



Clustering of obesogenic behaviors and association with body image among Brazilian adolescents in the national school-based health survey (PeNSE 2015)

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ABSTRACT

This study aimed to examine the association between clusters of obesogenic behaviors and body image indicators among a population-based sample of Brazilian adolescents. Data from a cross-sectional country representative survey of 9th grade students (N = 102,301) were analyzed. Physical activity (PA), sedentary behavior (SB) and body image indicators (i.e. satisfaction, perception, value, and weight control attitudes and behaviors) were self-reported. Three clusters were previously validated with two-steps cluster analysis: “Health-promoting SB and diet”, “Health-promoting PA and diet”, and “Health-risk”. Multinomial and binary logistic regression were used to associate clusters with body image indicators. Adolescents in the healthier clusters were more likely to be satisfied/very satisfied with body image and perceive themselves as having normal weight than those in the “Health-risk” cluster. Boys in both health-promoting clusters were more likely to consider body image as being important/very important and perceive themselves to be thin/very thin. Adolescents in the “Health-promoting PA and diet” cluster were more likely to be trying to lose or gain weight than those in the “Health-risk” cluster. Girls in the “Health-promoting SB and diet” cluster had lower odds of adopting unhealthy weight control behaviors than those in the “Health-risk” cluster. The effect of obesogenic behaviors on distinct aspects of body image was confirmed and found to vary according to different synergies between adolescents’ health-related behavior. These findings provide important insights on the understanding of behavioral profiles which can be targeted to prevent unhealthy weight control behaviors and weight related disorders, especially among girls.

1. Introduction

Obesogenic behaviors and obesity are associated to body image discontentment among children and adolescents and appears to be a serious public health concern due to their high prevalence and adverse effects on psychological health (Costa et al., 2016; Iannotti and Wang, 2013).

Different aspects of psychological health like body image seem to be influenced by obesogenic behaviors such as physical activity (PA), diet, and sedentary behavior (SB) (Huang et al., 2007; Finne et al., 2014). Indeed, body image is shaped by emotions, physical sensations, physical experience, and environment (Croll, 2005), in this sense, understanding behavioral patterns of PA, diet, and SB in adolescence appears to be important to better predict an individual’s health (Dodd et al., 2010; Leech et al., 2014).

However, these behaviors in adolescents occur synergistically in healthy and unhealthy ways (Kremers, 2010; Leech et al., 2015), and a negative lifestyle appears to have a harmful effect on psychological health such as some body image indicators, depressive tendencies, and life satisfaction (Iannotti and Wang, 2013).

Iannotti and Wang (2013) observed that, in the clustering pattern in which a negative lifestyle prevailed, body dissatisfaction appeared. This is an important concern considering that the prevalence overweight and obesity in children and adolescents has increased substantially in the last 40 years in developing countries; the pooled analysis of almost 130 million participants from 200 countries suggest that in 2016, 75 million girls and 117 million boys worldwide were moderately or severely underweight, and 50 million girls and 74 million boys were obese (NCD-RisC, 2017). Indeed, evidence suggests adverse relationship

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between obesity and body image consequences throughout the life-course (Mond et al., 2011). In the south of Brazil, body dissatisfaction was prevalent in more than 80.0% students aged 7–10 years and excess weight was associated with a normative discontent regarding body image (Costa et al., 2016).

On the other hand, a healthful pattern was associated with a better psychological disposition with fewer symptoms of depression and better life satisfaction, which indicates that the association between obesogenic behaviors and psychological health cannot be ignored. However, evidence about different clusters of obesogenic behaviors and psychological status remains limited, and obesogenic behaviors have been individually investigated with body image rather than considering synergy among them (Asare and Danquah, 2015; Añez et al., 2018; Miranda et al., 2018).

Studies suggest that many adolescents with body image dissatisfaction engage in a range of unhealthy body change strategies. For instance, excessive concern with body image and shape can lead to health-risk attitudes leading to use of drugs for weight control (Thorlton et al., 2014), restrictive dieting and disordered eating behaviors (Neumark-Sztainer et al., 2006), or even excessive PA practices and use of anabolic steroids (Yager et al., 2017). Therefore, identifying adolescents' health-related behaviors exposing factors that detract from or protect body image concerns such as feeling of embarrassment and body image satisfaction may constitute an important public health strategy as body image has been identified as an important interpersonal mediator for health status (Ssewanyana et al., 2018). This study aimed to examine the association between clusters of obesogenic behaviors (PA, diet, and SB) and body image indicators (satisfaction; perception; value; and weight control attitudes and behaviors) among a national population-based sample of Brazilian adolescents.

