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Racial discrimination predicts the increase in body weight and BMI in Black individuals from ELSA-Brasil cohort

Discriminação racial prediz o aumento do peso corporal e do IMC em indivíduos pretos da coorte ELSA-Brasil

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Abstract *We investigated whether racial discrimination accelerates the weight and Body Mass Index (BMI) gain in Blacks and Browns participants of the Brazilian Longitudinal Study of Adult Health (ELSA-Brasil) in four years of follow-up. We compared body weight and BMI between the 1st (2008-2010) and 2nd visit (2012-2014) of 5,983 Blacks and Browns participants. Exposure to racial discrimination and covariates (age, sex, education, and research center) were obtained at the 1st visit. Linear mixed effects models stratified by race/skin color were used. Report of racial discrimination was more frequent among Blacks (32.1%) than Browns (6.3%). During the follow-up period, Blacks and Browns gained an average of 1.4kg and 1.2kg, respectively. This increase was greater among those who reported discrimination when compared to those who did not, both in Blacks (2.1kg vs.1.0kg, p < 0.001) and Browns (1.9kg vs. 1.1kg, p < 0.05). The results of the interaction between racial discrimination and time showed that Blacks, but not Browns, who reported racial discrimination had greater weight and BMI gains between visits. Our results suggest that reducing racial discrimination would contribute to prevent and/or control obesity increase in the country.*

Key words *Racial discrimination, Racism, Weight gain, Cohort studies*

Resumo *Investigou-se se a discriminação racial acelera o ganho de peso corporal e o Índice de Massa Corporal (IMC) em pretos e pardos participantes do Estudo Longitudinal de Saúde do Adulto (ELSA-Brasil) em quatro anos de seguimento. Comparou-se o peso corporal e o IMC entre a 1ª (2008-2010) e a 2ª visita (2012-2014) de 5.983 participantes pretos e pardos. A exposição à discriminação racial e às covariáveis (idade, sexo, escolaridade e centro de pesquisa) foram obtidas na 1ª visita. Foram utilizados modelos lineares de efeitos mistos estratificados por raça/cor da pele. O relato de discriminação racial foi mais frequente entre pretos (32,1%) do que em pardos (6,3%). Durante o período de acompanhamento, pretos e pardos ganharam uma média de 1,4kg e 1,2kg, respectivamente. Esse aumento foi maior entre os que relataram discriminação, quando comparados aos que não relataram, tanto em pretos (2,1 kg vs. 1,0 kg, p < 0,001) quanto em pardos (1,9kg vs. 1,1kg, p < 0,05). Após ajustes, os pretos, mas não os pardos, que relataram discriminação racial apresentaram maiores ganhos de peso e IMC entre as visitas. Nossos resultados sugerem que a redução da discriminação racial pode contribuir para prevenir e/ou controlar o aumento da obesidade no país.*

Palavras-chave *Discriminação racial, Racismo, Ganho de peso, Estudos de coorte*

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Introduction

Black individuals and other minorities are disproportionately affected by overweight and obesity characterizing a deep racial inequality in prevalence[1-4] and incidence[5,6] of these two outcomes in different countries. The exposure to racial discrimination might explain, at least in part, this inequity[7]. In North American studies, perceived racial discrimination has been associated with higher BMI[5,8-10] and waist circumference[9,11-13]. However, most previous studies included only women[5,8,9,11,13] and only four studies were longitudinal[5,6,8,9]. A recent Brazilian study conducted with ELSA-Brasil participants demonstrated that racial discrimination increases the obesity incidence in Black individuals with low education[6]. However, we do not know if the exposure to racial discrimination can modify the trajectory of weight and BMI, accelerating the weight gain in exposed Black and Brown individuals vis-à-vis those not exposed. This investigation is important because weight gain, even when the gain is below the obesity cutoff, the upward trend can have negative health repercussions[14]. Moderate weight gains over time tend to be unnoticed and delay individuals and health professionals concerns and adoptions of control measures[14]. Thus, the identification of groups susceptible to greater weight gains over time is important to promote actions to prevent an early onset of obesity and related health problems[14]. We investigated whether racial discrimination accelerates weight and BMI gain in Black and Brown ELSA-Brasil participants after four years of follow-up.

