Racial inequality, racial discrimination and obesity incidence in adults from the ELSA-Brasil cohort

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ABSTRACT

Background This study investigated whether self-reported race/skin colour and perceived racial discrimination predict higher obesity incidence after approximately 4-year follow-up of the Brazilian Longitudinal Study of Adult Health (ELSA-Brasil). We also investigated whether these associations are modified by educational level.

Methods Following exclusion of individuals defined as obese (body mass index ≥30 kg/m^2) at baseline, associations between race/skin colour and obesity incidence between the first (2008–2010) and second (2012–2014) visits were investigated in 10 130 participants. Next, associations between perceived racial discrimination and obesity incidence among black (n=1532) and brown (n=2958) individuals were investigated separately. Racial discrimination (yes/no) was assessed using the Lifetime Major Event Scale. Logistic regression models adjusted for age, sex and research site were used. All analyses were stratified for educational level.

Results Obesity risk was higher in Blacks with high education compared with white individuals to the same education level (OR: 2.22; 95% CI 1.62 to 3.04) following adjustments. After adjustments, obesity incidence was higher among black individuals reporting racial discrimination compared with peers who did not report this experience, but only among the low education group (OR: 1.64; 95% CI 1.08 to 2.51). No statistical association with perceived discrimination was observed among brown individuals.

Conclusion Results are congruent with findings from other studies reporting associations between racial inequality and obesity incidence and also suggest racial discrimination may be one of the mechanisms leading to such inequalities. Also, it supports the paradox theory by which education modify the association in distinct directions.

INTRODUCTION

In Brazil, race/skin colour inequalities in health have historically been attributed solely to socioeconomic differences,[1] and experiences of racial discrimination have often been neglected or even denied.[2] Only in the 1990's the State began to implement affirmative action policies aiming to decrease racial inequalities,[1] and racial discrimination complaints began to be truly acknowledged in society. Still, cumulative disadvantage experienced by black individuals and brown individuals relative to white individuals remain large in the country and in virtually all fields, particularly socioeconomic[3] and health-related indicators, including obesity.[4 5]

Racial inequality in the distribution of risk factors and diseases such as obesity may be explained by unequal treatment according to race/skin colour within society,[6] a social construction that has incorporated the idea of white supremacy and black inferiority into the Brazilian culture.[7] A racist culture may impact health through differences in access to social opportunities and resources, knowledge and socioeconomic status stemming from structural racism.[6] North American studies have shown that body weight gain over time[8–10] and obesity incidence are greater among black individuals compared with white individuals.[11–13] Associations between race/skin colour and obesity have been investigated in three Brazilian studies (two cross-sectional and one longitudinal). Findings of both cross-sectional studies suggest that the prevalence of overall obesity is higher in black[5] relative to white women, with abdominal obesity being more prevalent in black and brown women than in those with white skin.[14] In the longitudinal study, body weight gain over time was also greater in black and brown compared with white women, with no racial difference between men.[15]

Other North American studies revealed that experiences of racial discrimination may play a significant role in obesity development[16–18] among black individuals. This is because unfair treatment is a stressor and therefore a potential trigger for risk behaviours and immunoendocrine changes associated with weight gain.[19] Despite being a well-recognised social issue, there is a lack of Brazilian studies on the associations between race/skin colour, racial discrimination and obesity incidence.

In addition, the intersectionality between two or more forms of subordination, such as race/skin colour, education and gender, can alter the impact that both have on the individual, producing inequalities in health outcomes.[20 21] Women and men may have a different perception of threatening experiences, with women having a more significant increase in cortisol levels when exposed to situations of social rejection.[22] The known health benefits resulting from higher socioeconomic levels appear to be lower in black individuals when compared with white individuals.[23 24] Despite this evidence, we found no study that assessed whether the association between race/colour, racial discrimination and obesity incidence vary according to educational level and sex.

This study investigated associations between race/skin colour and obesity incidence among the participants of the Brazilian Longitudinal Study of Adult Health (ELSA-Brasil) over 4 years of follow-up and to determine whether perceived racial discrimination increased the obesity risk in black and brown individuals in this cohort. Because race, gender and socioeconomic status matters in predicting variations in health, we also evaluated whether these associations are modified by education level.