2. Methods

2.1. Study design and participants

The present study used data from the third edition of the National School-based Health Survey (PeNSE) conducted in 2015. PeNSE was developed based on World Health Organization recommendations for student health survey; it was conducted with students enrolled in the 9th grade of elementary school and is part of the Brazilian Surveillance of Risk and Protective Factors for Chronic Diseases. It is a cross-sectional study performed triennially, and three editions were held (2009, 2012, and 2015) with a partnership between the Ministry of Health and Brazilian Institute of Geography and Statistics and support of the Ministry of Education of Brazil. The survey's core objective is to evaluate aspects of health and lifestyle behaviors of adolescents in public and private schools in Brazil. Participation of all subjects was in accordance with ethical guidelines. The project was submitted and approved by the National Committee of Ethics in Research number 1.006.467/2015.

The sample was representative of Brazilian public and private schools in urban and rural areas of the five geographical areas, including all the 26 capitals and the federal district. Data from 102,301 students among 3040 schools were observed. The sampling strategy included geographical stratification and multi-stage selection. The total number of stratified geographical regions was 53 (26 outside the capitals and 27 at the capitals). In all state capitals and the federal district, the primary and secondary sampling units were schools and classrooms, respectively. School selection was proportional to the total number of 9th-year classes while the classes in each school were chosen by simple random selection (schools with less than two 9th-grade classes = one classroom selected, two or more 9th-grade classes = two classrooms selected). The sizes of the samples were calculated to provide estimates in each one of the geographical strata with an approximate maximum error of 3% in absolute values with 95% confidence level. All 9th-grade

students enrolled in morning or afternoon shifts of the elementary schools were considered. In Brazil, most students attend school in two shifts either from early morning to around midday or from around midday to late afternoon. Further details of the sampling design can be found elsewhere (de Oliveira et al., 2017). Those who declined to take part in the research or did not report their age or sex on the questionnaire ($n = 229$; 0.22%) were excluded.

2.2. Measures

The questionnaire used in the survey was broadly based on the Global School-Based Student Health Survey and Youth Risk Behavior Surveillance System. A pilot test was conducted to make adjustments and determine adequacy. The survey was completed using an electronic questionnaire via smartphone. The measures of interest were previously validated (Guedes and Lopes, 2010).

2.3. Clustering procedures

The clustering procedures were previously identified and validated in Matias et al. (2018) study and three health-related behaviors were analyzed (PA, diet, and SB). Students' PA was assessed using the following question: *In the past seven days, without considering physical education class, how many days did you practice some physical activity like sports, dance, gym exercises, fighting sport, or other activity?* The answers ranged from none to seven days in a week.

Diet was assessed using seven questions in which adolescents reported on how many days in the last week they had eaten green salads or vegetables, fruits, deep-fried snacks, candies, soda, fast foods (e.g., hot dog or pizza from a fast food establishment), and ultra-processed foods (e.g. hamburger, mortadella, sausage, instant noodles or packet snacks). The possible answers ranged from one to seven days. An exploratory factor analysis was used to identify dietary patterns. The two food groups were 1) fried snacks, candies, soda, ultra-processed, and fast foods ("Snacks, Salt, and Beverages – SSB") and 2) green salads or vegetables and fruits ("Fruits and Vegetables – F&V").

SB was measured using the following question: *On a regular day, how much time do you spend watching television, playing videogames, talking with friends, or in other sitting activities?* The response options ranged from one to nine hours a day.

A two-step cluster analysis was conducted based upon four health-related variables (PA, SSB, F&V, and SB). Three clusters were identified in 100,794 adolescents (Table 1).

2.4. Body image variables

In the present study, body image represents a multidimensional construct characterized by four aspects: satisfaction, perception, value, and weight control attitudes and behaviors. The questions, questionnaire responses, and grouped categories are presented in Table 2.

