

Social position and anthropometric status among adults in the ELSA-Brasil study: a latent class analysis

Posição social e estado antropométrico entre adultos no estudo ELSA-Brasil: uma análise de classes latentes

Posición social y estatus antropométrico entre adultos en el estudio ELSA-Brasil: un análisis de clase latente

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Abstract

The objective of the present study was to evaluate the association between social position and anthropometric status in women and men Brazilian adult. This was a cross-sectional study that used baseline data collected from 2008 to 2010 for the Brazilian Longitudinal Study of Adult Health (ELSA-Brasil, in Portuguese), in the six major Brazilian state capital cities. A total of 15,105 active and retired civil servants aged from 35 to 74 years. Two latent variables were defined by latent class analysis, social position and anthropometric status. Both constructs and the analyses were separately evaluated by sex. Associations were assessed using multivariate logistic regression analysis with adjustment for age, self-reported skin color/race, and marital status. Around 44% of the women and 26% of the men were classified as overweight or obese. Social position tended to be lower in women (43.2%) and higher among men (40.4%). Heavier women were more likely to be black and brown-skinned, whereas slimmer women were more likely to be white. After adjustment, women's weight increased as social position decreased (OR = 1.52; 95%CI: 1.36-1.70), whereas in men weight decreased as social position decreased (OR = 0.87; 95%CI: 0.76-0.99). Social position affected the anthropometric status of women and men differently, with body patterns also being affected by ethnicity/skin color, showing the potentiality of taking the intersectional perspective when investigating the possible social determinants of the phenomenon.

Overweight; Latent Class Analysis; Developing Countries

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Introduction

In recent decades, the prevalence of excess weight, including overweight and obesity, has increased rapidly worldwide, representing the fastest growing health issue among the risk factors for chronic non-communicable diseases ^{1,2}. Excess weight has been attributed to unhealthy diet and physical inactivity, and it is a known risk factor for cardiovascular diseases, diabetes, hypertension, hypercholesterolemia and asthma, among other health problems ^{1,3}. In Brazil, its prevalence has been increasing since 1974 ⁴, and it rose from 16% in 1974, to 54% in 2017 ⁵, although with regional differences.

Among the social determinants of the phenomenon, poorer schooling and lower income have been associated with a greater risk of accumulating excess weight ^{6,7,8,9}. Unfavorable socioeconomic conditions in childhood contribute to the presence of obesity in the future, either at preschool age ^{10,11}, adolescence ^{12,13,14} or adult life ¹⁰, with notable differences between the sexes ^{13,15,16} explained by social position. Moreover, low maternal education is associated with unfavorable health conditions related to overweight ¹⁷.

In low and middle-income countries, the social conditions are one of the factors that potentially contribute to overweight and obesity in different stages of life. For instance, financial stress was associated with higher levels of obesity in North-American adults ². In this population, low socioeconomic position in childhood was associated with obesity in adults ¹⁰. Also, in Europe, over the last few years, higher obesity levels were observed among individuals exposed to low socioeconomic position ^{3,18}.

In Brazil, data from the *Family Budget Survey* (POF, in Portuguese) revealed that the only Brazilian region that the prevalence of overweight on women has increased continuously from 1989 to 2008-2009 is the Northeast, one of the poorest regions of the country. In the other regions there was an interruption in the increased prevalence between 1989 and 2002-2003 ¹⁹. The growing incidence of overweight and obesity in women has also been registered in other low and middle-income countries, and excess weight is believed to contribute to increasing health inequalities ^{12,20}.

Nevertheless, the relationship between social position and excess weight is modified by sex if there is an inverse association between monthly income and schooling, and excess weight in women, the proportion of men with excess weight increases as these social indicators improve ^{6,21}. Consequently, the *Brazilian Telephone Survey on the Risk and Protective Factors for Chronic Diseases* (Vigitel, in Portuguese) showed that the frequency of excess weight in men with at least 12 years of schooling was 1.5 times greater (56.5%) than that found for women (36.1%) with the same education level. However, among women with less schooling, there was a greater percentage of overweight and obesity compared to men ^{22,23}.

Social position has been traditionally analyzed in epidemiological studies using proxy variables as occupation, family income and schooling, which are undeniably relevant, but first employment tended in their reflection of the construct complexity. The concept of social position is similar to the social class and social status, however, it is broader as it encompasses an individual's position in society and comprehends their occupation, income, social capital, and material possessions. Many initiatives have been tested, particularly in the metric disciplines, in an attempt to achieve a representation of the complex construct of social position ²⁴. In a review article, Cabieses et al. ²⁵ discussed the indicators most commonly used in the construction of sensitive approximations for the definition of social position, emphasizing the relevance of the development of multidimensional measures of social position. Because of the limitations of body mass index (BMI), as an imprecise method of measuring body adiposity ²⁶, the most used index to classify anthropometric status, alternative methods and indicators has been proposed to measure body adiposity and anthropometric status with more accuracy for the use in screening for cardiometabolic risk ^{26,27,28}. Therefore, we tried to apply the construct definition as part of analytical strategy to describe the anthropometric status. This allowed the association between social position and excess weight anthropometric status to be studied based on a different perspective.

This study aims to evaluate the association between social position and anthropometric status in Brazilian adults.

Methods

Study design and participants

Women and men aged 35-74 years were enrolled in the *Brazilian Longitudinal Study of Adult Health* (ELSA-Brasil, in Portuguese) between 2008 and 2010 to investigate the development of chronic diseases, cardiovascular diseases, and diabetes. Initially, a total of 15,105 active and retired civil servants from six universities and research institutions, dwelling in six major metropolitan areas (Salvador – Bahia State, Belo Horizonte – Minas Gerais State, Rio de Janeiro, São Paulo, Vitória – Espírito Santo State, and Porto Alegre – Rio Grande do Sul State) ^{29,30} were identified as being eligible for the study. The exclusion criteria were: current or recent pregnancy (within the four months preceding the first interview), intention to stop working at the local institution in the near future, severely impaired cognition or communication skills, and, if retired, residing in an area located outside the metropolitan area in which the local institution was situated ²⁹.

Data collection and measures

Participants were interviewed and examined by trained personnel under supervision, following rigorous quality control protocols ³¹. Standardized questionnaires were used to obtain demographic and socioeconomic data including: age, sex, self-reported skin color/ethnicity, education level (below secondary school level, completed secondary school, university/postgraduate education), household per capita income, marital status, and number of children, besides whether the individual was providing care for another family member, and if they had full-time housekeeping services at home.

