikely to have been a sizeable problem. First, the test-retest reliability of the reported weight at age 20, measured 2 weeks apart, was similar across ethnic strata: intraclass correlation coefficients (ICC) of 0.94 for blacks, 0.94 for mulattos, and 0.95 for whites; second, the ICC for the agreement between reported (in questionnaire) and measured weight at entry were 0.98 for blacks, 0.99 for mulattos, and 0.99 for whites. These estimates were similar for men and women.

To our knowledge, this was the first investigation of the association between adult weight change and ethnicity of African descent conducted in a less developed society. Similar excess weight gain among blacks was observed in US studies.[1,2,10] However, those reporting the role of SEP position in this association limited the assessment to a single dimension, e.g. education.[10] We utilized several markers of both early and later-life SEP to better evaluate their impact on ethnic gradients.

In addition, we made the distinction between different perceived skin colour among people of African descent, which has been considered to be socially relevant in the Brazilian case.[23] This distinction has enabled us to observe that, among women, being mulatto or black had a somewhat different impact on weight change, compared with whites.

Weight gain during adult life is ultimately the consequence of sustained positive energy balance deriving mainly from higher calorie intake and/or reduced physical activity.[6] When macrostructural processes favour sedentarism and consumption of energy-dense food (MacDonald's, one of the main fast food chains worldwide, is the largest private employer in Brazil[24]), social disadvantage is associated with fewer resources for individuals opting for healthier lifestyles regarding dietary and physical activity patterns.[25]

Our results are consistent with the hypothesis that ethnicity—an overlooked dimension of the obesity epidemic in Brazil—was related to different socioeconomic trajectories, thus representing one of the axes of social adversity associated with weight change among females. Whatever the complex of factors linked to increased obesity, these exposures were patterned by ethnicity and gender. Socioeconomic disadvantage of blacks and mulattos results from persisting discrimination against them in Brazil,[15,23] despite the absence of legal segregation after the late abolition of slavery in 1888 and the pervasiveness of a 'racial democracy' myth.[23] Our results suggest that black and mulatto women, who at the start of their lives already combine two sources of social disadvantage (ethnicity and gender), may have been more vulnerable to the risk of weight gain superimposed by lower SEP across early and later-life course.

Among black and mulatto women, compared with whites, an increased risk of weight gain persisted after inclusion of socioeconomic and sociodemographic characteristics in the models. These characteristics, however, were only partially captured by our available indicators, which may also suffer from non-equivalence across ethnic groups.[26,27] Moreover, we did not directly measure the effects of ethnicity-based discrimination on chronic stress, which has been observed to be associated with weight gain through cortisol metabolism.[28] The possible role played by a 'thrifty gene' associated with lower resting energy expenditure in people of West African diaspora remains to be elucidated.[29]

Based on cross-sectional patterns of health-related behaviours, ethnic disparities in weight gain in our female study population are not likely to decrease. Patterns of leisure-time physical activity, for example, could help narrow the ethnic gap in weight gain that has occurred so far. However, among women, 58% of whites, 68% of mulattos, and 67% of blacks reported no such activity during the 2 weeks previous to study entry.

In addition, ethnic differences in obesity in the Brazilian population at large may actually widen over time. Although in our study reported past obesity at early adulthood was rare, the increase in the prevalence of childhood overweight in Brazil, in recent years, has been of a similarly high magnitude to the US.[30] Because Brazilian black and mulatto children occupy the most socially disadvantaged population strata (60% living below the poverty line[31]), the ethnic gap in obesity may widen due to its tracking into adult life[32] and to the association between parental and offspring obesity.[33] Also, an earlier onset of obesity may lead to poorer socioeconomic trajectories[6] further affecting health status.

Weight gain is associated with an increased risk of developing insulin resistance syndrome[34] and subclinical atherosclerosis,[35] and overweight increases the risk of hypertension, diabetes, and ischaemic heart disease.[36] Potentially, medical counselling might promote health-related behaviours needed to maintain the appropriate weight.[37] However, to have a positive impact on undesirable ethnic gradients in weight gain, medical care should not be influenced by ethnic discrimination. As elsewhere,[38] this may not be the case in Brazil: in Pelotas[39] and in Rio de Janeiro (MC Leal, personal communication, 2002), for instance, black women more frequently than whites reported what is considered substandard obstetric care.