2.5. Statistical analysis

All descriptive and inferential analyses were conducted using STATA package, version 15 (Stata Inc., College Station, TX, USA), and the procedures for complex sampling and weighting were used to incorporate strata, conglomerates, and sample weight. First, absolute and relative frequency with 95% confidence intervals (95%CI) were used to describe both outcome and exposure variables. Multinomial and binary logistic regression models were used to evaluate the associations between clusters and body image. The "Health-risk" cluster (low PA, 2–3 days of F&V and SSB, high SB) was defined as a reference category in the regression models. The analyses were adjusted for age (complete years), mothers' education (non-educated, incomplete elementary school, elementary school, high school, or college), ethnicity

Table 1
Students' clustering based on health-related behaviors. PeNSE, Brazil, 2015.

	Cluster 1 Health-promoting SB and diet n = 32,814 mean ± sd (range)	Cluster 2 Health-promoting PA and diet n = 45,234 mean ± sd (range)	Cluster 3 Health-risk n = 22,746 mean ± sd (range)
Physical activity (days/week)	0.68 ± 0.92 (0, 4)	4.56 ± 2.05 (0, 7)	0.86 ± 1.24 (0, 6)
Sedentary behavior (h/day)	2.59 ± 1.55 (1, 7)	3.85 ± 2.31 (1, 9)	7.78 ± 1.39 (3, 9)
SSB (days/week)	1.68 ± 0.97 (0, 4.8)	2.87 ± 1.49 (0, 7)	3.24 ± 1.45 (0, 7)
F&V (days/week)	2.68 ± 1.97 (0, 7)	4.10 ± 2.07 (0, 7)	2.58 ± 1.97 (0, 7)

Note: SSB: Snacks, Salt, and Beverages; F&V: Fruits and Vegetables.

(Caucasian, Afro-Descendant, indigenous, Asian, or multiethnic) and work status (employed or not employed). The results were expressed in odds ratios (OR) and their respective 95%CI.

3. Results

3.1. Sample characteristics

The sample was composed by adolescents (51.3% girls; 56.5% Afro-Descendants; 36.1% Caucasian) with a mean age of 14.3 ± 1.1 years old. Regarding mother's education, 25.6%, 17.3%, and 32.9% of adolescents' mothers had concluded their elementary degree, high school, and college, respectively. A total of 13.4% of the adolescents had a job. The proportions of adolescents who reported being satisfied/very satisfied with body image and who consider body image as important/very important were over 70% and 80%, respectively. Approximately 55% from adolescents perceived body image as normal weight while 25% perceived it as thin/very thin. The prevalence of adolescents who were trying to lose weight was 25.7%, almost 7% of them had used pills to control weight, and 7% reported the practice of vomiting or using laxatives to lose or avoid gaining weight. Detailed descriptions of body image variables according to gender are available in Table 3.

3.2. Associations between obesogenic clusters and body image satisfaction

Adolescents in the "Health-promoting SB and diet" (boys OR: 1.68, 95%CI: 1.45, 1.94; girls OR: 1.69, 95%CI: 1.53, 1.86) and "Health-promoting PA and diet" clusters (boys OR: 2.10, 95%CI: 1.84, 2.39; girls OR: 1.67, 95%CI: 1.51, 1.85) were more likely to be satisfied/very satisfied with body image than those in the "Health-risk" cluster (Table 4).

Table 2
Body image indicators with their respective questions, questionnaire responses and grouped categories used in analyses. PeNSE, Brazil, 2015.