All participants were asked about their first job. Moreover, the active civil servants were asked about their present work and the retired civil servants were asked about their last. The first work experience was used to classify participants according to social class, nature of occupation and social mobility based on the nature of occupation. Firstly, the socioeconomic classification of occupations was built according to Brazilian Classification of Occupations (CBO, in Portuguese), income and schooling. Scores of socioeconomic statuses of the occupations were calculated (mean between observed and expected income according to schooling). According to the scores produced, the socio-occupational strata were classified as upper-upper (highest educational level and highest income), upper-lower, middle-upper, middle-middle, lower-upper, lower-upper and lower-lower (lowest educational level and lowest income). This information was used together with income and education level to construct the following variables: social class and intergenerational social mobility ³⁰. Finally, these two variables were used to generate the social position as described below.

The weight, height, and waist circumference of all the participants were measured, with the individual in a standing position, barefoot and dressed in standardized clothing. Current weight was measured using a calibrated platform scale (Toledo 2096PP, Toledo do Brasil Ltda., Rio de Janeiro, Brazil) regulated to a precision of ± 0.1 kg, while height was measured to the nearest 0.1cm using a stadiometer (Seca-SE-216, Seca Brasil, São Paulo, Brazil). BMI was calculated as kg/m² and classified as underweight/normal weight (< 25kg/m²), overweight (25.0 to 29.9kg/m²) or obese (≥ 30 kg/m²). Abdominal obesity was evaluated by measuring waist circumference at the midpoint between the lower border of the ribs and the iliac crest using a non-stretchable tape measure (Mabis, Waukegan, United States) to the nearest 0.1cm (obesity was defined as ≥ 88 cm for women and ≥ 102 cm for men) ³². The hip circumference was measured at the maximal protrusion of the gluteus muscles to the nearest 0.1cm. The individual was considered to have android body fat distribution when their waist-to-hip ratio was ≤ 0.85 for women and ≤ 0.90 for men ³².

Data on leisure-time physical activity was obtained using the long form of the *International Physical Activity Questionnaire* (IPAQ) ³³. The individual was considered active if practicing strenuous or intense physical activity for ≥ 60 minutes per week or moderately strenuous physical activity for ≥ 150 minutes per week.

Routine food consumption over the previous 12 months was investigated using a validated 114-item *Food Frequency Questionnaire* (FFQ) and, analyzed by multiple correspondence and cluster analyses. Clusters of dietary patterns were investigated and four food frequency categories were defined in

accordance with those established for the ELSA-Brasil³⁴: (1) “traditional” (including beans and refined cereals); (2) “fruits and vegetables” (daily consumption of raw fruits and vegetables, grilled chicken and skimmed milk, with no consumption of red meat or beans); (3) “bakery products” (indicative of daily consumption of refined grains, cookies, bread, fried chicken, whole milk and no consumption of vegetables); (4) “low sugar/low fat” pattern (low-sugar/low-fat pattern with the consumption of whole grains).

Data analysis

Baseline data from the ELSA-Brasil were used. Two latent variables were defined by latent class analysis (LCA): social position (low/intermediate/high), addressing reported education level, income, social class, and intergenerational social mobility, and anthropometric status (slimmer/heavier), with the indicators being BMI, abdominal obesity and waist-to-hip ratio. The analyses were carried out separately for women and for men.

LCA, a methodology used to define the variables social position and anthropometric status, was proved adequate for the evaluation of variables that cannot be directly observed and that involve complex relationships. LCA has recently attracted the attention of the international scientific community in several fields of knowledge³⁵. The use of LCA allows for the association between social position and anthropometric status to be studied from a different perspective. LCA describes unobserved characteristics by modelling the observed response patterns of variables that capture the behavior of the construct of interest. Two parameters were examined for each latent variable: (a) class prevalence, which measured the proportion of individuals assigned to each latent class; and (b) the conditional probabilities (CP), i.e., the response patterns of the observed variables in a given latent class³⁶.

In LCA, selection of the optimal number of classes to characterize the data is based on different strategies, including an interpretation of the estimated conditional probabilities, or by using Akaike’s Information Criterion (AIC)³⁷, the Schwarz’s Bayesian Information Criterion (BIC), the sample-size-adjusted BIC^{38,39}, the Lo-Mendell-Rubin (LMR) likelihood ratio test, and bootstrap likelihood ratio test (BLRT). Entropy, which is related to a posteriori classification uncertainty, is one of the measures of model quality and values close to 1 indicate highly discriminatory classes⁴⁰. The conditional independence assumption was evaluated using bivariate residuals, the subjects were classified according to their most likely latent class membership, and the relationships between the factors of interest and anthropometric status were examined using logistic regression. The variable selection for the logistic regression model was primarily based on literature review. Among those variables, we included in the model those with the largest differences in their distribution between slimmer and heavier anthropometric status according to our data. Multivariate analyses were performed using logistic regression models to identify possible confounding factors (age, self-reported skin color/ethnicity, marital status, family caregivers, housemaid) and effect-modifying covariables (sex, leisure-time physical activity, food consumption, and number of children). The interaction was interpreted as a variable whose term of interaction in the complete model had a p-value ≤ 0.10 . The statistical criteria adopted to recognize confounding factors were based on a variation of at least 10% in the measurement of the principal association when the crude odds ratio (OR) was compared with the adjusted OR. LCA was conducted using Mplus 7.3 (<https://www.statmodel.com/>), with all the other analyses being conducted using Stata 12 (<https://www.stata.com>).

All individuals who agreed to participate in the study signed an informed consent form. The Institutional Review Boards of the six participating institutes evaluated and approved the ELSA-Brasil protocol.

Results

The latent variables were defined based on an analysis of 8,218 women and 6,887 men. For this study, 531 (3.5%) individuals of indigenous or oriental ancestry were excluded due to their small representation. Only 1.22% was excluded by missing data. The final analyses comprised 14,389 participants, 7,822 women and 6,567 men.

