Association of body image (dis)satisfaction and perception with food consumption according to the NOVA classification: Pró-Saúde Study

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ABSTRACT

The literature on body image and food consumption has generally focused on isolated food items, while over-looking the growing role of ultra-processed foods in the overall diet. The objective of this study was to assess the association of body image (dis)satisfaction and perception with food consumption, according to the NOVA classification, which takes into account the extent and purpose of industrial food processing. A silhouette scale developed considering the Brazilian adults' Body Mass Index was used to assess body image (dis)satisfaction and perception. Food consumption was evaluated using a Food Frequency Questionnaire, and its items were cate-gorized into three groups: unprocessed or minimally-processed foods and culinary preparations; processed foods; ultra-processed foods. The association was assessed using linear regression models. A total of 514 of Brazilian university employees were evaluated. Women dissatisfied due to excess weight consumed less unprocessed or minimally-processed foods and culinary preparations (-6.6, 95% CI: -10.7; -2.5) and more ultra-processed foods (3.7, 95% CI: 0.1; 7.2) compared to satisfied. Women that overestimated their body size consumed less unprocessed or minimally-processed food and culinary preparations (-4.2, 95% CI: -7.3; -1.1), compared to those who had not distorted body image. Food consumption appears to be more strongly associated with body image (dis)satisfaction than with perception. An association was established between body image dissatisfaction and unhealthy eating habits. This relation deserves public health attention since it may contribute to the de-velopment of chronic diseases and reduce the quality of life and body image assessment could be adopted by nutritionists and other health professionals in their practice.

1. Introduction

Body image can be defined as the representation of our own body which we form in our own mind, and the way in which it is in-corporated in our thoughts, feelings and emotions (Schilder, 1999; Tavares & Coelho, 2003). This representation can be influenced by biological and social characteristics, such as sex, age, race, and socio-economic and cultural status (Cash, 2004; Cash & Grasso, 2005). Media channels, particularly social media, can negatively influence body image by exposure to and worship of stereotypes of perfect bodies (Brown & Tiggemann, 2016; Damasceno, Lima, Vianna, Vianna, & Novaes, 2005; Tiggemann & Miller, 2010).

The concept of body image is captured by two dimensions: attitu-dinal and perceptual. The attitudinal dimension involves individual feelings expressing a liking or disliking of the body, i.e. dissatisfaction

with body image. This dimension also includes a behavioral compo-nent, expressing attitudes adopted as a consequence of body image representation, such as food consumption. The perceptual dimension can be defined as the presence or absence of distortion in identifying body size (Cash, 2011; Neves, Morgado, & Tavares, 2015; Thompson, 2004). There are a number of different instruments available for as-sessing body image, but most of them focus on adolescents or young adults and few have been developed and validated for use in the specific population being studied, particularly in the case of adults and elderly Brazilians (Laus et al., 2014).

Body image dissatisfaction and distorted perception has been asso-ciated with several adverse health behaviors and outcomes, such as unfavorable nutritional status, depression, extreme weight control practices and eating disorders (Claro, Santos, & Oliveira-Campos, 2014; Coelho, Giatti, Molina, Nunes, & Barreto, 2015; Kantanista, Król-

Zielińska, Borowiec, & Osiński, 2017; Lim et al., 2017; Nayir et al., 2016). As food consumption is an important behavioral factor in health, studies have also suggested the relation of body image with eating patterns and food habits (Bibiloni, Pich, Pons, & Tur, 2013; Nianogo, Kuo, Smith, & Arah, 2016; Tyrovolas, Koyanagi, Stickley, & Haro, 2016).

Traditionally, studies assessing the relationship between food consumption and health outcomes have analyzed the influence of single components, as isolated food items or nutrients (Borgi, Rimm, Willett, & Forman, 2016; Chopan & Littenberg, 2017; Gardner et al., 2018). This approach appears to be insufficient, given the complexity of non-communicable diseases (NCDs) and changes in the global food system (Monteiro, 2009; Monteiro, Moubarac, Cannon, Ng, & Popkin, 2013; Swinburn et al., 2011). To provide a deeper understanding of current dietary patterns, a food classification system was developed (NOVA classification) which takes into account the extent and purpose of industrial food processing (Monteiro, 2009; Monteiro et al., 2018, 2019). This classification includes the group of ultra-processed foods, which are industrial formulations that contain little or no fresh ingredients and incorporate a series of additives that mimic the flavor, aroma, color, texture and other sensory properties of natural foods and/or their preparations and typically have an unbalanced nutritional profile. These characteristics, allied with aggressive marketing and stimuli to adopt inadequate eating practices, render these products harmful to health, due to their nutritional profile (Monteiro, 2009; Monteiro et al., 2018; Rauber et al., 2018) and their relationship with the occurrence of obesity and NCDs (Canella et al., 2014; Fiolet et al., 2018; Gómez-Donoso et al., 2019; Hall et al., 2019; Srour et al., 2019).