Our findings suggest that efforts to control the obesity epidemic should consider complex associations of weight gain with distal determinants such as socioeconomic disadvantage, gender inequalities, and ethnic discrimination. Our results further indicate that categories of ethnicity utilized in epidemiological studies should reflect specific social meaning. For example, the non-white/white dichotomy does not capture the heterogeneity that exists among ethnic groups in Brazil and would not be sufficient for generating more detailed knowledge on the relationship between ethnicity and weight change. Finally, we believe that research focusing on multi-ethnic societies such as Brazil may shed light both on specific societal features of ethnicity-based discrimination—a historical, ever-changing phenomenon[40]—and on its potentially wide-ranging health consequences.

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KEY MESSAGES

- Non-white ethnicity was associated with increased weight gain during adult life among women (but not among men) in this Brazilian population of civil servants.
- Adult weight gain for mulatto women (mixed ethnicity) was intermediate between weight gain experienced by white and black women.
- Among women, the effect of non-white ethnicity on adult weight gain was partially mediated by early and later-life socioeconomic disadvantage.

References

[1] Lewis CE Jr, Jacobs DR, McCreath H *et al.* Weight gain continues in the 1990s: 10-year trends in weight and overweight from CARDIA Study. *Am J Epidemiol* 2000;**151:**1172–81.

[2] McTigue KM, Garrett JM, Popkin BM. The natural history of the development of obesity in a cohort of young U.S. adults between 1981 and 1998. *Ann Intern Med* 2002;**136:**857–64.

[3] Wardle J, Waller J, Jarvis MJ. Sex differences in the association of socioeconomic status with obesity. *Am J Public Health* 2002;**92:** 1299–311.

[4] Williams DR. Racial variation in adult health status: patterns, paradoxes, and prospects. In: Smelser NJ, Wilson WJ, Mitchell F (eds). *America Becoming: Racial Trends and Their Consequences*. *Vol. II*. Washington, DC: National Academy Press, 1996.

[5] Kumanyika S. Obesity in black women. *Epidemiol Rev*1987;**9:**31–50.

[6] World Heath Organization. *Obesity: Preventing and Managing the Global Epidemic*. WHO Obesity Technical Report 894. Geneva, Switzerland: World Health Organization, 2000.

[7] Peña M, Bacallao J. *Obesity and Poverty. A New Public Health Challenge*. Scientific Publication 576. Washington, DC: Pan American Health Organization, 2000.

[8] Martikainen PT, Marmot MG. Socioeconomic differences in weight gain and determinants and consequences of coronary risk factors. *Am J Clin Nutr* 1999;**69:**719–26.

[9] Sarlio-Lähteenkorva S, Lahelma E. The association of body mass index with social and economic disadvantage in women and men. *Int J Epidemiol* 1999;**28:**445–49.

[10] Burke GL, Bild DE, Hilner JE, Folsom AR, Wagenknecht LE, Sidney S. Differences in weight gain in relation to race, gender, age and education in young adults: the CARDIA Study. Coronary Artery Risk Development in Young Adults. *Ethn Health* 1996;**1:**327–35.

[11] Johnson JL, Heineman EF, Heiss G *et al.* Cardiovascular disease risk factors and mortality among black women and white women aged 40–64 years in Evans County, Georgia. *Am J Epidemiol* 1986;**123:** 209–20.

[12] Monteiro CA, Mondini L, Medeiros de Souza AL, Popkin BM. The nutrition transition in Brazil. *Eur J Clin Nut* 1995;**49:**105–13.

[13] Sichirei R, Coitinho DC, Leão MM, Recine E, Everhart JE. High temporal, geographic, and income variation in body mass index among adults in Brazil. *Am J Public Health* 1994;**84:**793–98.

[14] Monteiro CA, Conde WL, Popkin BM. Independent effects of income and education on the risk of obesity in the Brazilian adult population. *J Nutr* 2001;**131:**881–86S.

[15] Hasenbalg C, Silva NV. Notes on racial and political inequality in Brazil. In: Hanchard M (ed.). *Racial Politics in Contemporary Brazil.* Durham and London: Duke University Press, 1999.