Indicator	Question	Questionnaire response	Grouped categories
Satisfaction	How do you feel about your body?	(1) Very satisfied; (2) Satisfied; (3) Indifferent; (4) Dissatisfied; (5) Very dissatisfied	(1) Dissatisfied/Very Dissatisfied; (2) Indifferent; (3) Satisfied/Very satisfied
Perception	Regarding your body, do you consider yourself	(1) Very thin; (2) Thin; (3) Average; (4) Fat; (5) Very fat.	(1) Fat/Very fat; (2) Normal; (3) Thin/Very thin
Value	Do you consider your body image as:	(1) Very Important; (2) Important; (3) Somewhat important; (4) Not important	(1) Not important/Somewhat important; (2) Important/Very important
Weight attitudes	What are you doing about your weight?	(1) Doing nothing about; (2) Trying to lose weight; (3) Trying to gain weight; (4) Trying to maintain weight	(1) Doing nothing about; (2) Trying to lose weight; (3) Trying to gain weight; (4) Trying to maintain weight
Pills to lose weight	During the past 30 days, did you take any pills, powders, or liquids without a doctor's advice to lose weight or to keep from gaining weight?	(1) No; (2) Yes	(1) Did not use pills; (2) Used pills
Pills to gain weight	During the past 30 days, did you take any pills, powders, or liquids without a doctor's advice to gain weight?	(1) No; (2) Yes	(1) Did not use pills; (2) Used pills
Vomiting or using laxatives	During the past 30 days, did you vomit or take laxatives to lose or avoid gaining weight?	(1) No; (2) Yes	(1) Did not vomit or use laxatives; (2) Vomit or use laxatives

Table 3
Proportion (%) and 95% Confidence Intervals (95%CI) of body image indicators by gender. PeNSE, Brazil, 2015.

Variables	Boys (48.7%)		Girls (51.3%)	
	%*	95%CI	%*	95%CI
Body Image Satisfaction (n = 100,867)				
Dissatisfied/Very Dissatisfied	11.6	(11.1; 12.2)	23.3	(22.6; 24.1)
Indifferent to Body Image	10.5	(10.0; 11.1)	10.1	(9.7; 10.5)
Satisfied/Very Satisfied	77.9	(77.1; 78.6)	66.6	(65.8; 67.4)
Body Image Perception (n = 100,995)				
Perceives Body Image as Fat/Very Fat	14.6	(14.0; 15.2)	21.8	(21.2; 22.5)
Perceives Body Image as Normal Weight	59.2	(58.4; 60.0)	52.8	(52.0; 53.6)
Perceives Body Image as Thin/Very Thin	26.2	(25.5; 26.9)	25.4	(24.6; 26.1)
Body Image Value (n = 100,975)				
Not Important/Somewhat Important	18.1	(17.5; 18.9)	13.8	(13.3; 14.3)
Important/Very Important	81.9	(81.1; 82.5)	86.2	(85.7; 86.7)
Weight Attitude (n = 100,893)				
Doing nothing about weight	42.8	(42.1; 43.6)	36.2	(35.3; 37.0)
Trying to lose weight	20.5	(19.8; 21.2)	30.3	(29.5; 31.2)
Trying to gain weight	17.2	(16.6; 17.9)	15.4	(14.8; 15.9)
Trying to maintain weight	19.5	(18.8; 20.1)	18.1	(17.5; 18.8)
Pills Use to Gain Weight (n = 100,606)				
No	93.2	(92.7; 93.6)	94.8	(94.4; 95.1)
Yes	6.8	(6.4; 7.3)	5.2	(4.9; 5.6)
Pills Use to Lose Weight (n = 100,514)				
No	91.4	(90.8; 91.9)	94.4	(94.0; 94.8)
Yes	8.6	(8.1; 9.2)	5.6	(5.2; 6.0)
Vomiting or Laxative Use (n = 100,846)				
No	93.5	(93.0; 94.0)	92.5	(92.0; 92.9)
Yes	6.5	(6.0; 7.0)	7.5	(7.1; 8.0)

Note: *Weighted proportions.

Table 4

Cluster's profiles associated with body image satisfaction (n = 99,750), body image perception (n = 99,853) and body image value (n = 99,851) according to gender. PeNSE, Brazil, 2015.