The ever-increasing consumption of ultra-processed foods (Martins, Levy, Claro, Moubarac, & Monteiro, 2013), soaring rates of obesity (NCD Risk Factor Collaboration, 2016) and insufficient physical activity (Pitanga, Almeida, Queiroz, Aquino, & Matos, 2017) contradict the beauty standards characterized by anthropometric profiles promoted in sociocultural contexts as ideal (Algars et al., 2009). To the best of our knowledge, there are no studies evaluating the relationship between adults' body image and food consumption considering the extent and purpose of industrial food processing. Our hypothesis is that a negative body image is associated with negatively food consumption habits, for example, characterized by higher consumption of ultra-processed foods (de Oliveira da Silva et al., 2018) (independently of the Body Mass Index of the individual's). Possible reasons for that are related to the fact that ultra-processed foods are designed to be hyper-palatable and to stimulate overconsumption and have aggressive marketing strategies that promote them as healthy food options. However, the literature shows that the consumption of this food group is related to obesity and noncommunicable diseases. The objective of the present study was to assess body image, using adequate instruments validated for the Brazilian population, and to explore the relation of (dis)satisfaction and perception of body image with food consumption, according to the NOVA classification.

2. Methods

2.1. Design and population of study

A cross-sectional study of data from a subsample of phase 4 of the Pró-Saúde Study (EPS) was carried out. The EPS involves a cohort of Brazilian university employees of a university campus in the State of Rio de Janeiro, Brazil, and has the primary focus of investigating the socioeconomic and psychosocial aspects associated with the health status and behavior of this population (Faerstein, Chor, Lopes, & Werneck, 2005).

The subsample of participants was randomly selected and stratified by sex, age and educational level, considering the proportions of these strata in the EPS population. Data collection was carried out between 2012 and 2013 and involved 520 permanent employees living in the

city of Rio de Janeiro that took part in the baseline (Phases 1 and 2) of the EPS. Individuals classified as indigenous (n = 5) and Asian (n = 1) were excluded. Therefore, data for 514 individuals were analyzed. The variables of interest for the present study were related to body image and food consumption of the participants.

2.2. Body image and nutritional status assessment

Body image assessment was performed using the silhouette scales of Kakeshita (2008) and Kakeshita, Silva, Zanatta, and Almeida (2009) (supplementary material 1), which considered the BMI distribution of the Brazilian adult population, as suggested by other authors (Gardner et al., 1998, 1999). The reliability (test-retest) of the scales was previously assessed in two studies, including one with a subsample of participants of the Longitudinal Study on Adult Health (ELSA-Brazil), and considered adequate (Griep et al., 2012; Kakeshita et al., 2009). The scales contain 15 body images for each sex corresponding to mean BMI ranging from $12.5 \, kg/m^2$ to $47.5 \, kg/m^2$, with images differing by $2.5 \, kg/m^2$ (supplementary material 2).

For data collection, cards showing body images were presented and individuals were asked to indicate which silhouette most closely represented their body size on that day (perceived silhouette) and which figure best represented the body they wanted to have (desired silhouette). The corresponding number of the figure (ranging from 1 to 15) chosen by individuals was recorded.

For the assessment of nutritional status, trained research assistants measured the total body mass (kg) of the participants, using a digital scale (Filizola) with accuracy of 0.1 kg, and stature (m), using a fixed stadiometer (SECA) with accuracy of 0.1 cm. Taking these measures, the real body mass index (BMI) of each participant was calculated (kg/m^2). Additionally, in order to describe the studied population, we classified the BMI according to the World Health Organization recommendations (WHO, 1995).

In order to assess the perceptual dimension, the real BMI was converted into the corresponding current silhouette, considering the pre-established BMI values for each silhouette value with $\pm 1.25 \, kg/m^2$ variation (Kakeshita, 2008) (supplementary material 2).

Data on the desired, perceived and current silhouettes allowed the evaluation of both the attitudinal (based on (dis)satisfaction) and the perceptual body image dimensions. Body image (dis)satisfaction was rated based on the difference between the perceived silhouette and the desired silhouette, whereas perception of body image was rated based on the difference between the perceived silhouette and the current silhouette (calculated using the real BMI) (Coelho et al., 2015; Kakeshita, 2008). Participants were classified according to the categories of body image (dis)satisfaction and perception presented in Chart 1.

2.3. Food consumption assessment

Food consumption was assessed using a semi-quantitative Food Frequency Questionnaire (FFQ), validated by Sichieri and Everhart (1998), containing 82 foods or food groups. Amounts are predefined and expressed as household measures or food units. Respondents select from eight consumption frequencies (> 3 times/day; 2–3 times/day; 1 time/day; 5–6 times/week; 2–4 times/week; 1 time/week/1–3 times month; never or almost never). Consumption frequency reported was converted into daily frequency and subsequently associated with the amount of the portion/serving size to calculate the calories of each food item and total daily energy consumed. Calorie content of the foods was derived from the Brazilian Table of Food Compositions (Brasil, 2011). The total dietary energy was calculated for each individual. Then, the percentage of calories (% of the total dietary energy) derived from each food item was calculated. FFQ items were classified according to the NOVA classification, which categorizes foods according to extent and purpose of industrial food processing (Monteiro et al., 2018, 2016) as

follows:1) unprocessed or minimally-processed foods and culinary preparations based on these foods; 2) processed foods; and 3) ultra-processed foods. Some foods listed in the FFQ (French bread or sliced bread, butter or margarine, pizzas and pastas, such as lasagne, gnocchi and ravioli) can be classified into more than one of these groups according to the NOVA. Given that some foods can be classified into more than one group, the proportion of these foods was divided into more than one group based on data from Brazilian national surveys (Levy, Claro, Mondini, Sichieri, & Monteiro, 2012; Louzada et al., 2015). Thus, for the food item "French bread or sliced bread", calories were allocated at 75% to the processed foods group and 25% to the ultra-processed foods group. For "butter or margarine", 17% of calories were allocated to the unprocessed or minimally-processed food group and 83% to the ultra-processed group, respectively. For "pizzas" and "pastas, such as lasagne, gnocchi and ravioli", 50% of calories were allocated to the unprocessed or minimally-processed foods and culinary preparations and 50% to ultra-processed foods (Berti et al., 2019). Lastly, the proportion of daily energy for each of the NOVA groups (outcome variables) was calculated.