Material and methods

Study design and population

We used data from the 1st (2008-2010) and 2nd visit (2012-2014) of ELSA-Brasil, which is a prospective multicenter study, carried out with 15105 civil servants, aged between 35 and 74 years old, from universities and research institutions located in six Brazilian capitals[15]. The ELSA-Brasil cohort comprises of voluntary participants and efforts were made to recruit similar amounts of men and women, as well as predefined proportions of age groups and occupational categories. The sample size calculation was performed considering two main ELSA outcomes of interest: type 2 diabetes and myocardial infarction[15]. An alpha value of 5%, statistical power of 80%, exposure prevalence of 20%, and a relative risk of 2.0 was considered, reaching an estimate of 6,400 participants[15]. To enable the evaluation of sex-specific analyzes and to compensate for possible losses of follow-up, a desirable sample size of 15,000 participants was estimated[15]. This study was approved by the ethics committees of all institutions involved, and volunteers gave written consent to participate. Further study design and cohort profile details have been given elsewhere[15,16].

Of the 15105 participants of the 1st visit, 223 (1.5%) have died during the follow-up period and 868 (5.7%) did not attend the 2nd visit. All participants who declared themselves as Black or Brown and who attended both visits (n = 6100) were eligible to participate in this analysis. Brazilian indigenous (n = 145) and Asian descendent (n = 351) were excluded due to the small number of individuals, limiting the precision of estimates. Whites (n = 7258) were also not eligible, as racial discrimination primarily affects individuals of race/skin color historically stigmatized. Moreover, it is possible that racial discrimination reported by Whites (n = 64) has a different meaning and impact than that reported by Blacks/Browns[17].

We also excluded participants with missing data for racial discrimination (n = 11), weight (n = 39) or BMI (n = 23) and those who underwent bariatric surgery (n = 44). Thus, the final sample was composed of 5983 Black and Brown participants.

Outcome assessment

Body weight and BMI were measured at the 1st and 2nd study visits. Body weight was measured using an electronic scale with a maximum capacity of 200 kg and an accuracy of 50 g (Toledo, São Bernardo do Campo, Brazil) and height was measured using a fixed stadiometer with a precision of 0.1 cm (Seca-SE-216, Hamburg, Germany), following standard techniques[18]. BMI was calculated by dividing weight (kg) by height squared (m^2).

Racial discrimination

Perception of racial discrimination throughout life was assessed at the 1st visit of the study using a modified version of the *Lifetime Major Events Scale*[19]. This instrument measures unfair treatment in different contexts, such as public or workplaces, police stations, educational institu-

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tions and place of residence. More details of the scale have been given elsewhere[6].

Respondents who reported unfair treatment in any domains motivated by race/skin color were classified in the present study as having experience of racial discrimination. A study that evaluated the reliability of this modified version of the scale in a population similar to ELSA-Brasil obtained a Kappa coefficient of 0.85 (95%CI 0.72-0.98)[20].

Study covariates

Variables considered in the present study were: age (considered as a categorical variable in descriptive analysis and as a continuous variable in regression models), sex, education (university degree, high school, complete elementary school and incomplete elementary school), and research center (São Paulo, Rio de Janeiro, Minas Gerais, Espírito Santo, Bahia and Rio Grande do Sul).

Data analysis

Descriptive analyzes were performed using proportions, means and standard deviation. The racial discrimination prevalence was described separately by race/skin color and according to each characteristic evaluated.

To assess whether racial discrimination predicts changes in trajectory of weight and BMI over time, we used linear mixed-effects models, which is an adequate model for analysis of unbalanced spaced longitudinal data over time[21]. Racial discrimination and covariates were included in the models as fixed effects, and age variation was modeled as random effect to index time. All models included random effects on the intercept and slope allowing the individual's initial value and longitudinal trajectory to vary in relation to the average and the population trajectory[21]. Estimation of linear mixed effects models was made using the maximum restricted likelihood method (MLR)[22,23].