Variables	Boys				Girls			
	Crude		Adjusted		Crude		Adjusted	
	OR	IC95%	OR	IC95%	OR	IC95%	OR	IC95%
Outcome 1 - Body Image Satisfaction								
<i>Dissatisfied/Very Dissatisfied (ref)</i>								
Indifferent to Body Image								
Health-risk cluster	1.00		1.00		1.00		1.00	
Health-promoting SB and diet cluster	1.08	(0.89; 1.32)	1.13	(0.92; 1.38)	1.20*	(1.04; 1.39)	1.20*	(1.04; 1.40)
Health-promoting PA and diet cluster	1.16	(0.98; 1.37)	1.17	(0.99; 1.39)	1.14	(0.97; 1.34)	1.16	(0.99; 1.36)
Satisfied/Very Satisfied								
Health-risk cluster	1.00		1.00		1.00		1.00	
Health-promoting SB and diet cluster	1.75*	(1.51; 2.02)	1.68*	(1.45; 1.94)	1.79*	(1.62; 1.97)	1.69*	(1.53; 1.86)
Health-promoting PA and diet cluster	2.08*	(1.83; 2.37)	2.10*	(1.84; 2.39)	1.63*	(1.47; 1.80)	1.67*	(1.51; 1.85)
Outcome 2 - Body Image Perception								
<i>Perceives Body Image as Fat/Very Fat (ref)</i>								
Perceives Body Image as Normal Weight								
Health-risk cluster	1.00		1.00		1.00		1.00	
Health-promoting SB and diet cluster	1.62*	(1.41; 1.86)	1.52*	(1.32; 1.74)	1.66*	(1.50; 1.84)	1.58*	(1.43; 1.76)
Health-promoting PA and diet cluster	1.85*	(1.63; 2.09)	1.84*	(1.63; 2.08)	1.45*	(1.30; 1.62)	1.48*	(1.33; 1.65)
Perceives Body Image as Thin/Very Thin								
Health-risk cluster	1.00		1.00		1.00		1.00	
Health-promoting SB and diet cluster	1.25*	(1.06; 1.47)	1.17*	(1.00; 1.38)	1.17*	(1.04; 1.32)	1.14*	(1.01; 1.28)
Health-promoting PA and diet cluster	1.25*	(1.09; 1.44)	1.25*	(1.09; 1.44)	0.97	(0.86; 1.10)	0.99	(0.88; 1.12)
Outcome 3 - Body Image Value								
<i>Not Important/Somewhat Important (ref)</i>								
Important/Very Important								
Health-risk cluster	1.00		1.00		1.00		1.00	
Health-promoting SB and diet cluster	1.25*	(1.08; 1.44)	1.20*	(1.04; 1.38)	1.06	(0.95; 1.19)	1.04	(0.93; 1.16)
Health-promoting PA and diet cluster	1.53*	(1.36; 1.71)	1.51*	(1.35; 1.69)	1.19*	(1.06; 1.34)	1.18*	(1.05; 1.33)

Note: *Significant at $p < 0.05$ (Wald test for heterogeneity); OR: Odds Ratio; 95%CI: Confidence Interval of 95%; Models adjusted for age, maternal education, ethnicity and work status.

3.3. Associations between obesogenic clusters and body image perception

Boys in both healthy clusters ("Health-promoting SB and diet" OR: 1.17, 95%CI: 1.00; 1.38; "Health-promoting PA and diet" OR: 1.25, 95%CI: 1.09, 1.44) and girls in the "Health-promoting SB and diet" cluster (OR: 1.14, 95%CI: 1.01, 1.28) were more likely to consider body image thin/very thin compared to a fat/very fat body image perception. Adolescents in both healthy clusters were also more likely to perceive body image as normal weight compared to those in the "Health-risk" cluster (Table 4).

3.4. Associations between behavioral clusters and body image value

Boys in both healthiest clusters ("Health-promoting SB and diet" OR: 1.20, 95%CI: 1.04, 1.38; "Health-promoting PA and diet" OR: 1.51, 95%CI: 1.35, 1.69) and girls in the "Health-promoting PA and diet" cluster (OR: 1.18, 95%CI: 1.05, 1.33) had higher ORs for considering body image important/very important over somewhat important/not important compared to those in the "Health-risk" cluster (Table 4).

3.5. Associations between behavioral clusters and weight control attitudes and behaviors

Adolescents in the "Health-promoting PA and diet" cluster were more likely to be trying to lose (boys OR: 1.42, 95%CI: 1.25, 1.62; girls OR: 1.74, 95%CI: 1.57, 1.93) or gain weight (boys OR: 1.40, 95%CI: 1.22, 1.62; girls OR: 1.24, 95%CI: 1.11, 1.39) than those in the "Health-risk" cluster. Both healthiest clusters were associated with trying to maintain weight among boys ("Health-promoting SB and diet" OR: 1.22, 95%CI: 1.04, 1.43; "Health-promoting PA and diet" OR: 2.25,

95%CI: 1.97, 2.58) and girls ("Health-promoting SB and diet" OR: 1.21, 95%CI: 1.08, 1.36; "Health-promoting PA and diet" OR: 2.37, 95%CI: 2.11, 2.66) compared to the "Health-risk" cluster and doing nothing about weight (Table 5).