2.4. Sociodemographic variables

Information on sociodemographic variables were collected using a self-report questionnaire. Data were collected for the following study variables: sex (man and woman), age (as continuous variable), education (incomplete primary; complete primary; incomplete secondary; complete secondary; incomplete university; complete university; postgraduate); race/skin color (black; mixed-race; white; Asian; indigenous). Household income as well as number and age of dependents on the reported income were used to calculate the equivalent per capita income (continuous variable), using the OECD equivalence scale (OECD, 2011, 2008).

2.5. Data analysis

Initially, absolute and relative frequencies were calculated in relation to sex (man; woman), age (grouped in ≤ 44 years; 45–59 years; $\geq$ 60 years), education (grouped in completed primary; completed secondary; higher education or above); race/skin color (black; mixed-race; white), equivalent income (grouped in < 3 minimum wages (MW); 3–6 MW; > 6 MW) based on 2012 Brazilian minimum wage (R$ 622.00), and nutritional status (underweight; adequate; overweight; obese class I; obese class II; obese class III).

Body image variables were expressed as frequency and NOVA food groups as a proportion of the total dietary energy, along with their respective 95% confidence intervals (95% CI). In all the descriptive analyses, the absence of overlapping of confidence intervals was considered a statistically significant difference, at a 5% significance level. In the sequence, we described the mean proportion of energy of the NOVA groups (unprocessed or minimally-processed foods and culinary preparations; processed foods and ultra-processed foods) according to the categories of (dis)satisfaction and perception of body image with their respective 95% CI. To determine statistical difference, ANOVA was performed considering p < 0.05 as significant.

Associations between body image (dis)satisfaction and perception categories (exposure variables) and the consumption of each NOVA food group (outcome variables) was assessed, with results expressed as the mean energy proportion derived from each NOVA food group, stratified by sex, using crude (bivariate analyses) and multiple linear regression models. Multiple models were adjusted for sociodemographic variables frequently associated with food consumption and body image, such as age (continuous variable), education and race/skin color (both as categorical variables, considering original categories collected). Equivalent income was not included given that the models were better adjusted using education as a marker of socioeconomic status. Additionally, we included the BMI (as continuous variable) to

Table 1
Distribution of sociodemographic and anthropometric characteristics of the population. Pró-Saúde Study, 2012–13.

SOCIODEMOGRAPHIC VARIABLES		n	Proportion (%)
Sex (n = 514)	Female	267	51.9
	Male	247	48.1
Age (n = 514)	≤ 44 years	100	19.5
	45–59 years	321	62.5
	≥ 60 years	93	18.0
Race/skin color[a] (n = 507)	Black	109	21.5
	Mixed-race	149	29.4
	White	249	49.1
Education[a] (n = 510)	Up to Primary complete	32	6.3
	Secondary complete	198	38.8
	Higher education or above	280	54.9
Equivalent Income[a][b] (n = 504)	< 3 minimum wages	151	30.0
	3-6 minimum wages	203	40.3
	> 6 minimum wages	150	29.7
Body Mass Index (BMI) (n = 514)	Underweight	5	1.0
	Adequate	143	27.8
	Overweight	214	41.6
	Obese class I	104	20.2
	Obese class II	37	7.2
	Obese class III	11	2.2

[a] Number of participants differs from total due to missing data.
[b] Brazilian minimum wage prevailing in 2012.

adjust the models. Regression coefficients represent the difference in caloric participation of each NOVA food group for body image categories, compared to the reference category.

All statistical analyses were performed using Stata 14.2 statistical software package.

2.6. Ethical aspects

The present study was approved by the Research Ethics Committee of the Instituto de Medicina Social da Universidade do Estado do Rio de Janeiro (CAAE:0041.0.259.000-11). Participants agreed to participate in the study through the Informed Consent Form (ICF), ensuring the privacy of the data obtained.

3. Results

The sociodemographic characteristics of the study population are given in Table 1. Over half of the population (51.9%) was female and aged 45–59 years (62.5%). Regarding race/skin color, 49.1% of participants self-declared as being white. Regarding education, 54.9% had attained higher educational level or above. For equivalent income, most of the population had an income of 3–6 minimum wages (40.3%). In terms of nutritional status, the majority of the population was overweight (41.6%).

Data on body image (dis)satisfaction and perception are shown in Table 2. Given the differences found between men and women for body image (dis)satisfaction and perception, besides the analysis of the population as a whole, separate analyses for each sex were also carried out. With regard to body image (dis)satisfaction, 72.3% of participants presented dissatisfied due to excess weight. No differences were found between sex. With regard to perception, more than half of the population overestimated their body size, where rates were higher among women (64.3%) than men. Among men, 52.8% exhibited no distortion.