To verify the association of racial discrimination with BMI and weight, we included in the model covariates pointed out in the literature as potential confounders of this association, such as age, sex, education and research center[24-28]. To assess whether racial discrimination affected the speed of weight and BMI gains with increasing age (time), we entered an interaction term between racial discrimination*age (time) in the fully adjusted models. When the interaction term was statistically significant, the predicted means of weight and BMI gains according to racial discrimination were estimated and displayed graphically. Considering previous evidences that have showed that education[26] and sex[9,29] modified the effect of racial discrimination and obesity-related outcomes, we tested the interaction between racial discrimination and sex and between racial discrimination and education. However, these interactions were not statistically significant ($p > 0.05$) and variables sex and education were only used for adjustment. Adjustments were retained in the models regardless of the p-value and interaction terms were retained when p-value < 0.05.

All analyzes were performed using the Stata 14.00 software (Stata Corporation, College Station, United States), considering a significance level of 5%.

Results

Median follow-up time was 3.9 years, with an interquartile range of 3.6-4.1 years. The mean age of participants was 51 years old and 54,9% were female. Of the total participants, 63.5% were Brown and 36.5% Black. Racial discrimination was reported more frequently among Blacks (32.1%) than among Browns (6.3%). The racial discrimination prevalence was higher in men and individuals with higher education in both categories of race/skin color (Table 1).

Average weight among Blacks and Browns at the first visit was 75.3kg and 73.1kg, respectively. On average, Blacks gained 1.4kg during the follow-up period and Browns gained 1.2kg. This increase was greater among those who reported discrimination when compared to those who did not report it among both Blacks (2.1kg *versus* 1.0kg, $p < 0.001$) and Browns (1.9kg *versus* 1.1kg, $p < 0.05$).

Results of mixed-effects regression models show that the experience of racial discrimination was not an independent predictor of change in the speed of weight and BMI trajectories among Brown individuals, since the interaction term between racial discrimination*age (time) was not statistically significant in this group (Table 2). Among Blacks, the interaction term between racial discrimination*age (time) was statistically significant (Table 2), showing that Blacks who reported racial discrimination had a greater and more accelerated increase in weight and BMI gains over the follow-up period than Blacks who did not report it.

At age 35, black individuals who did not report racial discrimination were, on average,

Table 1. Characteristics of Black and Brown individuals participating in the study and perceived racial discrimination prevalence according to these characteristics at the 1st visit of the Brazilian Longitudinal Study on Adult Health (ELSA-Brasil), 2008-2010.

Characteristics	Total N = 5983	Brown N = 3802	Racial discrimination prevalence in Browns (%)	Black N = 2181	Racial discrimination prevalence in Blacks (%)
Age (%)					
35-44	23.6	24.3	6.7	22.6	35.8
45-54	42.9	43.1	6.8	42.5	34.7
55-64	25.9	25.3	4.6	26.8	29.5
65-74	7.6	7.3	7.2	8.2	17.4
Sex (%)					
Men	45.1	48.6	7.5	39.1	34.8
Women	54.9	51.5	5.1	60.9	30.4
Education (%)					
University degree	36.3	41.0	6.0	28.1	45.8
High school	46.0	42.8	6.6	51.7	29.1
Complete elementary school	9.5	8.4	6.0	11.5	22.0
Incomplete elementary school	8.2	7.8	5.7	8.8	19.4
Nutritional status (%)					
Normal weight	33.7	36.2	5.4	29.2	32.3
Overweight	41.4	41.6	6.1	41.0	32.1
Obesity	24.9	22.2	8.1	29.8	32.0

Source: Authors.

Table 2. Association between racial discrimination with weight and BMI over four years of follow-up in Brown and Black individuals participating in the Brazilian Longitudinal Study on Adult Health (ELSA-Brasil) (2008-2010 and 2012-2014).

		Brown β (CI95%)[1]	Black β (CI95%)[1]
Weight	Intercept	**72.78 (70.79; 74.76)*****	**77.43 (74.14; 80.72)*****
	Age (time)	**0.17 (0.13; 0.20)*****	**0.12 (0.06; 0.17)*****
	Racial discrimination		
	No	Ref.	Ref.
	Yes	0.20 (-6.65; 7.05)	**-9.97 (-15.06; -4.88)*****
	Racial discrimination x Age (time)	0.06 (-0.07; 0.19)	**0.21 (0.11; 0.31)*****
Body mass index	Intercept	**22.29 (21.59; 22.98)*****	**23.41 (22.23; 24.58)*****
	Age (time)	**0.10 (0.09; 0.12)*****	**0.09 (0.07; 0.11)*****
	Racial discrimination		
	No	Ref.	Ref.
	Yes	0.28 (-2.17; 2.74)	**-3.41 (-5.25; -1.56)*****
	Racial discrimination x age (time)	0.01 (-0.04; 0.06)	**0.07 (0.04; 0.11)*****

[1]Model adjusted for age, sex, education, research center and interaction term racial discrimination; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$; CI = confidence interval.