[16] Lovell PA, Wood CH. Skin color, racial identity, and life chances in Brazil. *Latin American Perspectives* 1998;**25:**90–109.

[17] Goldthorpe JH, Erickson R. *The Constant Flux: A Study of Class Mobility in Industrial Societies*. Oxford: Oxford University Press, 1993.

[18] Skidmore T. *Black into White: Race and Nationality in Brazilian Thought*. Durham, NC: Duke University Press, 1995.

[19] Sansone L. The new politics of black culture in Bahia, Brazil, In: Govers C, Vermuellen H (eds). *The Politics of Ethnic Consciousness*, New York: St Martin's Press, 1997.

[20] Wade P. *Race and Ethnicity in Latin America*, Chicago: Pluto Press, 1997.

[21] Telles EE. Racial ambiguity among the Brazilian population. *Ethnic and Racial Studies* 2002;**25:**415–41.

[22] IBGE (Brazilian Institute of Geography and Statistics). *Synthesis of Social Indicators 1999*. Rio de Janeiro: Brazilian Institute of Geography and Statistics, 2000.

[23] Fry P. Politics, nationality, and the meaning of 'race' in Brazil. *Daedalus* 2000;**129:**83–118.

[24] Schlosser E. *Fast Food Nation*. London: Penguin, 2001.

[25] Aboderin I, Kalache A, Ben-Shlomo Y *et al. Life Course Perspectives on Coronary Heart Disease, Stroke and Diabetes: Key Issues and Implications for Policy and Research*. Geneva: World Health Organization, 2002.

[26] Williams DR, Collins C. US socioeconomic and racial differences in health: patterns and explanations. *Annu Rev Sociol* 1995;**21:** 349–86.

[27] Kaufman JS, Cooper RS, McGee DL. Socioeconomic status and health in blacks and whites: the problem of residual confounding and the resiliency of race. *Epidemiology* 1997;**8:**621–28.

[28] Bjorntorp P. Obesity and cortisol. *Nutrition* 2000;**16:**924–36.

[29] Kwame O. Metabolic consequences of the West African diaspora: lessons from the thrifty gene. *J Lab Clin Med* 1999;**133:**98–111.

[30] Wang Y, Monteiro C, Popkin BM. Trends of obesity and underweight in older children and adolescents in the United States, Brazil, China, and Russia. *Am J Clin Nutr* 2002;**75:**971–77.

[31] Henriques R. *Racial Inequality in Brazil: Trends in Living Standards during the 1990s*. Discussion Text number 807. Rio de Janeiro: Institute of Applied Economic Research (IPEA), 2001. (Portuguese).

[32] James PT, Leach R, Kalamara E, Shayegui M. The worldwide obesity epidemic. *Obesity Res* 2001;**9:**228S–33S.

[33] Parsons TJ, Power C, Manor O. Fetal and early life growth and body mass index from birth to early adulthood in 1958 British cohort: longitudinal study. *BMJ* 2001;**323:**1320–21.

[34] Everson SA, Goldberg DE, Helmrich SP, Lakka TA, Lynch JW, Kaplan GA. Weight gain and the risk of developing insulin resistance syndrome. *Diabetes Care* 1998;**21:**1637–43.

[35] Stevens J, Tyroler HA, Cai J *et al.* Body weight change and carotid artery wall thickness: the Atherosclerosis Risk in Communities (ARIC) Study. *Am J Epidemiol* 1998;**147:**563–73.

[36] Wilson PWF, D'Agostino RB, Sullivan L, Parise H, William Kannel B. Overweight and Obesity as Determinants of Cardiovascular Risk The Framingham Experience. *Arch Intern Med* 2002;**162:** 1867–72.

[37] Galuska DA, Will JC, Serdula MK, Ford ES. Are health care professionals advising obese patients to lose weight? *JAMA* 1999;**282:** 1576–78.

[38] Bopal R. Spectre of racism in health and health care: lessons from history and the United States. *BMJ* 1998;**316:**1970–73.

[39] Barros FC, Victora CG, Horta BL. Ethnicity and infant health in Southern Brazil. A birth cohort study. *Int J Epidemiol* 2001;**30:**1001–8.

[40] Fredrichson GM. *Racism: A Short History*. Princeton: Princeton University Press, 2002.