METHODS

Study design and population

A longitudinal study based on data collected on the first (2008–2010) and second (2012–2014) visits of the ELSA-Brasil that is a prospective multicentre study involving 15 105 civil servants working at higher education and research institutions located in six Brazilian capital cities: São Paulo, Belo Horizonte, Salvador, Porto Alegre, Rio de Janeiro and Vitória.[25] Active or retired civil servants aged 35–74 years were eligible for participation. Further details on the ELSA-Brasil cohort profile are available in another study.[25]

Of 15 105 participants attending the first visit, 204 (1.4%) died during the follow-up and 887 (5.9%) did not attend the second visit. Of the 14 014 participants who attended the second visit, those who were not obese in the first visit and with valid weight and height data in both visits (n=10 770) were eligible to participate. Participants with missing race/skin colour data (n=123) or self-declared Brazilian indigenous (n=101) or Asian descendent (n=308) were excluded, as they would be under-represented and might therefore negatively affect estimate accuracy. Individuals with missing racial discrimination data (n=15) or submitted to bariatric surgery (n=46) were also excluded, as well as white individuals reporting racial discrimination (n=47). The latter exclusion was deemed appropriate since experiences of racial discrimination affect primarily individuals with historically stigmatised race/skin colour. In addition, racial discrimination reported by Whites may have different meaning and impact compared with that by black/brown individuals. For example, according to a previous study, affirmative policies aimed to attenuate racial inequalities may be interpreted as institutional racism against those with white skin by some white individuals.[26] The final sample employed to investigate associations between race/skin colour and obesity incidence comprised 10 130 participants (94.1% of eligible participants).

The final sample employed to investigate associations between racial discrimination and obesity incidence comprised 1532 black and 2958 brown individuals, given experiences of racial discrimination refer to these subgroups and are not equally applicable to self-declared white individuals (n=5640).

Response variable

Obesity incidence in the second ELSA-Brasil follow-up visit was used as a response variable in this study. Body weight was measured using an electronic scale with 200 kg maximum capacity and 50 g precision (Toledo, São Bernardo do Campo, Brazil). Height was measured using a wall-mounted stadiometer with 0.1 cm precision (Seca-SE-216, Hamburg, Germany), according to standardised techniques.[27] Body mass index (BMI) was calculated as weight (kg) divided by height squared (m^2). Obesity (yes/no) was defined as BMI $\geq 30\ kg/m^2$.

Explanatory variables

Race/skin colour

Self-declared race/skin colour was obtained using the question: 'The Brazilian Census (IBGE) describes people's skin color or race as Black, Brown, White, Asian descendent and Brazilian indigenous. If you were to answer the CENSUS today, how would you described your skin colour or race?' with the following possible answers: Black, White, Brown, Asian descendent and Brazilian indigenous.

Racial discrimination throughout life

Racial discrimination over the life course was assessed using the modified version of the Lifetime Major Events Scale.[28 29] This scale assesses unfair treatment perception in different contexts (such as public or workplaces, police stations, education institutions and place of residence) and related reasons (race/skin colour, gender, religion, physical disabilities, sexual orientation, socioeconomic status, political activism, age, physical appearance and others (specify)). Interviewees were allowed to select more than one context or reason.

Interviewees reporting unfair treatment in any of the contexts and incriminating race/skin colour as the motivating factor were described as positive for perceived racial discrimination. Reliability of the modified versions of the Lifetime Major Events Scale has been assessed in a population similar to that of ELSA-Brasil and was thought to be very good (kappa coefficient=0.85; 95% CI 0.72 to 0.98).[29]

Study covariates

Covariates were measured during the first visit using standardised questionnaires administered by a trained and certified team.

Analyses of associations between race/skin colour and racial discrimination with obesity incidence were adjusted for potentially confounding variables as per the literature, such as age (continuous) and sex. This was a multicentre study involving individuals living in six cities located in different Brazilian states. Therefore, the research site was defined as a potential confounding factor, since varying proportions of self-declared white, brown and black individuals in different sites may impact racial self-classification as well as perception of racial discrimination.[30] Moreover, the prevalence of obesity differed across different regions.