Source: Authors.

2.6kg and 0.91 kg/m² higher than those who reported racial discrimination. However, as can be seen in Figure 1, weight gain in individuals who reported racial discrimination was more accelerated, causing this difference to disappear at age 47. Subsequently, an inversion was observed and, at the age 79, black individuals who reported racial discrimination had, on average, 6.7 kg and 2.25 kg/m² greater than those who did not report racial discrimination (Figure 1).

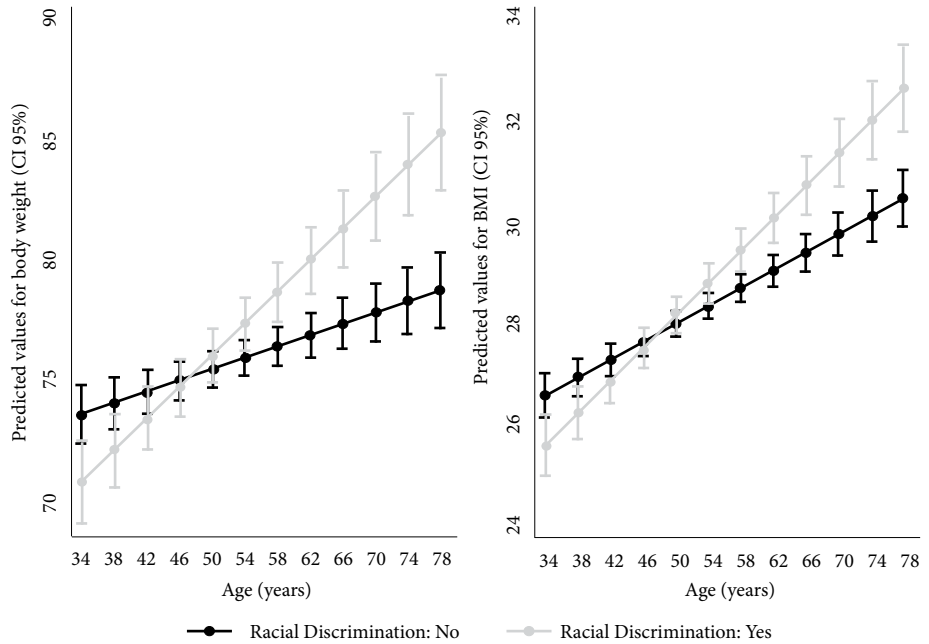

Figure 1. Prediction* of the averages (95%CI) of weight (Kg) and BMI (Kg/m²) over age (time) in Black individuals according to racial discrimination. Brazilian Longitudinal Study of Adult Health (ELSA-Brazil) (2008-2010 and 2012-2014).

* Predictions were made using estimates from the models adjusted for age, sex, education, research center and interaction term racial discrimination*time. † An average variation of four years in age was considered.

Source: Authors.

Discussion

We found evidence that Blacks who reported racial discrimination presented a greater and more accelerated increase in weight compared to Blacks who did not report it, and this association was independent from sex, education and research center. As expected, the results for the BMI were similar, since with the change in weight there is also a change in the BMI, since the height of the individuals does not change significantly over time. However, we found no evidence that racial discrimination modifies weight or BMI trajectory among Browns over time.