In relation to pill consumption, girls in the "Health-promoting SB and diet" cluster had lower ORs for using pills to lose (OR: 0.66, 95%CI: 0.56, 0.78) or gain (OR: 0.61, 95%CI: 0.51, 0.73) weight than those in the "Health-risk" cluster (Table 4). Similarly, girls in the "Health-promoting SB and diet" were less likely to practice vomiting or taking laxatives to lose or avoid gaining weight (OR: 0.63, 95%CI: 0.54; 0.73).

4. Discussion

The present study aimed to examine the association between clusters of obesogenic behaviors (PA, diet, and SB) and body image indicators among Brazilian adolescents. In general, it was observed that the effect of obesogenic behaviors on distinct aspects of body image varied according to their clustering and adolescents in both healthiest clusters seemed to present a better body image perception. They were also more likely to be engaged in weight control attitudes than those in the "Health-risk" cluster. A previous study observed that adolescents with a healthiest pattern of behaviors (higher probability of meeting PA and SB recommendations with a healthier diet) presented better life satisfaction and overall health status (Iannotti and Wang, 2013). In the same study, adolescents with lower probability of meeting PA recommendations and lower consumption of fruits and vegetables were more dissatisfied with their bodies than those with the healthiest pattern of behaviors (Iannotti and Wang, 2013). These findings confirmed the association between patterns of obesogenic behaviors and adolescents' psychological health (Iannotti et al., 2009).

Table 5

Cluster's profiles associated with weight attitude (n = 99,767) and consumption of pills to lose (n = 99,511) or to gain weight (n = 99,441) according to gender. PeNSE, Brazil, 2015.

Variables	Boys				Girls			
	Crude		Adjusted		Crude		Adjusted	
	OR	IC95%	OR	IC95%	OR	IC95%	OR	IC95%
Outcome 1 - Weight Attitude								
<i>Doing nothing about weight (ref)</i>								
Trying to lose weight								
Health-risk cluster	1.00		1.00		1.00		1.00	
Health-promoting SB and diet cluster	0.98	(0.85; 1.12)	1.06	(0.92; 1.22)	0.90*	(0.82; 0.98)	0.96	(0.88; 1.06)
Health-promoting PA and diet cluster	1.42*	(1.25; 1.62)	1.42*	(1.25; 1.62)	1.77*	(1.60; 1.96)	1.74*	(1.57; 1.93)
Trying to gain weight								
Health-risk cluster	1.00		1.00		1.00		1.00	
Health-promoting SB and diet cluster	0.97	(0.84; 1.12)	0.99	(0.86; 1.14)	0.92	(0.82; 1.03)	0.92	(0.82; 1.03)
Health-promoting PA and diet cluster	1.41*	(1.23; 1.62)	1.40*	(1.22; 1.62)	1.25*	(1.11; 1.39)	1.24*	(1.11; 1.39)
Trying to maintain weight								
Health-risk cluster	1.00		1.00		1.00		1.00	
Health-promoting SB and diet cluster	1.18*	(1.01; 1.38)	1.22*	(1.04; 1.43)	1.17*	(1.05; 1.32)	1.21*	(1.08; 1.36)
Health-promoting PA and diet cluster	2.26*	(1.98; 2.59)	2.25*	(1.97; 2.58)	2.39*	(2.13; 2.69)	2.37*	(2.11; 2.66)
Outcome 2 - Pills use to lose weight								
<i>Do not used pills (ref)</i>								
Used pills								
Health-risk cluster	1.00		1.00		1.00		1.00	
Health-promoting SB and diet cluster	1.20	(0.98; 1.47)	1.10	(0.89; 1.36)	0.69*	(0.58; 0.81)	0.66*	(0.56; 0.78)
Health-promoting PA and diet cluster	1.09	(0.90; 1.33)	1.03	(0.84; 1.26)	1.12	(0.97; 1.31)	1.09	(0.94; 1.27)
Outcome 3 - Pills use to gain weight								
<i>Do not used pills (ref)</i>								
Used pills								
Health-risk cluster	1.00		1.00		1.00		1.00	
Health-promoting SB and diet cluster	1.02	(0.84; 1.23)	0.93	(0.76; 1.14)	0.67*	(0.56; 0.79)	0.61*	(0.51; 0.73)
Health-promoting PA and diet cluster	1.18	(1.00; 1.39)	1.12	(0.95; 1.33)	0.94	(0.80; 1.11)	0.93	(0.79; 1.10)
Outcome 4 - Vomiting or Laxative Use								
<i>Neither vomit nor use laxatives (ref)</i>								
Vomit or use laxatives								
Health-risk cluster	1.00		1.00		1.00		1.00	
Health-promoting SB and diet cluster	1.28	(1.03; 1.60)	1.16	(0.94; 1.44)	0.65	(0.56; 0.75)	0.63	(0.54; 0.73)
Health-promoting PA and diet cluster	1.00	(0.80; 1.26)	0.96	(0.76; 1.20)	1.00	(0.85; 1.17)	0.97	(0.82; 1.14)