Most women and men were aged from 45 to 54 years (39.6% and 39.1%, respectively), more than 50% self-reported as white (skin color/ethnicity), with most being married or in a stable union and without a housemaid. Women were more likely than men to be caregivers, 23.5% of them had no children, and their social position was more likely to be low (43.1%) as opposed to high (32.7%). Most men were married or in a stable relationship and had three or more children, while 25% reported performing vigorous physical activity in their leisure time (Table 1).

When the women were compared as a function of anthropometric status, heavier women were more likely to be black and brown-skinned and slimmer women were more likely to be white. In marital status, most of the heavier individuals were in the group of women divorced and among those who report “fruit and vegetables” dietary pattern. Conversely, the group of heavier men were more likely to report “bakery products” dietary pattern. Regarding the results to social position latent variable, the heavier women were more likely to be “intermediate” social position and the men in “high” social position. One-third of the women considered “heavier” reported practicing vigorous physical activity during their leisure time, however, this activity was most common among men classified as “slimmer” (83.3%) (Table 1).

Table 1

Sociodemographic and socioeconomic characteristics, diet and physical activity of study participants at baseline. *Brazilian Longitudinal Study of Adult Health (ELSA-Brasil), 2008-2010.*

Characteristic	Overall		Women (n = 4,574)				Overall		Men (n = 5,101)			
	n *	%	Slimmer		Heavier		n *	%	Slimmer		Heavier	
			n	%	n	%			n	%	n	%
Age (years)												
35-44	1,779	21.6	1,213	26.5	566	15.5	1,561	22.7	1,264	24.8	297	16.6
45-54	3,256	39.6	1,866	40.8	1,390	38.2	2,683	39.1	2,000	39.2	683	38.3
55-64	2,379	29.0	1,164	25.4	1,215	33.3	1,855	26.9	1,306	25.6	549	30.7
65-74	804	9.8	331	7.3	473	13.0	788	11.4	531	10.4	257	14.4
Self-reported skin color/ethnicity												
White	4,192	51.5	2,497	55.1	1,695	47.1	3,599	53.0	2,579	51.2	1,020	58.1
Black	1,456	17.9	670	14.8	786	21.8	941	13.9	718	14.3	223	12.7
Brown	2,175	26.8	1,160	25.6	1,015	28.2	2,027	29.9	1,554	30.9	473	26.9
Marital status												
Divorced	1,781	21.7	943	26.0	838	29.9	670	9.7	514	11.1	156	9.7
Married or in a stable union	4,351	53.0	2,496	68.8	1,855	66.1	5,633	81.8	4,131	90.0	1,502	92.2
Single	1,185	14.4	702	19.3	483	17.2	360	5.2	284	6.2	76	4.8
Widowed	546	6.6	228	6.3	318	11.4	83	1.3	63	1.4	20	1.3
Other	354	4.3	204	5.6	150	5.3	141	2.0	109	2.3	32	2.0
Family caregivers												
No	7,328	89.3	4,136	90.6	3,192	87.6	6,296	91.5	4,659	91.4	1,637	91.9
Yes	880	10.7	430	9.4	450	12.4	582	8.5	437	8.6	145	8.1
Housemaid												
No	6,098	74.2	3,297	72.1	2,801	76.9	5,247	76.2	3,941	77.3	1,306	73.1
Yes	2,120	25.8	1,277	27.9	843	23.1	1,639	23.8	1,159	22.7	480	26.9
Number of children												
None	1,928	23.5	1,191	26.1	737	20.2	1,033	15.0	809	15.9	224	12.5
1 or 2	4,471	54.4	2,567	56.1	1,904	52.3	3,542	51.4	2,665	52.2	877	49.1
3 or more	1,819	22.1	816	17.8	1,003	27.5	2,312	33.6	1,627	31.9	685	38.4

(continues)

Table 1 (continued)

Characteristic	Women						Men					
	Overall		Slimmer (n = 4,574)		Heavier (n = 3,644)		Overall		Slimmer (n = 5,101)		Heavier (n = 1,786)	
	n *	%	n	%	n	%	n *	%	n	%	n	%
Dietary pattern												
Fruits and vegetables	2,526	30.8	1,380	30.2	1,146	31.5	1,324	19.3	958	18.8	366	20.6
Bakery products	1,570	19.2	796	17.5	774	21.3	2,112	30.7	1,578	31.0	534	30.0
Traditional	3,628	44.2	2,075	45.5	1,553	42.7	3,262	47.4	2,413	47.3	849	47.7
Low sugar/Low fat	472	5.8	308	6.8	164	4.5	177	2.6	147	2.9	30	1.7
Vigorous or intense leisure time physical activity (minutes per week)												
≥ 60	1,318	16.3	906	20.2	412	11.4	1,780	26.2	1,482	29.5	298	16.9
< 60	6,778	83.7	3,584	79.8	3,194	88.6	5,008	73.8	3,546	70.5	1,462	83.1
Social position latent variable												
High	2,684	32.7	1,680	36.7	1,004	27.6	2,786	40.5	1,996	39.1	790	44.2
Intermediate	1,985	24.2	1,150	25.1	1,805	49.5	1,372	19.9	2,065	40.5	664	37.2
Low	3,549	43.1	1,744	38.2	835	22.9	2,729	39.6	1,040	20.4	332	18.6

* Total N = 15,105. Values are missing for some of the variables producing small differences.

Note: data are show according to sex, both overall and by the latent variable anthropometric status. Social class coded for the 13,746 participants for whom that information was available. Intergenerational social mobility for the 12,734 participants for whom this information was available.