Racial discrimination also predicted changes in BMI and waist circumference over 8 years of follow-up in CARDIA cohort, but only among Black women[5]. Additionally, the Black Women's Health Study found that racial discrimination was associated with weight gain[8] and obesity incidence[5] in Black women, but this study did not investigate such association among men. A previous study in ELSA-Brasil cohort found that obesity incidence was higher among Blacks who reported racial discrimination compared with peers who did not, but differently from the present study this association was observed only among men and women with low education[6]. This apparent difference between previous results from ELSA-Brasil and our current results, may be explained by the greater baseline BMI of Blacks and Browns with low education (low education: 27.6 Mg/m² *versus* high education 26.8 Kg/m², p < 0,001, *data not shown*), placing them at greater risk to achieve the obesity cut off than individuals with higher education, plus the fact that the follow up time was relatively short (3.8 years on average).

In our study, the prevalence of perceived racial discriminations was higher in participants with high levels of education. These results are in line with evidence showing that individuals with high levels of education can perceive[26] and suffer[30] more racial discrimination. Previous stu-

dy also showed that education can interact with racial discrimination, changing the outcome in different ways[6]. However, we did not find interaction between the two variables in our analysis.

We also investigated the role of racial discrimination experience in weight/BMI among Browns, as the Brazilian racial classification does not reproduce the binary division between Blacks and Whites found in other societies, such as the USA and 43% of the Brazilian population declares themselves as Brown[31]. Studies indicate that Browns, like Blacks, have a greater social disadvantages when compared to Whites[32]. However, racial discrimination did not predict greater speed of weight and BMI gains among Browns in the present study, corroborating our previous findings that also failed to identify an association between perceived discrimination and obesity incidence among Browns. This finding may be related to the much lower prevalence of racial discrimination among Browns (6.3%) as compared to Blacks (32.1%).

According to the ecosocial theory of Nancy Krieger[33], individuals exposed to structural and interpersonal racism can biologically incorporate exposures arising from that specific ecological and social contexts in which they live, explaining the racial inequality in weight trajectories across time. The structural racism generates inequalities in the distribution of resources, and life opportunities, since it operates in all individual's life levels in a connected way[28]. The concomitant exposure to adverse social contexts and to interpersonal racism can increase the stress load[28], which will activate physiological adaptations in the nervous, endocrine and immune systems and trigger pro-inflammatory responses[34]. For example, the exposure to stress is related to increase in cortisol and other pro-inflammatory markers as a result of hyperactivity of the hypothalamic-pituitary-adrenal axis, leading to a chronic inflammatory state[35]. This chronic inflammation is related to fat accumulation in the abdominal region and increased appetite, generating a greater preference for consumption of caloric foods[35].

We must emphasize that the ELSA-Brasil population has a higher average income and education level than the general Brazilian population. It is known that individuals with higher education may have greater perception of racial discrimination than those with lower education[26]. However, a representative study of the Brazilian population aged 16 or over[32] found greater prevalence of racial discrimination than the observed in ELSA-Brasil baseline. Thus, if the reporting of racial discrimination is underestimated in this study in relation to the Brazilian population, this would cause a dilution in the estimated associations, as some exposed individuals would be misclassified as not exposed, leading to a reduction in the magnitudes of the observed associations with weight and BMI gains herein. In addition, as we chose to continuously assess weight gain and BMI over time, our study does not make it possible to assess how racial discrimination influences the change in the classification of the weight status of individuals, that is, it is not possible to indicate by this study if racial discrimination influences an increase in the prevalence and incidence of obesity. However, weight gain can have negative repercussions for health even when the individual does not reach the cutoff point that characterizes obesity[14].

Our results are important for a better understanding of the complex relationships between racial discrimination and obesity, and reinforce the evidence that racial discrimination can be an important component of persistent racial inequality in health. The knowledge generated by this work add evidences that support the development of actions seeking to reduce racial inequalities, such as the expansion of affirmative action policies and the development of other public policies to promote equity. Besides, these results prompt the need of expanding access to quality health services of Blacks and Browns, an essential ingredient to reduce racial inequalities in health in Brazil.

Collaborations

The primary responsibility for data analysis and drafting the manuscript were AV Machado, LV Camelo and SM Barreto. S Menezes, D Chor, RH Griep, JMN Guimarães, S Alvim, MDCB Molina and L Giatti reviewed and commented on the data analysis, interpretation and drafts. Each author contributed important intellectual content during manuscript drafting or revision and accepts accountability for the overall work by ensuring that questions pertaining to the accuracy or integrity of any portion of the work are appropriately investigated and resolved.

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