Analyses of associations between race/skin colour and obesity incidence were not adjusted for education, considering race/skin colour is a determinant of years and quality of education and thus an antecedent variable.[31] However, considering that the effect of race/colour and racial discrimination on health could be different according to education level[23 24 32 33] and because we found evidence of multiplicative interaction between race/skin colour and education ($p<0.05$), all analyses were stratified by education (high: university degree or more vs low: high school or less). We found no interaction between the explanatory variables and gender, and for this reason, the analysis was not stratified by gender.

Data analysis

Descriptive analysis according to race/skin colour and education level was conducted using proportions, mean and SD for categorical and continuous variables, respectively.

We used logistic regression models to assess associations between obesity incidence and explanatory variables stratifying by education level (high: university degree or more vs low: high

Table 1 Baseline characteristics of study participants according to race/skin colour. The Brazilian Longitudinal Study of Adult Health (ELSA-Brasil), 2008-2010, N=10130.

Variables	White N=5640	Brown N=2958	Black N=1532
Age, mean (SD)	52.1 (9.3)	50.6 (8.6)	51.4 (8.7)
Sex (%)			
Men	46.4	50.0	43.2
Women	53.6	50.0	56.8
Education (%)			
University degree	69.0	42.5	29.2
High school	24.8	42.1	50.6
Complete elementary school	3.7	8.1	11.4
Incomplete elementary school	2.6	7.3	8.8
Research site			
São Paulo	64.5	22.1	13.3
Minas Gerais	52.1	35.9	12.0
Rio Grande do Sul	79.1	8.9	12.0
Bahia	19.9	46.7	33.4
Rio de Janeiro	57.4	31.4	11.3
Espírito Santo	45.9	43.6	10.5
Racial discrimination (%)*			
No	–	94.3	67.8
Yes	–	5.8	32.2

*White individuals who reported racial discrimination were excluded from analysis.

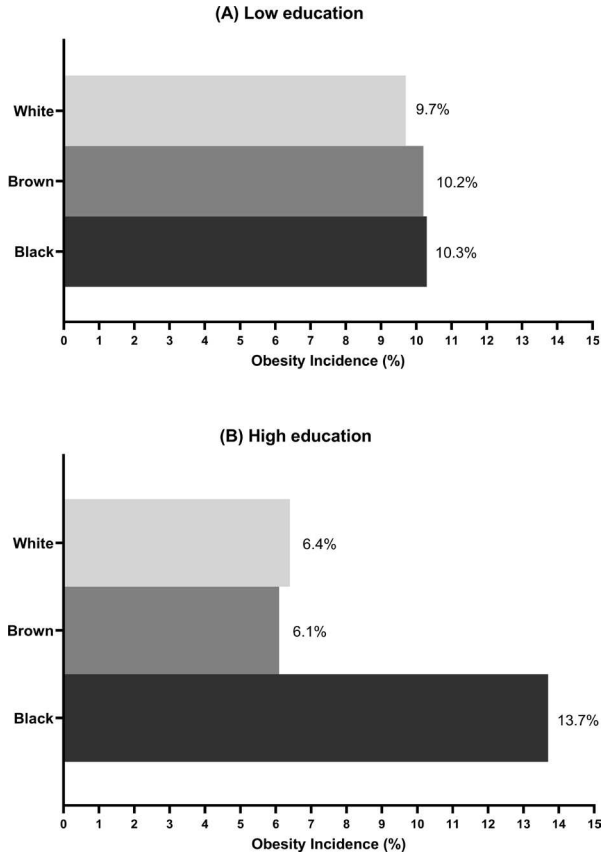

Figure 1 Obesity incidence according to race/skin colour stratified by educational level: low education (A) and high education (B) over 4-year follow-up. The Brazilian Longitudinal Study of Adult Health (ELSA-Brasil), 2008/2010–2012/2014, N=10 130. High education: university degree or more; low education: high school or less.

school or less). Risks were estimated using OR and 95% CIs. Univariate association between race/skin colour and obesity incidence (crude OR) was assessed first. Age, sex and research site were then included in the model (adjusted model). Analysis of associations between racial discrimination and obesity incidence, among brown and black individuals separately, was also conducted using crude and adjusted models (age, sex and research site). Adjustments were retained regardless of the p value.

Follow-up time of this cohort varied. Hence, sensitivity analysis was carried out to assess whether results would differ between individuals with follow-up shorter than 2 years or longer than 5 years and the study population overall.

Analyses were conducted using Stata V.14.0 software.