Note: *Significant at $p < 0.05$ (Wald test for heterogeneity); OR: Odds Ratio; 95%CI: Confidence Interval of 95%; Models adjusted for age, maternal education, ethnicity and work status.

In the present study, adolescents in the “Health-promoting PA and diet” and “Health-promoting SB and diet” clusters were more likely to be satisfied with their body image, to perceive body image as thin/very thin or normal weight, and to consider body image as important. Despite the current results, the complexity of the relationships of diet, PA, and SB with body image appears not to be unidirectional. Studies have demonstrated that adolescents with higher levels of body dissatisfaction engage in fewer health-promoting behaviors, such as PA (Añez et al., 2018), and more in health-compromising behaviors such as unhealthy weight control, binge eating, and chronic dieting (Neumark-Sztainer et al., 2006). On the other hand, adolescents with more frequency of PA were less likely to show body dissatisfaction, and those with higher screen-based media use were more likely to be dissatisfied (Finne et al., 2014). A study with Brazilian girls verified that the frequency of daily access to Facebook and Instagram was associated with body image dissatisfaction (Lira et al., 2017).

There is evidence that PA, SB, and diet are correlated with energy expenditure and correspond to weight control behaviors strategies (Wang et al., 2006). This is particularly interesting considering that boys and girls in the “Health-promoting PA and diet” cluster were more likely to be trying to gain, lose, and maintain weight. Adolescents in this cluster practiced PA for more days/week while those in the “Health-promoting SB and diet” cluster consumed unhealthy food on fewer weekdays. Iannotti and Wang (2013) found a similar healthy

cluster pattern in which adolescents were more likely to be trying to lose weight than adolescents in other clusters, including the unhealthy one. However, it is not clear which behavioral attitudes have higher impact on weight control according to the adolescents’ perception. For instance, a study with Brazilian students aged 7–19 years old observed that 56% of the adolescents reported exercising to lose weight while 40% reported dieting (Vilela et al., 2004). On the other hand, a study with North American children and adolescents showed that unhealthy food habits (e.g., excess of sugar and fat) were selected as main reasons for overweight at their age (Economos et al., 2014), which may lead to attitudes more focused on dieting to weight control (Iannotti and Wang, 2013).

Interestingly, the null association between the “Health-promoting SB and diet” and weight loss/gain behavior, even for girls, can suggest that body image distortion can be prevented if a behavior with less exposure to screen time appears (Rodgers et al., 2015; Mallick et al., 2014).

Another important aspect is that adolescents’ beliefs and attitudes regarding their body image are influenced by cultural context (e.g., ethnicity and religion) and social media exposure (Mallick et al., 2014). The review from Mallick et al. (2014) verified that the thin body ideal commonly observed in Western countries has been evidenced in Eastern countries such as the Philippines, Thailand, Taiwan, Japan, and the United Arab Emirates. However, the attitudes towards weight control

differ between regions. The use of laxatives and diet pills or powders for weight loss as well as forced vomiting were observed among approximately 7% of American girls (Thorlton et al., 2014). In north India, on the other hand, avoiding certain foods and skipping meals were common behaviors among girls with an observed prevalence of 20% (Mishra and Mukhopadhyay, 2011).