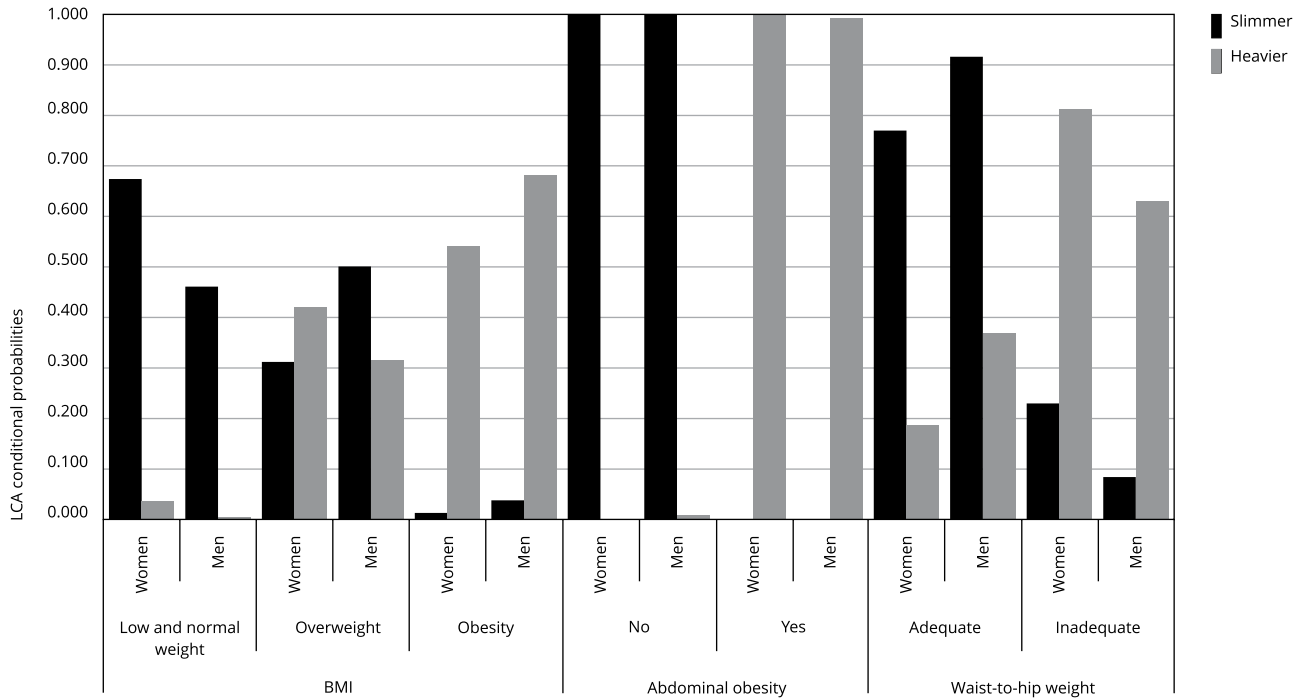
We described anthropometric latent status by the classes named “slimmer” and “heavier” defined separately for women and men (Figure 1). These latent classes were characterized based on their CP, which implies specific response patterns for each of the classes. Therefore, “slimmer” individuals were more likely to have low or normal weight (women CP = 0.674 and men CP = 0.461), absence of abdominal obesity (women CP = 1.000 and men CP = 1.000) and adequate waist-to-hip ratio (women CP = 0.770 and men CP = 0.916). The “heavier” individuals were more likely to be overweight (women CP = 0.421 and men CP = 0.316) or be obese (women CP = 0.542 and men CP = 0.681), with presence of abdominal obesity (women CP = 1.000 and men CP = 0.992) and inadequate waist-to-hip (women CP = 0.812 and men CP = 0.631). About 44% of women and 26% of men were classified as being in the “heavier” profile.

The social position latent classes were named as “high”, “intermediate”, or “low” (Figure 2). Individuals in the “high” social position were characterized by being more likely to have finished college or have a graduate degree (women CP = 0.998 and men CP = 1.000), with higher per capita income (women CP = 0.689 and men CP = 0.729), high social class (women CP = 0.773 and men CP = 0.864) and ascending intergenerational social mobility (women CP = 0.745 and men CP = 0.797). Whereas individuals in the “intermediate” social position includes those with college/graduate degree or high school (women CP = 0.633 and men CP = 0.377), middle per capita income (women CP = 0.852 and men CP = 0.856), middle social class (women CP = 0.912 and men CP = 0.773) and ascending intergenerational social mobility (women CP = 0.799 and men CP = 0.906). On the other hand, individuals in the “low” social position failed to complete high school (women CP = 0.653 and men CP = 0.550), have middle per capita income (women CP = 0.724 and men CP = 0.720), low social class (women CP = 1.000 and men CP = 1.000), and descending/stable intergenerational social mobility (women CP = 0.241 and men CP = 0.426).

The estimated effect of social position on the latent variable anthropometric status was analyzed according to sex, because in literature the relationship between social position and excess weight is modified by sex, with a significantly positive association found among women (OR = 1.73; 95%CI: 1.56-1.92), whereas the inverse was true for men (OR = 0.81; 95%CI: 0.72-0.91) (Table 2). According to the unadjusted analysis, women with low social position were 73% more likely (95%CI: 1.56-1.92) to be classified as heavier comparing with those in high social position. Furthermore, women with

Figure 1

Conditional probabilities regarding the latent class analysis (LCA) model for the anthropometric status construct by sex. *Brazilian Longitudinal Study of Adult Health (ELSA-Brasil), 2008-2010.*



BMI: body mass index.

intermediate social position were 21% more likely to be classified as “heavier” (95%CI: 1.08-1.37). Following adjustment for age, self-reported skin color/ethnicity and marital status, this positive association decreased only among women in low social position (OR = 1.52; 95%CI: 1.36-1.70). However, the opposite occurred for men, with those in low social position having a 19% lesser likelihood of being heavier (95%CI: 0.72-0.91) compared to men in high social position, with the association remaining significant (OR = 0.87; 95%CI: 0.77-0.99) after adjustment for age, self-reported skin color/ethnicity and marital status. Statistical significance was lost following adjustment only in the group of men in intermediate social position (Table 2).

In both women and men, evaluation of the interaction failed to confirm any modifiers effects from among the various possible variables, whereas age, self-reported skin color/ethnicity and marital status were shown to be a confounder of the associations.