The mean proportion of energy represented by the three food groups assessed is shown in Table 3. No differences were noted between the sexes for any of the three food groups. The largest proportion of energy

Table 2
Frequency of body image (dis)satisfaction and perception according to sex. Pró-Saúde Study, 2012–13. (n = 512).

BODY IMAGE VARIABLES	WOMEN		MEN		TOTAL	
	n	% (95% CI)	n	% (95% CI)	n	% (95% CI)
(DIS)SATISFACTION						
Satisfied	49	18.4 (14.2–23.6)	67	27.2 (22.0–33.2)	116	22.6 (19.2–26.5)
Dissatisfied due to thinness	11	4.2 (2.3–7.3)	15	6.1 (3.7–9.9)	26	5.1 (3.5–7.4)
Dissatisfied due to excess weight	206	77.4 (72.0–82.0)	164	66.7 (60.5–72.3)	370	72.3 (68.2–76.0)
PERCEPTION						
Not distorted	84	31.6 (26.2–37.4)	130	52.8 (46.5–59.0)	214	41.8 (37.6–46.1)
Underestimated body size	11	4.1 (2.2–7.3)	21	8.5 (5.6–12.8)	32	6.3 (4.4–8.7)
Overestimated body size	171	64.3 (58.3–69.8)	95	38.6 (32.7–44.9)	266	51.9 (47.6–56.3)

95% CI = 95% confidence interval. Level of significance of 5%.
Note: data missing for two participants due to answer not given.

consumed was derived from unprocessed or minimally-processed foods and culinary preparations based on these foods, followed by ultra-processed foods.

The description of the contribution of NOVA food groups according to body image (dis)satisfaction and perception categories is shown in Table 4. With regard to (dis)satisfaction, women satisfied with their body image reported a higher consumption of unprocessed or minimally-processed and culinary preparations (64.4%) compared to those dissatisfied due to excess weight (58.0%). Women satisfied with their body image reported a lower consumption of ultra-processed food than women dissatisfied due to excess weight (23.6% and 27.8%, respectively). Among men, food consumption not changed according to body image (dis)satisfaction. For perception, women not distorted reported a higher consumption of unprocessed or minimally-processed and culinary preparations (61.9%) compared to those who overestimated their body size (58.0%).

The associations between body image and food consumption according to NOVA food groups, expressed as crude and adjusted coefficients of the linear regression, are shown in Tables 5 and 6. In the following, the results of the models adjusted by sociodemographic variables and BMI were highlighted. Consumption of unprocessed or minimally-processed foods and culinary preparations was lower among women dissatisfied due to excess weight (-6.6, 95% CI: -10.7; -2.5) and they reported a higher consumption of processed foods and ultra-processed foods (2.9, 95% CI: 0.5; 5.4, and, 3.7, 95% CI: 0.1; 7.2, respectively) compared to the reference group (satisfied). Men who were dissatisfied due to excess weight reported a lower consumption of ultra-processed foods (-4.5, 95% CI: -7.9; -1.1). Regarding perceived body image, women who overestimated body size reported a lower proportion of energy from unprocessed or minimally-processed foods and culinary preparations (-4.2, 95% CI: -7.3; -1.1) and a higher consumption of processed foods (2.2, 95% CI: 0.3; 4.0) compared to the reference group (non-distorted perception group). Men who overestimated body size reported higher consumption of processed foods (2.0, 95% IC: 0.4; 3.6). No statistical differences were found for the categories of dissatisfied due to thinness and underestimated body size. Food consumption was more strongly associated with body image (dis)satisfaction than with body image perception. The inclusion of BMI in regression models resulted in attenuation of the effect in the

coefficients.

4. Discussion

In the population of Brazilian university employees studied, the prevalence of individuals dissatisfied due to excess weight and women that overestimated their body size was high. The proportion of unprocessed or minimally processed foods and culinary preparations based on these foods predominated in both sexes, followed by ultra-processed foods. Food consumption appears to be more strongly associated with body image (dis)satisfaction than with perception. Consumption of unprocessed or minimally-processed foods and culinary preparations based on these foods was lower (and of ultra-processed foods higher) in women dissatisfied due to excess weight.

The scenario for body image and food consumption seen in the present study is consistent with findings of previous studies involving the Brazilian population, showing a high prevalence of body image dissatisfaction and distortion, as well as a high consumption of ultra-processed foods (Coelho et al., 2015; Kakeshita, 2008; Martins et al., 2013; Santos Silva, Nahas, de Sousa, Del Duca, & Peres, 2011). Ultra-processed food intake in the population studied, as well as in Brazil as a whole (Louzada et al., 2015), is lower than levels seen in the United States and Canada (Martínez Steele, Popkin, Swinburn, & Monteiro, 2017; Moubarac, Batal, Louzada, Martinez Steele, & Monteiro, 2017). However, an increment of calories from ultra-processed foods has been observed in Brazil between 2003 and 2009 (20.8% vs 25.4%) (Martins et al., 2013) and this trend is concerning due to the already confirmed link between this pattern of consumption and the occurrence of both obesity and chronic diseases (Canella et al., 2014; Fiolet et al., 2018; (Silva et al., 2018).