RESULTS

Median follow-up time was 3.9 years, with IQR of 3.5–4.1 years and varying from 1.7 to 6 years. Mean age of participants was 52 years and 55.7% self-declared white, 29.2% brown and 15.1% black. Most participants were women (53.0%) and had high education (university degree or more) (55.2%). Table 1 shows that the percentage of individuals with high education was lower among black (29.2%) and brown individuals (42.5%) than among white individuals (69%).

Perceived racial discrimination was more prevalent among black individuals (32.2%) compared with those with brown (5.8%) (table 1). Among black individuals, the prevalence of racial discrimination was higher in individuals with high education than those with low education (46.6% vs 26.3%), with much smaller prevalence and differences by educational group among Browns (low education: 6.1%; high education: 5.3%).

The obesity incidence after 4-year follow-up was 8.3%. Obesity incidence was higher in black and brown individuals relative to white individuals (11.3%, 8.5% and 7.4%, respectively; p value <0.001). Among white and brown individuals, the obesity incidence was higher in those with low education. However, among those with black skin, this incidence was higher in individuals with high education (figure 1).

After model adjustments, we found that the race/skin colour brown was not associated with the incidence of obesity either in the low education group or in the high education group. Yet, black race/skin colour was associated with greater chances of obesity (OR: 2.22; 95% CI 1.62 to 3.04) but only in the high education group (figure 2).

In brown and black individuals, regardless of educational level, we observed that obesity incidence was higher among those who reported racial discrimination (figure 3A,B). However, the obesity incidence gap between individuals who reported and did not report racial discrimination was more pronounced among individuals with low education both in those with brown and black skin (figure 3A,B).

After model adjustments, the exposure to racial discrimination remained statistically associated with higher chances of obesity only among black individuals with low education (OR: 1.64; 95% CI 1.08 to 2.51) (table 2). In individuals with brown skin, the association between racial discrimination and obesity incidence also seems to be higher among those with low education, but this association did not reach statistical significance (table 2).

Sensitivity analysis failed to reveal meaningful differences between the results reported for whole study population overall and the findings obtained following exclusion of individuals

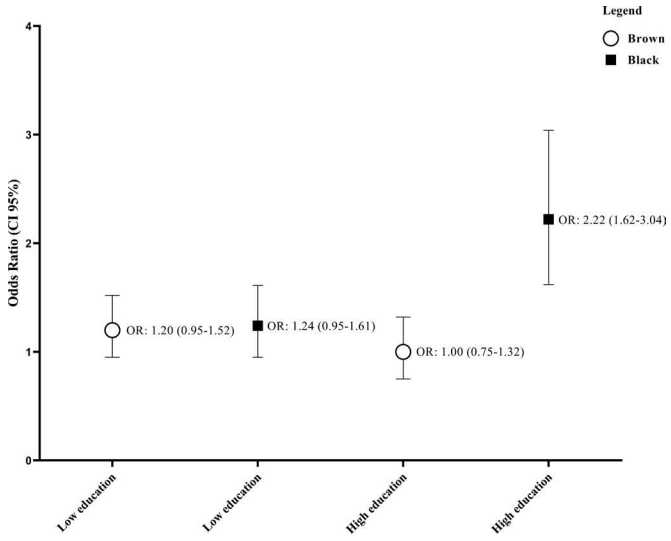

Figure 2 Association between race/skin colour and obesity incidence stratified by educational level (low and high) after 4-year follow-up. The Brazilian Longitudinal Study of Adult Health (ELSA-Brasil), 2008/2010–2012/2014, n=10 130. Notes: model adjusted for sex, age and research site. Reference category: self-declared White individuals for both strata (low and high educational level). High education: university degree or more; low education: high school or less.

with follow-up shorter than 2 years (n=1) or longer than 5 years (n=135).

DISCUSSION

In a large multiracial multicentre cohort of Brazilian civil servants, we observed a pronounced inequality between black and white individuals in the risk of developing obesity over the course of a 4-year follow-up. We also found that this black–white difference in the obesity incidence was modified by educational level, since it was observed only among those with high education. The obesity incidence was also higher among black individuals who reported racial discrimination relative to those not reporting similar experiences, being this association higher and statistically significant only among Blacks with low education. Participants self-declared Brown did not present difference in the obesity risk compared with those with white skin and, among those with brown skin, racial discrimination was also not statistically associated with obesity incidence.