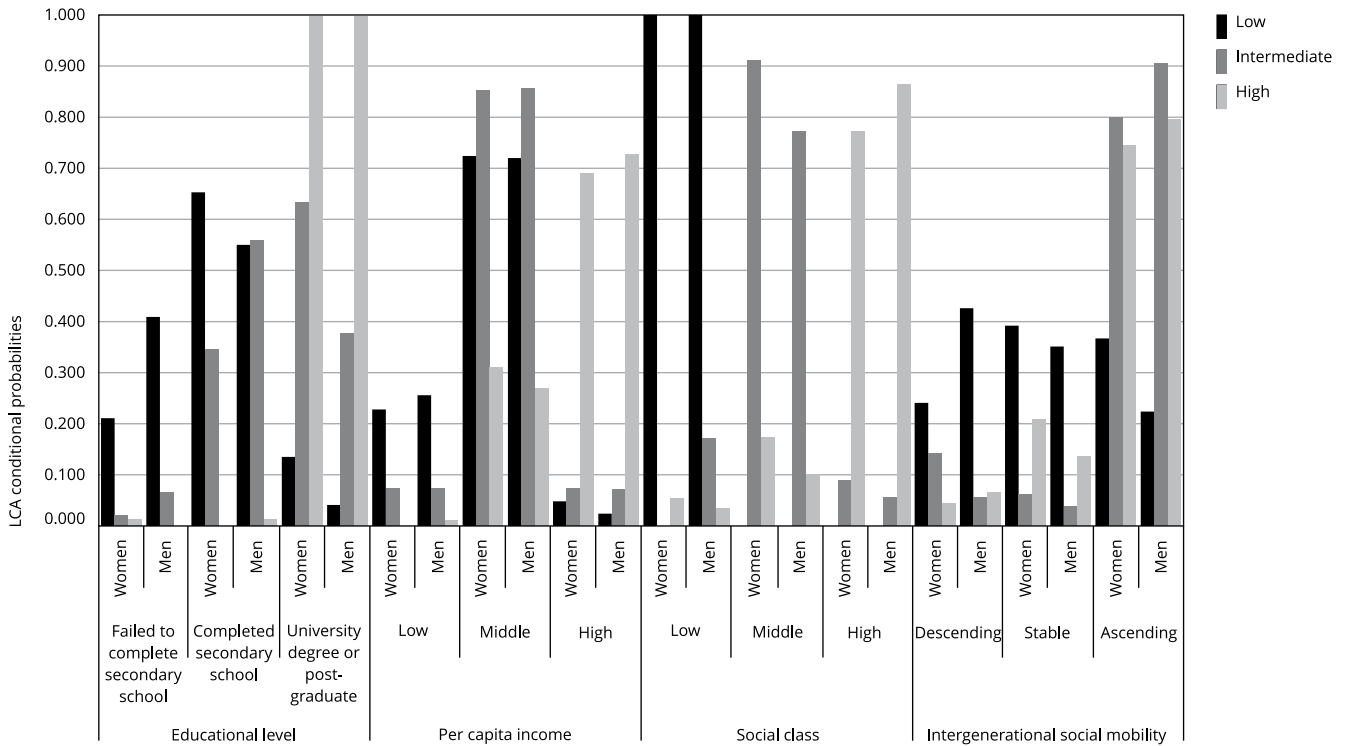
Discussion

The results of this study agrees with the literature, showing an association between excess weight and social position ^{6,7,8,9,17}, although modified by sex, here a proxy for gender. Specifically among women, the lower the social position, the higher the excess weight, especially brown-skinned and black individuals. On the other hand, in male individuals, the lower the social position, the lower the excess weight.

Other authors have also demonstrated the association between social position and excess weight only in women, and the opposite among men ²¹. Based on these results, it becomes clear that obe-

Figure 2

Conditional probabilities regarding the latent class analysis (LCA) model for the social position construct by sex. *Brazilian Longitudinal Study of Adult Health (ELSA-Brasil)*, 2008-2010.

**Table 2**

Estimated effect of the social position on the anthropometric status according to sex. *Brazilian Longitudinal Study of Adult Health (ELSA-Brasil)*, 2008-2010.

	Women		Men	
	OR	95%CI	OR	95%CI
Crude				
Social position				
High	1.00	-	1.00	-
Intermediate	1.21	1.08-1.37	0.81	0.69-0.94
Low	1.73	1.56-1.92	0.81	0.72-0.91
Adjusted *				
Social position				
High	1.00	-	1.00	-
Intermediate	1.31	1.15-1.48	0.94	0.80-1.10
Low	1.52	1.36-1.70	0.87	0.76-0.99

95%CI: 95% confidence interval; OR: odds ratio.

* Adjusted for age, self-reported skin color/race and marital status.

sity cannot be considered exclusive of groups with better social position. Likewise, attributing the increase in its occurrence to changes in lifestyle resulting exclusively from the increase in the mean income of Brazilians^{41,42} is a simplified interpretation of a complex phenomenon. Therefore, this interpretation must consider the social context and gender aspects across study population.

Regarding ethnicity/skin color, compared to men, twice as many black and brown-skinned women were classified as “heavier”. The factor represented by parity may be contributing to this finding, since a higher proportion of white women were nulliparous (25.2%), and a fewer (18.3%) had three or more children. Black women were also more likely (66.1%) to fall into the lower socioeconomic construct compared to white women (31.5%) and brown-skinned women (51.3%) (data not shown). These findings are in agreement with the results of other studies, showing that the social position of black women was more likely to be low and they were more likely to be obese^{43,44} or to undergo greater increases in BMI over time⁴⁵. The literature has shown that in population groups at a greater social disadvantage and residents of areas with high rates of inequity, the likelihood of excess weight is particularly high among women¹³.

Furthermore, restricting interpretation of the growth in obesity rates in women to biological specificities⁴⁶ is not supported by current findings in view of the differences found as a function of social position. For example, parity and the menopause are female factors that evidently need to be considered. In developed countries, adiposity in the postmenopausal period is known to be associated with greater parity, as found in the *Million Women Study* in which BMI was 1.7kg/m² greater in women with four or more children⁴⁶. In Brazilian women of reproductive age, excess weight was dependent on pre-pregnancy BMI⁴⁷ and was associated with multiparity^{48,49}. In the ELSA-Brasil, only 23.5% of the women were nulliparous and it was precisely those women who were most likely to be classified as “slimmer” (61.8%) (data not shown). As expected, no difference in anthropometric status was found for the men adjusted for the number of children they had. Multiparity as an etiological factor of obesity is associated primarily with the physiological alterations that occur during pregnancy, and the postnatal period that predispose the woman to the accumulation of body fat. The deposition of abdominal fat postpartum is associated with changes in lipid metabolism⁵⁰. However, motherhood leads to profound changes in the daily life of Brazilian women, resulting from gender inequalities in caring for the house and the family⁵¹. There is evidence that the responsibility for caring for ill relatives or for individuals with special needs reduces women’s ability to engage in leisure time physical activities and to get around⁵². The conflict between the demands made by work and family and having less time to spend looking after themselves is associated with an increase in overweight and obesity in women⁵³.