Women dissatisfied due to excess weight reported a consumption of 3.7% more calories from ultra-processed foods than those that were satisfied, according to adjusted analysis. Direct comparisons with other studies investigating the relationship between body image and food consumption are hampered by differences in methods used to measure body image, food groups evaluated and populations. In addition, most studies have focused on dissatisfaction and did not assess the perception dimension. Nevertheless, it should be noted that the magnitude of the difference between satisfied and dissatisfied women was even higher

Table 3
Mean proportion (%) of energy derived from the food groups of the NOVA classification according to sex. Pró-Saúde Study, 2012–13. (n = 514).

FOOD GROUPS	WOMEN	MEN	TOTAL
	$\bar{x}$ (95% CI)	$\bar{x}$ (95% CI)	$\bar{x}$ (95% CI)
Unprocessed or minimally-processed foods and culinary preparations	59.4 (57.9–60.8)	60.5 (59.1–61.9)	59.9 (58.9–60.9)
Processed foods	13.7 (12.9–14.5)	13.3 (12.5–14.0)	13.5 (12.9–14.0)
Ultra-processed foods	26.9 (25.7–28.2)	26.3 (25.1–27.4)	26.6 (25.7–27.5)

95% CI = 95% confidence interval.

Table 4
Mean proportion of energy (%) derived from food groups in the NOVA classification, according to body image (dis)satisfaction and perception categories stratified by sex. Pró-Saúde Study, 2012–13. (n = 512).

	FOOD GROUPS								
	Unprocessed or minimally processed foods and culinary preparations			Processed foods			Ultra-processed foods		
(DIS)SATISFACTION	Women $\bar{x}$ (95% CI)	Men $\bar{x}$ (95% CI)	Total $\bar{x}$ (95% CI)	Women $\bar{x}$ (95% CI)	Men $\bar{x}$ (95% CI)	Total $\bar{x}$ (95% CI)	Women $\bar{x}$ (95% CI)	Men $\bar{x}$ (95% CI)	Total $\bar{x}$ (95% CI)
Satisfied	64.4 (61.6–67.1)	60.4 (57.8–63.1)	62.1 (60.1–64.0)	12.0 (10.4–13.7)	12.4 (11.2–13.6)	12.2 (11.3–13.2)	23.6 (21.3–25.8)	27.1 (24.7–29.6)	25.6 (23.9–27.4)
Dissatisfied due to thinness	63.0 (56.1–69.8)	57.9 (53.1–62.7)	60.1 (56.0–64.1)	11.1 (8.5–13.7)	14.6 (10.8–18.3)	13.1 (10.6–15.6)	25.9 (20.5–31.3)	27.5 (22.6–32.3)	26.8 (23.3–30.4)
Dissatisfied due to excess weight	58.0 (56.3–59.7)	60.8 (59.1–62.6)	59.3 (58.0–60.5)	14.2 (13.3–15.2)	13.5 (12.6–14.4)	13.9 (13.2–14.6)	27.8 (26.3–29.2)	25.6 (24.2–27.0)	26.8 (25.8–27.8)
p value	p ≤ 0.01	p = 0.62	p = 0.07	p = 0.05	p = 0.27	p = 0.04	p = 0.03	p = 0.46	p = 0.53
PERCEPTION									
Not distorted	61.9 (59.4–64.4)	61.6 (59.7–63.4)	61.7 (60.2–63.2)	12.4 (11.0–13.8)	12.4 (11.5–13.3)	12.4 (11.6–13.2)	25.7 (23.5–27.9)	26.0 (24.4–27.7)	25.9 (24.6–27.2)
Underestimated body size	62.0 (55.3–68.8)	60.6 (55.3–65.8)	61.1 (57.0–65.1)	10.3 (7.6–13.0)	14.2 (11.3–17.0)	12.8 (10.7–15.0)	27.6 (21.8–33.5)	25.3 (21.0–29.5)	26.1 (22.7–29.5)
Overestimated body size	58.0 (56.1–59.8)	59.2 (56.9–61.5)	58.4 (57.0–59.8)	14.6 (13.5–15.6)	14.3 (13.1–15.5)	14.5 (13.7–15.3)	27.5 (25.9–29.0)	26.5 (24.6–28.4)	27.1 (25.9–28.3)
p value	p = 0.04	p = 0.04	p ≤ 0.01	p = 0.01	p = 0.04	p ≤ 0.01	p = 0.41	p = 0.84	p = 0.38

95% CI = 95% confidence interval.
p value obtained by ANOVA test.

than the aforementioned increase (4.6%) observed over 6 years in the Brazilian population (Martins et al., 2013). A study based on data from the Longitudinal Study of Adult Health (ELSA-Brazil) that used similar methods to those in the present study found similar results. In the study, an association between unhealthy eating habits (defined as pizza; hamburger; hotdog; ham/mortadella/salami; fried savories and soft drinks) and both body image dissatisfaction due to excess weight among both sexes was found. The authors assume that the foods comprising the unhealthy category are ultra-processed foods (de Oliveira da Silva et al., 2018). Thus, the present results on women dissatisfied due to excess weight corroborate the data reported by the study. Small R-squared values were observed in the association analyses, but we believe that it is reasonable, considering that multiple factors influence food consumption.