Regarding the use of pills to control weight, the present results showed that girls in the “Health-promoting SB and diet” cluster were less likely to use pills to lose or gain weight than those in the “Health-risk” cluster. It is interesting to note that girls in this same cluster were more likely to be trying to maintain weight but not to gain or lose it. Adolescents in the “Health-promoting SB and diet” cluster differed from those in the “Health-risk” cluster mainly in the consumption of SSB and the lower daily time spent in SB, which includes watching TV and using the computer. Consequently, it was expected that adolescents in this cluster were less exposed to TV and social media advertising/influences regarding unhealthy food habits (e.g., fast food) and body ideals. Exposure to social media and advertisements is being evidenced as a risk for body image dissatisfaction (Rodgers et al., 2015), and there is evidence of media exposure being a major contributor to body dissatisfaction and weight control behaviors among adolescent girls (Mallick et al., 2014), which could explain the lower probability of using pills, vomit, or use laxatives as weight control for girls in the “Health-promoting SB and diet” cluster. The contextual environment has been considered in the investigation of predictors or consequences of unfavorable body image and may explain why the “Health-promoting SB and diet” cluster was observed as a protective factor for body image indicators.

The present study has presented some strengths. The sample comprised a nationally representative sample of students from Brazil, and the cluster analysis allowed investigation of which behaviors coexist among this population. As the cluster, patterns may be unique to particular cultures, this study contributed to filling a gap in the literature evaluating patterns of health-related behaviors associated with distinct aspects of psychological health in less-developed countries.

Nevertheless, this study has some limitations that should be considered. The design was cross-sectional and, consequently, includes the biases of cross-sectional cluster analysis. Although this is a national survey, the adapted questionnaire was applied to a sample from a single city of Brazil during the validation procedures. Notwithstanding, a transcultural adaptation of the instrument to Brazilian Portuguese cultured language was carefully conducted by including semantic, idiomatic, cultural and conceptual equivalences. It is important to consider that an adiposity indicator, such as BMI, may be a potential confounder for the associations between health behaviors and body image. However, weight and height information were not properly collected and could not be included in the adjusted analyses. Based on the current literature, it was assumed that a set of behaviors that, when combined, might be protective or deleterious for obesity; however, it is important to note that obesity represents a condition where the interaction between multiple causes appear, including genetic, environmental, and psychosocial factors. The concept of body image was also constrained by a set of indicators that might not represent the body image construct. Mood-related perception change, for example, was not investigated. The overall SB measure included distinct components of screen time behaviors and social activities related to body image, making it difficult to identify its role in body image perceptions and attitudes. In addition, evidence supports the hypothesis that TV-watching and advertisement exposure can be related to worse body image perception (Mallick et al., 2014), although this relationship could not be confirmed with the present SB measure. The diet indicators were evaluated as the frequency of days in which specific foods were consumed. The daily or weekly food intake was not measured, which may have limited the understanding about dietary patterns. Despite assuming the association between patterns of obesogenic behaviors and adolescents’ psychological health, no other measures of mental health

were observed, and results would be more supportive if further measures related to psychological health were considered.

5. Conclusions

It was observed that the effect of obesogenic behaviors on distinct aspects of body image varied according to their clustering among Brazilian adolescents. These results support the holistic perspective on the relationship between modifiable behaviors and psychological health outcomes. It is important to consider that, even knowing that some behaviors are independently related to health, they can occur simultaneously, which can affect health in different ways. The clustering approach of behaviors over psychological status is recent and requires further exploration. These findings provide important insights on the understanding of behavioral profiles which can be targeted to prevent unhealthy weight control attitudes and weight related disorders, especially among girls. Future researches on clustering of health behaviors related to psychological health should look deeper to subgroups where positive and negative behaviors coexist, understanding of how to minimize the impact of a negative behaviors on the cluster itself and in the psychological outcomes. Also, the behavioral transition over time should be a matter of debate.

6. Compliance with ethical standards

Ethical approval: All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent: Informed consent was obtained from all individual participants included in the study.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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