On the other hand, in this analysis the factors that maintained men and women with different anthropometric conditions in the group of those with the highest social position may be associated with cultural differences in their self-evaluation of body image⁵⁴. Studies on cognitive distortions of body image have shown that white women are more dissatisfied with their body image than black men and women⁵⁵. The quest for thinness is more common in women, since they feel pressured to fit a socially constructed standard that is disseminated in the media and in social relationships⁵⁵.

The strongpoints of the present study include the large sample size and the use of measurements directly verified by trained, certified interviewers using extremely rigorous methodology, and the standardization and normalization of the procedures across all the centres³¹. The use of LCA in the composition of the constructs, which included variables commonly analyzed as single domains, allowed social position to be examined in greater complexity. The use of constructs obtained through LCA is one of the strengths of this study, as this type of analysis allows participants to be classified into mutually exclusive groups taking variables that are difficult to measure directly, such as social position, into consideration concomitantly. However, analyses conducted to evaluate the association between the constructs were performed without taking measurement errors of the latent variables into consideration, which could potentially underestimate the effects evaluated^{56,57}.

There is a possibility that some confounding factor could still be present in the results and the absence of reverse causality cannot be discarded, although social position includes the variable inter-generational social mobility, that precedes, temporally, the current anthropometric status. It should also be noted that it is not possible to rule out information bias, such as memory, especially the one about the first work. Moreover, the sample included in the ELSA-Brasil is not a representation of the Brazilian population that are voluntary civil servants with stable jobs, meaning that the results cannot

be extrapolated to the general population. It is important to emphasize this possible limitation in our analyses with respect to absence of groups at the extreme ends of the spectrum in this sample, such as the very rich and the very poor groups. Therefore, it is possible that the magnitude of the associations between social position and anthropometric status could be greater. However, these results are in agreement with findings from major nationwide studies conducted with samples that are indeed a representation of the Brazilian population.

In conclusion, the results reported here suggest that social position has a different effect on the anthropometric status of women and men, with a possible effect of skin color/ethnicity determining body patterns. Analyzing the variations between women and men, considering the question of gender in the interpretation of findings, enriches rationalization of the problem under investigation and supplies subsidies for the elaboration of policies and actions that would be more appropriate for its control. In Brazil and in countries with similar characteristics, these results could be useful for the elaboration of policies aimed at promoting health by focusing on different aspects of weight control for women and for men. Public health interventions should incorporate strategies designed to inhibit the obesity considering racial/ethnic inequality and gender differences. Further longitudinal studies should be conducted to attempt to explain the association between social position and anthropometric status from an inter-sectional perspective, considering skin color/ethnicity and sex.

Contributors

S. M. A. Matos and L. D. A. F. Amorim contributed in the acquisition, analysis and interpretation of the data, writing, and critical review of the manuscript. F. J. G. Pitanga, A. P. Patrão and L. O. Cardoso contributed in the analysis and interpretation of the data and critical review of the manuscript. S. M. Barreto, D. Chor, M. C. B. Molina, M. L. Barreto and E. M. L. Aquino participated in the conception and design of the research, acquisition of data and critical review of the manuscript.

Additional informations

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References

1. World Health Organization. Non communicable diseases country profiles. Geneva: World Health Organization; 2014.
2. Brahmbhatt M. Social and physical determinants of obesity in adults. *Adv Obesity Weight Manag Control* 2017; 6:17-23.
3. Hoebel J, Kuntz B, Kroll LE, Schienkiewitz A, Finger JD, Lange C, et al. Socioeconomic inequalities in the rise of adult obesity: a time-trend analysis of national examination data from Germany, 1990-2011. *Obes Facts* 2019; 12:344-56.
4. Instituto Brasileiro de Geografia e Estatística. Estudo Nacional da Despesa Familiar – ENDEF. Rio de Janeiro: Instituto Brasileiro de Geografia e Estatística; 1977.
5. Secretaria de Vigilância à Saúde, Ministério da Saúde. *Vigitel 2017: Vigilância de Fatores de Risco e Proteção para Doenças Crônicas por Inquérito Telefônico*. Brasília: Ministério da Saúde; 2018.
6. Gigante DP, Victora CG, Matijasevich A, Horta BL, Barros FC. Association of family income with BMI from childhood to adult life: a birth cohort study. *Public Health Nutr* 2013; 16:233-9.
7. Faeh D, Braun J, Bopp M. Prevalence of obesity in Switzerland 1992-2007: the impact of education, income and occupational class. *Obes Rev* 2011; 12:151-66.
8. Vernay M, Malon A, Oleko A, Roudier C, Sze-go E, Deschamps V, et al. Association of socioeconomic status with overall overweight and central obesity in men and women: the French Nutrition and Health Survey 2006. *BMC Public Health* 2009; 9:215.