Another Brazilian study explored the association between body image and eating habits, more specifically fruit and vegetable consumption. No associations were found between regular consumption of these foods and dissatisfaction due to being lighter or heavier than ideal for either sex (EpiFloripa - Santos Silva et al., 2011). These findings differ to those of the present study, given that these foods belong to the unprocessed or minimally-processed foods group. However, it is important to point out disparities between the studies in terms of the approach used to assess fruit and vegetable consumption (amount and frequencies). Also, other foods comprise the unprocessed or minimally-processed foods and culinary preparations group, where fruit and vegetables constitute only one component and whose consumption in Brazil is low (Canella et al., 2018; Jaime et al., 2015).

With regard to the North-American population, a study drawing on data from the National Health and Nutrition Examination Survey (2007–2012) assessed the association between total daily dietary energy intake and body image. Data on (dis)satisfaction with weight was collected by the question: "would you like to weigh differently to what you weigh now?". Weight perception was assessed by the question: "do you consider yourself: adequate weight, underweight or overweight?". The results indicated that individuals wanting to weigh less had higher odds of low energy reporting than those satisfied with their weight, suggesting that weight dissatisfaction might be associated with low energy consumption. No association with perception was found (Tyrovolas et al., 2016). However, the fact that only total energy consumption was assessed, without considering the quality of the foods consumed, precludes comparison with the results of the present study. Future studies should evaluate behavior for weight control along with body image.

Taken together, these results underscore the urgent need for strategies regulating ultra-processed foods. Reformulation of these products into their "premium" versions yields no clear health benefits (Scrinis & Monteiro, 2018). However, individuals on a calorie-controlled diet owing to body image dissatisfaction are induced into thinking that these food products are healthy and/or less caloric when in fact they can be more energy rich than meals prepared using unprocessed or minimally-processed foods (Monteiro, 2009). The same holds true for individuals that overestimate their body size and seek to slim, often needlessly. These claims can lead to increased consumption of these products, maintaining or increasing dissatisfaction due to excess weight and/or overestimation of body image, thereby creating a vicious cycle.

Comparing findings for different age groups reveals that dissatisfaction with body image in adults and adolescents has different repercussions with regard to eating habits. In adolescents, dissatisfaction is sometimes related to healthier or restrained eating habits, which may promote eating disorders and unhealthy dietary patterns (Bibiloni, Pich, Pons, & Tur, 2013; Chisuwa & O'Dea, 2010; Claro et al., 2014; Silva, Barufaldi, Andrade, Santos, & Claro, 2018; Ribeiro-Silva et al., 2018). For adults, studies suggest that this relationship is associated with unhealthy eating habits, manifested by higher consumption of ultra-processed foods. This association is more evident among women because they tend to be more vulnerable than men to be influenced by

Table 5

Association between body image (dis)satisfaction and proportion of energy derived from food groups of the NOVA classification, expressed as crude and adjusted coefficients. Pró-Saúde Study, 2012–13.

		Crude coefficient (95% CI)			Coefficient adjusted for sociodemographic variables [a] (95% CI)			Coefficient adjusted for sociodemographic variables and BMI [b] (95% CI)		
		Women	Men	Total [c]	Women	Men	Total [c]	Women	Men	Total [c]
Unprocessed or minimally processed foods and culinary preparations	Satisfied	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
	Dissatisfied due to thinness	-1.4 (-9.1; 6.4)	-2.5 (-8.8; 3.7)	-2.0 (-6.9; 2.9)	-4.1 (-12.1; 4.0)	-2.4 (-9.0; 4.0)	-3.9 (-8.9; 1.2)	-4.3 (-12.5; 3.8)	-3.2 (-9.8; 3.4)	-4.3 (-9.4; 0.8)
	Dissatisfied due to EW	-6.4* (-10.0; -2.7)	0.4 (-2.8; 3.5)	-2.8* (-5.2; -0.4)	-7.0* (-10.6; -3.4)	1.5 (-1.7; 4.8)	-2.4 (-4.9; 0.0)	-6.6* (-10.7; -2.5)	3.1 (-0.9; 7.1)	-1.6 (-4.5; 1.2)
	R-square	0.05	0.00	0.01	0.13	0.05	0.04	0.13	0.06	0.04
Processed foods	Satisfied	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
	Dissatisfied due to thinness	-1.0 (-5.4; 3.5)	2.2 (-1.1; 5.5)	0.9 (-1.8; 3.5)	0.7 (-4.1; 5.5)	1.7 (-1.7; 5.2)	1.6 (-1.2; 4.5)	0.5 (-4.4; 5.3)	1.5 (-2.0; 5.0)	1.4 (-1.5; 4.3)
	Dissatisfied due to EW	2.2* (0.1; 4.3)	1.1 (-0.5; 2.8)	1.7* (0.3; 3.0)	2.6* (0.4; 4.7)	0.9 (-0.8; 2.6)	1.6* (0.3; 3.0)	2.9* (0.5; 5.4)	1.4 (-0.8; 3.5)	2.1* (0.5; 3.7)
	R-square	0.02	0.01	0.01	0.06	0.05	0.02			
Ultra-processed foods	Satisfied	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
	Dissatisfied due to thinness	2.3 (-4.3; 8.8)	0.3 (-5.0; 5.6)	1.2 (-3.0; 5.3)	3.4 (-3.5; 10.3)	0.7 (-4.8; 6.2)	2.2 (-2.1; 6.5)	3.8 (-3.1; 10.9)	1.7 (-3.8; 7.3)	2.9 (-1.4; 7.2)
	Dissatisfied due to EW	4.2* (1.0; 7.3)	-1.5 (-4.2; 1.2)	1.2 (-0.9; 3.2)	4.4* (1.3; 7.5)	-2.4 (-5.2; 0.3)	0.8 (-1.2; 2.9)	3.7* (0.1; 7.2)	-4.5* (-7.9; -1.1)	-0.4 (-2.8; 1.9)
	R-square	0.03	0.01	0.00	0.07	0.05	0.03	0.08	0.02	0.02