As far as we know, studies investigating associations between race and obesity incidence in middle aged and older adults are lacking. Studies with adolescents and young adults[11–13] have also indicated higher obesity incidence in individuals with socially stigmatised race/skin colour (Blacks and Hispanics) compared with Whites. A Brazilian study investigating associations between race/skin colour and BMI gain (but not obesity incidence) in a cohort with similar sociodemographic features to the ELSA cohort has been published. In that study, mean BMI gain was higher in black and brown compared with white women after 8-year follow-up[15] but not in men. Differently from the present study, this previous study did not find an interaction between education and race/skin colour.

Mechanisms through which race/skin colour could lead to unequal distribution of obesity may be related to structural racism, a term describing the many ways racial discrimination is promoted within society.[34] Structural racism fosters

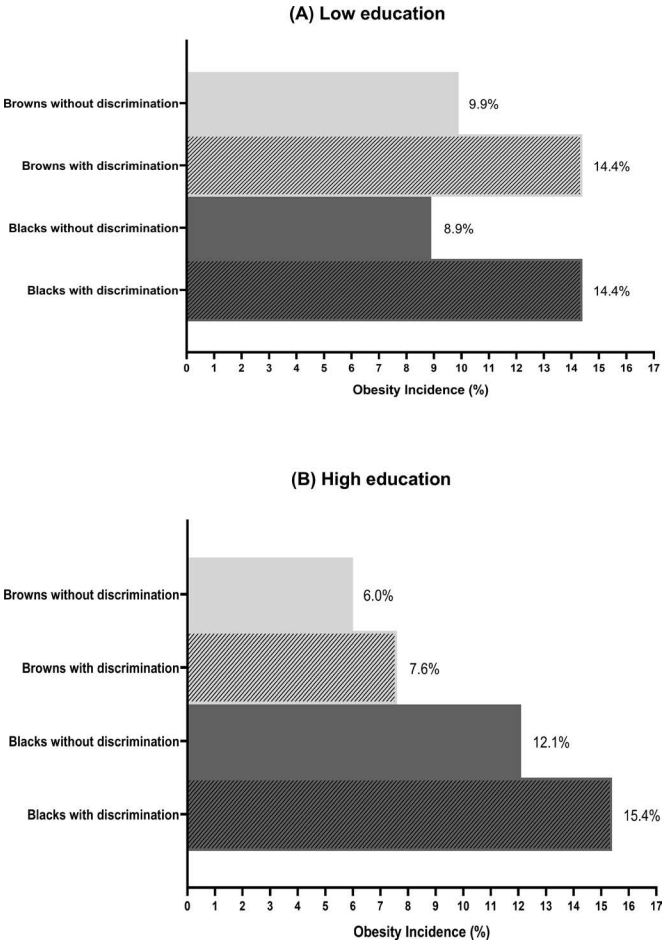

Figure 3 Obesity incidence according to racial discrimination among individuals brown and black stratified by educational level: low education (A) and high education (B) after 4-year follow-up. The Brazilian Longitudinal Study of Adult Health (ELSA-Brasil), 2008/2010–2012/2014, N=4490. High education: university degree or more; low education: high school or less.

discriminatory beliefs and values as well as unequal distribution of resources, giving rise to conditions that impact health, such as the establishment of a racist culture, chronic stress, disparities in access to employment opportunities, knowledge and social resources, and socioeconomic status, not to mention unfair treatment stemming from interpersonal racism.[6 34]

In the present study, we found that declaring themselves as black was associated with increased obesity risk, but only in the high education group. This finding is consistent with results from previous studies that show that the difference in self-perceived health between Whites and Blacks are more pronounced at higher socioeconomic levels.[24] Also, it seems that the health benefits resulting from higher socioeconomic levels are lower in black individuals when compared with white individuals.[23 24] Among the explanations for this phenomenon is a greater perception of social and economic inequalities experienced by black individuals as they ascend the social hierarchy.[24] In addition, in Brazil, black and brown individuals earn less than white individuals in all educational levels[35] and have lower income in all social classes (estimated through occupational classification).[36] Additionally, it is known that the perception of racial discrimination is also higher among individuals with higher levels of formal education than in those with less education.[32 33] This fact