9. Kamphuis CBM, Oude Groeniger J, Poelman MP, Beenackers MA, Van Lenthe FJ. How does bridging social capital relate to health-behavior, overweight and obesity among low and high educated groups? A cross-sectional analysis of GLOBE-2014. *BMC Public Health* 2019; 19:1635.
10. Cameron AJ, Spence AC, Laws R, Hesketh KD, Lioret S, Campbell KJ. A review of the relationship between socioeconomic position and the early-life predictors of obesity. *Curr Obes Rep* 2015; 4:350-62.
11. Goodell LS, Wakefield DB, Ferris AM. Rapid weight gain during the first year of life predicts obesity in 2-3 year olds from a low-income, minority population. *J Community Health* 2009; 34:370-5.
12. Monteiro CA, Conde WL, Lu B, Popkin BM. Obesity and inequities in health in the developing world. *Int J Obes Relat Metab Disord* 2004; 28:1181-6.
13. Monteiro CA, Moura EC, Conde WL, Popkin BM. Socioeconomic status and obesity in adult populations of developing countries: a review. *Bull World Health Organ* 2004; 82:940-6.
14. Bann D, Johnson W, Li L, Kuh D, Hardy R. Socioeconomic inequalities in childhood and adolescent body-mass index, weight, and height from 1953 to 2015: an analysis of four longitudinal, observational, British birth cohort studies. *Lancet Public Health* 2018; 3:e194-203.
15. Chor D, Andreozzi V, Fonseca MJM, Cardoso LO, James SA, Lopes CS, et al. Social inequalities in BMI trajectories: 8-year follow-up of the Pró-Saúde study in Rio de Janeiro, Brazil. *Public Health Nutr* 2015; 18:3183-91.
16. Subramanian SV, Perkins JM, Emre O, Smith GD. Weight of nations: a socioeconomic analysis of women in low- to middle-income countries. *Am J Clin Nutr* 2011; 93:413-21.
17. Coelho DM, Camelo LV, Giatti L, Chor D, Guimarães JMN, Mill JG, et al. Racial differences in the association between early socioeconomic position, birth weight, and arterial stiffness in adults from ELSA-Brasil. *Ann Epidemiol* 2019; 34:45-51.
18. Rasmussen M, Damsgaard MT, Morgen CS, Kierkegaard L, Toftager M, Rosenwein SV, et al. Trends in social inequality in overweight and obesity among adolescents in Denmark 1998-2018. *Int J Public Health* 2020; 65:607-16.
19. Instituto Brasileiro de Geografia e Estatística. Pesquisa de Orçamentos Familiares 2008-2009. Rio de Janeiro: Instituto Brasileiro de Geografia e Estatística; 2011.
20. Mitchell S, Shaw D. The worldwide epidemic of female obesity. *Best Pract Res Clin Obstet Gynaecol* 2015; 29:289-99.
21. Pradeilles R, Griffiths PL, Norris SA, Feeley AB, Rousham EK. Socio-economic influences on anthropometric status in urban South African adolescents: sex differences in the Birth to Twenty Plus Cohort. *Public Health Nutr* 2015; 18:2998-3012.
22. Secretaria de Vigilância à Saúde, Ministério da Saúde. Vigitel 2014: Vigilância de Fatores de Risco e Proteção para Doenças Crônicas por Inquérito Telefônico. Brasília: Ministério da Saúde; 2015.
23. Ferreira RAB, Benicio MHD'A. Obesidade em mulheres brasileiras : associação com paridade e nível socioeconômico. *Rev Panam Salud Pública* 2015; 37:337-42.
24. Muntaner C, Rocha KB, Borrell C, Vallebuona C, Ibáñez C, Benach J, et al. Clase social y salud en América Latina. *Rev Panam Salud Pública* 2012; 31:166-75.
25. Cabieses B, Zitko P, Pinedo R, Espinoza M, Albor C. ¿Cómo se ha medido la posición social en investigación en salud? Una revisión de la literatura internacional. *Rev Panam Salud Pública* 2011; 29:457-68.
26. Bergman RN, Stefanovski D, Buchanan TA, Sumner AE, Reynolds JC, Sebring NG, et al. A better index of body adiposity. *Obesity (Silver Spring)* 2011; 19:1083-9.
27. Almeida RT, Pereira AC, Fonseca MJM, Matos SMA, Aquino EML. Association between body adiposity index and coronary risk in the Brazilian Longitudinal Study of Adult Health (ELSA-Brasil). *Clin Nutr* 2020; 39:1423-31.
28. Eickemberg M, Amorim LDF, Almeida MCC, Pitanga FJG, Aquino EML, Fonseca MJM, et al. Obesidade abdominal no ELSA-Brasil: construção de padrão-ouro latente e avaliação da acurácia de indicadores diagnósticos. *Ciênc Saúde Colet* 2020; 25:2985-98.
29. Aquino EML, Barreto SM, Bensenor IM, Carvalho MS, Chor D, Duncan BB, et al. Brazilian Longitudinal Study of Adult Health (ELSA-Brasil): objectives and design. *Am J Epidemiol* 2012; 175:315-24.
30. Schmidt MI, Duncan BB, Mill JG, Lotufo PA, Chor D, Barreto SM, et al. Cohort profile: Longitudinal Study of Adult Health (ELSA-Brasil). *Int J Epidemiol* 2015; 44:68-75.
31. Schmidt MI, Griep RH, Passos VM, Luft VC, Goulart AC, Menezes GMS, et al. Estratégias e desenvolvimento de garantia e controle de qualidade no ELSA-Brasil. *Rev Saúde Pública* 2013; 47 Suppl 2:105-12.
32. World Health Organization. Waist circumference and waist-hip ratio. Geneva: World Health Organization; 2008.
33. Matsudo S, Araújo T, Matsudo V, Andrade D, Andrade E, Oliveira LC, et al. Questionário internacional de atividade física (Ipaq): estudo de validade e reprodutibilidade no Brasil. *Rev Bras Ativ Fis Saúde* 2001; 6:5-18.
34. Cardoso LO, Carvalho MS, Cruz OG, Melerle C, Luft VC, Molina MDCB, et al. Eating patterns in the Brazilian Longitudinal Study of Adult Health (ELSA-Brasil): an exploratory analysis. *Cad Saúde Pública* 2016; 32e00066215.
35. Zhang X, van der Lans I, Dagevos H. Impacts of fast food and the food retail environment on overweight and obesity in China: a multilevel latent class cluster approach. *Public Health Nutr* 2012; 15:88-96.