Note: n differs between models (crude: n = 512; adjusted: n = 501). 95% CI = 95% confidence interval; EW = excess weight. *significant difference for perception and (dis)satisfaction categories.

[a] Model adjusted for sociodemographic variables: age, race/skin color and education.

[b] Model adjusted for sociodemographic variables and current BMI.

[c] Additional sex adjustment.

Table 6

Association between body image perception and proportion of energy derived from food groups of the NOVA classification, expressed as crude and adjusted coefficients. Pró-Saúde Study, 2012–13.

		Crude coefficient (95% CI)			Coefficient adjusted for sociodemographic variables [a] (95% CI)			Coefficient adjusted for sociodemographic variables and BMI [b] (95% CI)		
		Women	Men	Total	Women	Men	Total [c]	Women	Men	Total [c]
Unprocessed or minimally processed foods and culinary preparations	Not distorted	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
	Underestimated BS	0.1 (−7.4; 7.7)	−1.0 (−6.1; 4.1)	−0.6 (−4.9; 3.6)	−1.5 (−9.3; 6.2)	−3.1 (−8.6; 2.4)	−2.8 (−7.3; 1.6)	−2.7 (−10.4; 5.1)	−3.1 (−8.7; 2.6)	−3.4 (−8.0; 1.1)
	Overestimated BS	−4.0* (−7.1; −0.8)	−2.4 (−5.3; 0.5)	−3.3* (−5.4; −1.2)	−4.3* (−7.4; −1.2)	−2.6 (−5.6; 0.4)	−3.5* (−5.6; −1.4)	−4.2* (−7.3; −1.1)	−2.6 (−5.7; 0.5)	−3.4* (−5.5; −1.3)
	R-square	0.02	0.01	0.02	0.10	0.05	0.06	0.12	0.05	0.06
Processed foods	Not distorted	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
	Underestimated BS	−2.1 (−6.3; 2.1)	1.8 (−0.9; 4.4)	0.4 (−1.9; 2.8)	−1.4 (−5.9; 3.2)	2.2 (−0.7; 5.2)	1.1 (−1.4; 3.7)	−1.2 (−5.8; 3.4)	2.0 (−0.9; 5.1)	1.1 (−1.4; 3.7)
	Overestimated BS	2.1* (0.4; 3.9)	1.9* (0.4; 3.4)	2.1* (0.9; 3.2)	2.2* (0.4; 4.0)	1.9* (0.3; 3.5)	2.1* (1.0; 3.3)	2.2* (0.3; 4.0)	2.0* (0.4; 3.6)	2.2* (1.0; 3.3)
	R-square	0.03	0.03	0.03	0.06	0.07	0.04	0.07	0.07	0.07
Ultra-processed foods	Not distorted	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
	Underestimated BS	1.9 (−4.5; 8.4)	−0.8 (−5.1; 3.6)	0.2 (−3.5; 3.8)	2.9 (−3.7; 9.5)	0.9 (−3.8; 5.6)	1.7 (−2.1; 5.5)	3.9 (−2.8; 10.5)	1.0 (−3.8; 5.9)	2.3 (−1.6; 6.2)
	Overestimated BS	1.8 (−0.9; 4.5)	0.5 (−2.0; 2.3)	1.2 (−0.5; 3.0)	2.1 (−0.6; 4.8)	0.7 (−1.9; 3.2)	1.4 (−0.4; 3.2)	2.0 (−0.6; 4.7)	0.6 (−2.0; 3.2)	1.2 (−0.6; 3.0)
	R-square	0.01	0.00	0.00	0.05	0.04	0.04	0.07	0.04	0.04

Note: n differs between models (crude: n = 512; adjusted: n = 501). 95% CI = 95% confidence interval; BS = body size. *significant difference for perception and (dis)satisfaction categories.

[a] Model adjusted for sociodemographic variables: age, race/skin color and education.

[b] Model adjusted for sociodemographic variables and current BMI.

[c] Additional sex adjustment.

Chart 1

Rating of body image (dis)satisfaction and perception.

Source: adapted from Coelho et al. (2015) and Kakeshita (2008).

	(Dis)satisfaction (perceived silhouette – desired silhouette)	Perception (perceived silhouette – current silhouette)
Difference	Rating	Rating
between −1 and 1	Satisfied	Not distorted
≤ −2	Dissatisfied due to thinness	Underestimated body size
≥2	Dissatisfied due to excess weight	Overestimated body size

the media in the quest for the perfect body (Algars et al., 2009; Brown & Tiggemann, 2016; Carrotte, Prichard, & Lim, 2017; Mingoia, Hutchinson, Wilson, & Gleaves, 2017; Tiggemann & Zaccardo, 2015).

