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

Abstract

The objective of the present study was to evaluate the association between social position and anthropometric status in women and men Brazilian adults. 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

Correspondence

S. M. A. Matos
Instituto de Saúde Coletiva, Universidade Federal da Bahia,
Rua Basílio da Gama s/n, Campus Universitário do Canela,
Salvador, BA 40110-040, Brasil.
salvim@ufba.br

1 Instituto de Saúde Coletiva, Universidade Federal da Bahia, Salvador, Brasil.
2 Faculdade de Educação, Universidade Federal da Bahia, Salvador, Brasil.
3 Universidade Federal de Minas Gerais, Belo Horizonte, Brasil.
4 Escola Nacional de Saúde Pública Sergio Arouca, Fundação Oswaldo Cruz, Rio de Janeiro, Brasil.
5 Centro de Ciências da Saúde, Universidade Federal do Espírito Santo, Vitória, Brasil.

doi: 10.1590/0102-311X00168918

This article is published in Open Access under the Creative Commons Attribution license, which allows use, distribution, and reproduction in any medium, without restrictions, as long as the original work is correctly cited.
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) 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.

Data collection and measures

Participants were interviewed and examined by trained personnel under supervision, following rigorous quality control protocols. 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. 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 ± 0.1kg, 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 (≥ 30kg/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 ≥ 88cm for women and ≥ 102cm for men). 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.

Data on leisure-time physical activity was obtained using the long form of the International Physical Activity Questionnaire (IPAQ). 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-Brasil: (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 knowledge. 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 class.

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), the Schwarz’s Bayesian Information Criterion (BIC), the sample-size-adjusted BIC, 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 classes. 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 |             | Overall |             |
|---------------------------------------------|---------|-------------|---------|-------------|
|                                             | n *     | %           | n       | %           |
| **Age (years)**                             |         |             |         |             |
| 35-44                                       | 1,779   | 21.6        | 1,213   | 26.5        |
| 45-54                                       | 3,256   | 39.6        | 1,866   | 40.8        |
| 55-64                                       | 2,379   | 29.0        | 1,164   | 25.4        |
| 65-74                                       | 804     | 9.8         | 331     | 7.3         |
| **Self-reported skin color/ethnicity**      |         |             |         |             |
| White                                       | 4,192   | 51.5        | 2,497   | 55.1        |
| Black                                       | 1,456   | 17.9        | 670     | 14.8        |
| Brown                                       | 2,175   | 26.8        | 1,160   | 25.6        |
| **Marital status**                         |         |             |         |             |
| Divorced                                    | 1,781   | 21.7        | 943     | 20.0        |
| Married or in a stable union                | 4,351   | 53.0        | 2,496   | 58.8        |
| Single                                      | 1,185   | 14.4        | 702     | 13.3        |
| Widowed                                     | 546     | 6.6         | 228     | 4.9         |
| Other                                       | 354     | 4.3         | 204     | 4.5         |
| **Family caregivers**                       |         |             |         |             |
| No                                          | 7,328   | 89.3        | 4,136   | 90.6        |
| Yes                                         | 880     | 10.7        | 430     | 9.4         |
| **Housemaid**                               |         |             |         |             |
| No                                          | 6,098   | 74.2        | 3,297   | 72.1        |
| Yes                                         | 2,120   | 25.8        | 1,277   | 27.9        |
| **Number of children**                      |         |             |         |             |
| None                                        | 1,928   | 23.5        | 1,191   | 26.1        |
| 1 or 2                                      | 4,471   | 54.4        | 2,567   | 56.1        |
| 3 or more                                   | 1,819   | 22.1        | 816     | 17.8        |

(continues)
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

---

**Table 1 (continued)**

| Characteristic                      | Overall (n = 15,105) | Women (n = 6,574) | Men (n = 8,531) |
|-------------------------------------|----------------------|------------------|-----------------|
|                                     | n *                  | %                | n *             | %                |
| **Dietary pattern**                 |                      |                  |                 |
| Fruits and vegetables               | 2,526                | 30.8             | 1,380           | 30.2             |
| Bakery products                     | 1,570                | 19.2             | 796             | 17.5             |
| Traditional                         | 3,628                | 44.2             | 2,075           | 45.5             |
| Low sugar/Low fat                   | 472                  | 5.8              | 308             | 6.8              |
|                                      | Total                |                   |                 |
| **Vigorous or intense leisure time**|                      |                  |                 |
| physical activity (minutes per week)|                      |                  |                 |
| ≥ 60                                | 1,318                | 16.3             | 906             | 20.2             |
| < 60                                | 6,778                | 83.7             | 3,584           | 79.8             |
| **Social position latent variable** |                      |                  |                 |
| High                                | 2,684                | 32.7             | 1,680           | 36.7             |
| Intermediate                        | 1,985                | 24.2             | 1,150           | 25.1             |
| Low                                 | 3,549                | 43.1             | 1,744           | 38.2             |

* 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.
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-
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 time 45. 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 women 13.

Furthermore, restricting interpretation of the growth in obesity rates in women to biological specificities 46 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 1.7 kg/m² greater in women with four or more children 46. In Brazilian women of reproductive age, excess weight was dependent on pre-pregnancy BMI 47 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 metabolism 50. However, motherhood leads to profound changes in the daily life of Brazilian women, resulting from gender inequalities in caring for the house and the family 51. 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 around 52. 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 women 53.

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 image 54. Studies on cognitive distortions of body image have shown that white women are more dissatisfied with their body image than black men and women 55. 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 relationships 55.

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 centres 31. 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

ORCID: Sheila Maria Alvim Matos (0000-0003-2080-9213); Leila Denise Alves Ferreira Amorim (0000-0002-1112-2332); Francisco José Gondim Pitanga (0000-0002-1033-8684); Ana Luisa Patrão (0000-0002-2027-5461); Sandhi M. Barreto (0000-0001-7383-7811); Dora Chor (0000-0002-3941-5786); Leticia de Oliveira Cardoso (0000-0003-1312-1808); Maria del Carmen Bisi Molina (0000-0002-8614-988X); Mauricio Lima Barreto (0000-0002-0215-4930); Estela M. L. Aquino (0000-0002-8204-1249).

Acknowledgments

The authors thank the volunteers who take part in this study, and also Maria da Conceição C. Almeida for her contributions during the writing of this paper.

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. Hoebl 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. Vigilite 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, Szego 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. 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.

18. Eickemberg M, Amorim LDAF, 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. Ciência Saúde Coletiva 2020; 25:2985-98.

19. 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.

20. 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.

21. Schmidt MI, Grieb RH, Passos VM, Luft VC, Goulart AC, Menezes GMS, et al. Estratégias de desenvolvimento de garantia e controle de qualidade no ELSA-Brasil. Rev Saúde Pública 2013; 47 Suppl 2:105-12.

22. Secretaria de Vigilância à Saúde, Ministério da Saúde. 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 LDAF, 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. Ciência Saúde Coletiva 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, Grieb RH, Passos VM, Luft VC, Goulart AC, Menezes GMS, et al. Estratégias de 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 de Validade e Reproduzibilidade no Brasil. Rev Saúde Pública 2012: 36(4):0006215.

34. Cardoso LO, Carvalho MS, Cruz OG, Meirele 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; 32e0006215.

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 BK, 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 determinants 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 MHDA. Obesity and weight change related to parity and breast-feeding among parous women in Brazil. Public Health Nutr 2001; 4:465-70.

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. Gravена 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 decrecia 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

Submitted on 06/Sep/2018
Final version resubmitted on 26/Oct/2020
Approved on 27/Nov/2020