36. Collins LM, Lanza ST. Latent class and latent transition analysis: with applications in the social, behavioral, and health sciences. Hoboken: John Wiley & Sons; 2010. (Wiley Series in Probability and Statistics).
37. Akaike H. Factor analysis and AIC. *Psychometrika* 1987; 52:317-32.
38. Schwarz G. Estimating the dimension of a model. *Ann Stat* 1978; 6:461-4.
39. Sclove SL. Application of model-selection criteria to some problems in multivariate analysis. *Psychometrika* 1987; 52:333-43.
40. Muthén LK, Muthén BO. Mplus user's guide. Los Angeles: Muthén & Muthén; 2007.
41. Batista Filho M, Risin A. A transição nutricional no Brasil: tendências regionais e temporais. *Cad Saúde Pública* 2003; 19 Suppl 1:S181-91.
42. Kain J, Vio F, Albala C. Obesity trends and determinant factors in Latin America. *Cad Saúde Pública* 2003; 19 Suppl 1:S77-86.
43. James SA, Fowler-Brown A, Raghunathan TE, Van Hoewyk J. Life-course socioeconomic position and obesity in African American women: the Pitt County Study. *Am J Public Health* 2006; 96:554-60.
44. Baltrus PT, Lynch JW, Everson-Rose S, Raghunathan TE, Kaplan GA. Race/ethnicity, life-course socioeconomic position, and body weight trajectories over 34 years: the Alameda County Study. *Am J Public Health* 2005; 95:1595-601.
45. Krishna A, Razak F, Lebel A, Smith GD, Subramanian SV. Trends in group inequalities and interindividual inequalities in BMI in the United States, 1993-2012. *Am J Clin Nutr* 2015; 101:598-605.
46. Bobrow KL, Quigley MA, Green J, Reeves GK, Beral V. Persistent effects of women's parity and breastfeeding patterns on their body mass index: results from the Million Women Study. *Int J Obes* 2013; 37:712-7.
47. Coitinho DC, Sichieri R, Benicio MHD'A. Obesity and weight change related to parity and breast-feeding among parous women in Brazil. *Public Health Nutr* 2001; 4:865-70.
48. Rodrigues MLCF, Costa THM. Association of the maternal experience and changes in adiposity measured by BMI, waist: hip ratio and percentage body fat in urban Brazilian women. *Br J Nutr* 2001; 85:107-14.
49. Gravena AF, Brischiliari SCR, Lopes TCR, Agnolo CMD, Carvalho MDB, Pelloso SM. Excess weight and abdominal obesity in postmenopausal Brazilian women: a population-based study. *BMC Womens Health* 2013; 13:46.
50. Lassek WD, Gaulin SJC. Changes in body fat distribution in relation to parity in American women: A covert form of maternal depletion. *Am J Phys Anthropol* 2006; 131:295-302.
51. Madalozzo R, Martins SR, Shiratori L. Participação no mercado de trabalho e no trabalho doméstico: homens e mulheres têm condições iguais? *Revista Estudos Feministas* 2010; 18:547-66.
52. Pitanga FJ, Matos SM, Almeida MC, Molina MC, Aquino EM. Factors associated with leisure time physical activity among ELSA-Brasil participants: ecological model. *Prev Med* 2016; 90:17-25.
53. Pinto KA, Griep RH, Rotenberg L, Almeida MCC, Barreto RS, Aquino EML. Gender, time use and overweight and obesity in adults: results of the Brazilian Longitudinal Study of Adult Health (ELSA-Brasil). *PLoS One* 2018; 13:e0194190.
54. Demarest J, Allen R. Body image: gender, ethnic, and age differences. *J Soc Psychol* 2000; 140:465-72.
55. Winter VR, Danforth LK, Landor A, Pevehouse-Pfeiffer D. Toward an understanding of racial and ethnic diversity in body image among women. *Soc Work Res* 2019; 43:69-80.
56. Asparouhov T, Muthén B. Auxiliary variables in mixture modeling: three-step approaches using Mplus. *Struct Equ Modeling* 2014; 21:329-41.
57. Lanza ST, Tan X, Bray BC. Latent class analysis with distal outcomes: a flexible model-based approach. *Struct Equ Modeling* 2013; 20:1-26.

Resumo

O objetivo do estudo foi avaliar a associação entre posição social e o estado antropométrico em brasileiros adultos de ambos os sexos. O estudo transversal usou dados coletados entre 2008 e 2010 pelo Estudo Longitudinal de Saúde do Adulto (ELSA-Brasil), nas seis maiores capitais brasileiras. Um total de 15.105 funcionários públicos, ativos e aposentados, de ambos os sexos, entre 35 e 74 anos de idade. Duas variáveis latentes foram definidas pela análise de classes latentes: posição social e estado antropométrico. Os construtos e análises foram avaliados separadamente por sexo. As associações foram avaliadas com o uso de análise de regressão logística multivariada, ajustada para idade, cor/raça e estado civil. Em torno de 44% das mulheres e 26% dos homens foram classificados com sobrepeso ou obesidade. A posição social tendia a ser mais baixa nas mulheres (43,2%) e mais alta nos homens (40,4%). Houve uma proporção maior de mulheres com sobrepeso ou obesidade entre as pretas e pardas, e proporção maior de mulheres magras entre as brancas. Nas mulheres, após ajustes, o peso aumentava na medida em que a posição social diminuía (OR = 1,52; IC95%: 1,36-1,70), enquanto nos homens o peso diminuía junto com a diminuição da posição social (OR = 0,87; IC95%: 0,76-0,99). A posição social afetou de maneira diferente o estado antropométrico de mulheres e homens, com perfis corporais afetados também pela raça/cor da pele, indicando o potencial de levar em conta a perspectiva interseccional ao investigar os possíveis determinantes sociais do fenômeno.

Sobrepeso; Análise de Classes Latentes; Países em Desenvolvimento

Resumen

El objetivo de este estudio fue evaluar la asociación entre posición social y estatus antropométrico de adultos brasileños de ambos sexos. Fue un estudio transversal, realizado usando datos de referencia recogidos entre 2008 y 2010, del Estudio Longitudinal Brasileño de Salud en Adultos (ELSA-Brasil), llevado a cabo en seis de las mayores capitales de estado brasileñas. Un total de 15.105 activos y jubilados, mujeres y hombres funcionarios públicos de 35 a 74 años de edad. Se definieron dos variables latentes mediante análisis de clases latentes: posición social y estatus antropométrico. Ambos constructos y análisis fueron evaluados separadamente por sexo. Las asociaciones fueron evaluadas usando una regresión logística multivariada con ajuste por edad, color de piel/raza autoinformado y estatus marital. Alrededor de un 44% de las mujeres y un 26% de los hombres fueron clasificados como con sobrepeso u obesos. La posición social tendió a ser más baja en mujeres (43,2%) y más alta entre hombres (40,4%). Las mujeres con más peso tenían más probabilidad de ser negras y mulatas/mestizas y las mujeres más delgadas tenían más probabilidad de ser blancas. En mujeres, tras el ajuste, se incrementó más el peso cuanto mayor decrecía la posición social (OR = 1,52; IC95%: 1,36-1,70), mientras en hombres el peso decrecía al igual que la posición social (OR = 0,87; IC95%: 0,76-0,99). La posición social afectó diferentemente al estatus antropométrico de mujeres y hombres, con los patrones corporales también estando afectados por etnicidad/color de piel, mostrando su potencialidad tomando en consideración la perspectiva transversal, cuando se está investigando los posibles determinantes sociales del fenómeno.

Sobrepeso; Análisis de Clases Latentes; Países en Desarrollo

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