A negative body image – for any dimension investigated – is associated with a series of behaviors related to physical and mental health, negatively impacting the quality of life of the population (Cash, 2004; Cash & Grasso, 2005; Nayir et al., 2016). The findings of this article suggest that a negative body image, considering the two dimensions assessed (attitudinal and perceptual), is associated to unhealthy eating, particularly when analyzing feelings about body (dis)satisfaction. This association is reason for concern because the prevalence of dissatisfied individuals in the population is high, as observed in the present and previous studies (Coelho et al., 2015; Santos Silva et al., 2011).

In this study, it is not possible to infer a cause and effect relationship between body image and food consumption due to the cross-sectional design. We suggest that future studies focus on investigating the possible mechanisms involved in the relationships found in our study.

However, considering our findings and the potential health impact of body image dissatisfaction and/or distortion through a poor diet (characterized by low consumption of unprocessed or minimally-processed foods and culinary preparations and high consumption of ultra-processed foods), public policies to promote a healthier food consumption are urgent, given that individual choices and behaviors are influenced by context and food environment. A number of proposals regulating ultra-processed foods are undergoing review (Hawkes et al., 2015). Front-of-pack nutrition information appear to be an effective alternative for reducing the intake of ultra-processed foods (Arrúa et al., 2017; Chile, 2017; Olivares-Cortés et al., 2017). Taxing sugar-sweetened foods and beverages is another effective way of controlling consumption, helping to reduce obesity rates (Colchero, Molina, & Guerrero-López, 2017; Fletcher, Frisvold, & Tefft, 2011; Hernández-F, Batis, Rivera, & Colchero, 2019; Sharma, Hauck, Hollingsworth, & Siciliani, 2014). The influence which advertising of ultra-processed foods exerts on the population should not be underestimated. This is particularly relevant in the context of the present study, whereby media also has a negative influence on body image. This emphasizes the need for implementing laws to govern the aggressive marketing by the food industry, given that such measures have proven effective (Maia et al., 2017). Integrating the public policy actions outlined above is paramount to weaken the associations found, as are food and nutrition education programs encouraging the consumption of unprocessed or minimally-processed foods and culinary preparations.

This study has some limitations. No instrument for assessing food consumption, developed and validated for the NOVA classification, is yet available owing to the recency of the development and publication of the classification system. Also, the FFQ used includes foods which can be classified into more than one NOVA group. In order to resolve this shortcoming, different proportions of energy of these foods were allocated into different groups according to data from national food consumption. While the FFQ provides a picture of eating habits by assessing a 6-month period, body image is a snapshot at the time of the evaluation and may be influenced by a host of factors. For the evaluation of body image, the original categorization proposed by the author of the silhouette scale (Kakeshita, 2008) was not used. Due to

the small size of the original reference categories (satisfied and not distorted classified as a difference of silhouettes = 0) and taking into account that no important differences were observed, we opted to be more flexible in classifying the individuals (satisfied and not distorted classified as a difference of silhouettes between −1 and 1). Data obtained using the original body image classification are available in the supplementary material 3.

The cross-sectional study design precludes any inference on the causality of events. Food consumption was the study outcome given the large number of studies addressing this relationship. However, given its relationship with obesity, consumption can also be considered an exposure, in as far as it can impact body image and create a vicious circle of influence. Considering the previously verified relationship between BMI and ultra-processed food consumption (Juul, Martinez-Steele, Parekh, Monteiro, & Chang, 2018; Louzada et al., 2015; Mendonça et al., 2016), current BMI, and not body image, might be associated with food consumption, which reinforces the importance of including BMI adjustment in regression models. Lastly, because age can influence body image, a sensitivity analysis involving only elderly participants (60 years or older) was performed. No differences in magnitude or statistical significance of percentages or coefficients were found. Consequently, the original number of individuals was maintained, including age in the adjusted coefficients. However, it should be noted that the method used to assess body image is empirically based, since it was developed according to the BMI of Brazilian adults and this scale has a greater number of silhouette options to ensure the difference between them is minimal. Nevertheless, although this study was an advance in the attempt to measure perceptual distortion, the measure used has limitations since the BMI corresponding to each silhouette is not able to assess different components of the individuals' body size, disregarding body composition. A strength of the present investigation is that it elucidates the scenario of body image (dis)satisfaction and perception in men, a sex generally not included in studies on this theme. Another strength is the innovative use of the NOVA classification. This system is increasingly recognized and adopted in reports, statements, and comments by the Food and Agriculture Organization (FAO) and the Pan-American Health Organization (PAHO), besides in national and international scientific journals, and represents an important way for assessing foods and their implications for public health.

5. Conclusion

Body image (dis)satisfaction and perception were associated with food consumption. There was association of both overestimation of body size and dissatisfaction due to excess weight in women with low consumption of unprocessed or minimally-processed foods and culinary preparations. Furthermore, in this cross-sectional study, dissatisfaction due to excess weight in women was associated with a higher consumption of ultra-processed foods, suggesting that this group is more likely to adopt unhealthy eating habits as a result of negative body image.

Body image and food consumption can be modified, highlighting the importance of implementing strategies that address ultra-processed foods to reduce their deleterious effects on health and enhance the

population's quality of life.

Declarations of interest

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.appet.2019.104464.

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