Table 2 Association between racial discrimination and obesity incidence according to race/skin colour and education level over 4 years of follow-up of participants of the Brazilian Longitudinal Study of Adult Health (ELSA-Brasil), 2008–2010; 2012–2014

	OR (95% CI)			
	Brown		Black	
	High education† N=1258	Low education‡ N=1700	High education† N=447	Low education‡ N=1085
Model 0	1.28 (0.50 to 3.27)	1.53 (0.87 to 2.72)	1.32 (0.77 to 2.26)	**1.73 (1.14 to 2.60)****
Model 1	1.19 (0.46 to 3.10)	1,62 (0.90 to 2.90)	1.30 (0.75 to 2.26)	**1.64 (1.08 to 2.51)***

Model 0: unadjusted model.
Model 1: model 0+sex, age and research site.
*P<0.05, **p<0.01, ***p<0.001.
†University degree or more.
‡High school or less.

was also observed in the presented study since the prevalence of racial discrimination was 46.5% and 26.3% among black participants with high education and with low education, respectively.

This higher perception of racial discrimination among Blacks with higher education may be a consequence of greater awareness of unfair treatment and, therefore, tends to be more frequently reported among those with more education.[32] It is also noteworthy that there is a very small number of Blacks who occupy higher levels in the social hierarchy, which might induce the feeling of being 'out of place' among them, and increase their exposure to and perception of racial discrimination.[37] All of this has the potential to generate additional psychosocial stress among Blacks with high education, which could explain the effect of black race/skin colour on the incidence of obesity being greater and statistically significant only among individuals with high level of education.

This study revealed higher obesity incidence among black and brown individuals that reported racial discrimination compared with those who have not reported this experience. These results support existing evidence that experience of racial discrimination may be a significant factor in the relation between race/skin colour and obesity. This finding is also congruent with data from longitudinal North American studies conducted with women and reporting associations between racial discrimination and higher obesity incidence,[16] weight and waist circumference gain[17] in black women. In the Coronary Artery Risk Development in Young Adults Study (CARDIA), which included both sexes, racial discrimination was also associated with waist circumference and BMI gain, but only in black women.[18]

We also found, after stratifying the analyses by education, that the association between racial discrimination and obesity incidence was statistically significant only among black individuals with low education, since the obesity incidence gap between individuals according to racial discrimination was more pronounced among those with low education. To our knowledge, there is no previous study that evaluated the modification effect of educational level on the association between racial discrimination and obesity incidence, but a cross-sectional study with Australians demonstrated that the association between oral health impairment and racial discrimination was stronger among low socioeconomic groups, which is in accordance with our findings.[38] Our results are also in line with the intersectional theory, as there is evidence that individuals who are in more than one disadvantaged position (eg, woman, black, with low socioeconomic status) report higher levels of psychological distress, worse health and greater functional limitations.[39]

As regards physiological mechanisms, racial discrimination may increase the obesity risk through additional stress. Higher stress levels may trigger physiological, nervous, endocrine and immune adaptations with proinflammatory effects.[40] Increased cortisol levels in response to stress-induced hypothalamic–pituitary–adrenal axis hyperactivity is one such example.[19] High cortisol levels are also associated with chronic inflammation and may promote abdominal fat accumulation and increased appetite, including the desire for calorie-dense foods.[19]

We also investigated the association between race/skin colour and racial discrimination with obesity incidence among brown individuals, since the black–white binary division of race typical of societies, such as the USA, does not apply to racial classification in Brazil. In the last demographic census, 43.1% of Brazilian citizens self-declared brown and 7.6% black skin colour.[41] Despite sizeable socioeconomic differences between black and brown individuals in Brazil, these groups are relatively close and at great social disadvantage relative to white individuals.[42] In this study, the associations of race/skin colour and racial discrimination with obesity incidence was statically significant in Blacks, but not in Browns. The low prevalence of perceived racial discrimination in brown individuals (5.8%) may have prevented us from detecting a statistically significant association in this group. Besides, the Brazilian context is complex and paradoxical: on the one hand, Brown and black individuals share lower socioeconomic status and fewer opportunities as compared with Whites; on the other hand, brown individuals seem to experience comparatively less prejudice and racial discrimination than black or attribute perceived discrimination to other reasons, such as 'physical appearance' and/or socioeconomic status.[42] Likewise in a representative national study,[42] the prevalence of racial discrimination among brown individuals was 5.55 times lower compared with black individuals. Different from the USA, where racism is largely associated with ancestry,[43] racial discrimination in Brazil is strongly based on phenotype. Race reality perception in Brazil is therefore understandably different between brown and black individuals[44] and varies among brown individuals depending on the racial composition of the area of residence.[30] Self-declared brown individuals may also do so based on their own skin colour or that of their parents, with no affirmed black cultural identity, which may interfere with perception of experienced discrimination as racial discrimination.[44] Given the complexity of the racial discrimination phenomenon and cultural and historical features specific to Brazil, further studies are warranted for deeper understanding the different roles of racial discrimination in the development of obesity among brown and black individuals found in our study.

As far as we know, this is the first study to address associations between obesity incidence, race/skin colour and racial discrimination in Brazil. Lack of longitudinal studies investigating similar associations at the global level emphasises the relevance of this work. Large sample size and high statistical power, along with inclusion of individuals living in different regions of Brazil, are other strengths of this study. Furthermore, this analysis was adjusted for major known confounding factors. Finally, different from previous studies, analyses of associations between race/skin colour and obesity incidence were stratified by educational level, which added another layer in the explanation on the interrelationships between race and socioeconomic level.

Some limitations of this study must be emphasised. The ELSA-Brasil is not representative of Brazil as whole, as it comprises exclusively civil servants working at public higher education and research institutions. Hence, participants in this study have higher average income and education compared with the Brazilian population at large. Individuals with higher education may be more aware of unfair treatment.[32] However, a study conducted with a representative sample of the Brazilian population aged 16 years or older, detected much higher prevalence of racial discrimination over the life course compared with this cohort (41.1% vs 32.1%, 14.7% vs 5.7% and 7.5% vs 0.8%, in black, brown and white individuals, respectively).[42] Also, follow-up time may also have been too short to identify small statistical associations.

Findings of this study highlighted the size of racial inequality in obesity incidence appear to differ according to education. They also support existing evidence on the contribution of racial discrimination to increased obesity risk among black individuals, adding that this association is modified by level of education. The evidence accumulated so far shows that high levels of racial inequality must be accounted for in Brazilian strategies and policies aimed at obesity prevention and control, contributing to strengthening and promoting racial equity. Such policies and strategies may include affirmative actions, improved access to healthcare and better health services provision to black individuals.

What is already known on this subject

- Prevalence and incidence of obesity are higher among black and brown individuals.
- Racial discrimination may partially explain racial disparities in development of obesity, but studies are scarce.
- Racial discrimination has only recently began to be acknowledged and investigated in Brazil.

What this study adds

- There was a pronounced inequality between black and white individuals in obesity incidence after about 4-year follow-up.
- Black–white difference in the obesity incidence varied by educational level, being greater and statistically significant only among individuals with high education.
- Among black individuals, perceived racial discrimination increased the odds of obesity, but this association was only present among individuals with low education.

Correction notice This article has been corrected since it first published. The provenance and peer review statement has been included.

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Contributors AVM, LVC and SMB wrote the analysis plan and had the primary responsibility for data analysis and drafting the manuscript. DC, RHG, JMNG and LG 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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Competing interests None declared.

Patient consent for publication Not required.

Ethics approval ELSA-Brasil research protocol was approved by the Research Ethics Committee of Universidade de São Paulo (USP), Research Ethics Committee of Universidade Federal de Minas Gerais (UFMG), Research Ethics Committee of Fundação Oswaldo Cruz (FIOCRUZ), Research Ethics Committee of Universidade Federal do Espírito Santo (UFES), Research Ethics Committee of Universidade Federal da Bahia (UFBA), Research Ethics Committee of Universidade Federal do Rio Grande do Sul (UFRGS) and also by the National Research Ethics Committee (CONEP).

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available on reasonable request. The data used in this study are available for research proposal on request to the ELSA's Datacenter and to the ELSA's Publications Committee (publiELSA). Additional information can be obtained from the ELSA's Datacenter (estatisticaelsa@ufrgs.br) and from the ELSA Coordinator from the Research Center of Minas Gerais (sbarreto@medicina.ufmg.br).

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