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Breakfast patterns and weight status among adolescents: a study on the Brazilian National Dietary Survey 2008–2009

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Abstract

Examining the composition of breakfast concerning weight status is essential for evaluating adolescent health and understanding this gap. This study aimed to identify breakfast patterns and investigate the relationship with weight status among Brazilian adolescents. We used a subsample of 7425 adolescents aged 10–19 years from the 2008–2009 Brazilian Household Budget Survey. Breakfast eaters were those with intake of at least 50 kcal (209·2 kJ) between 05.00 and 10.00 hours. Breakfast dietary patterns were derived by principal component factor analysis with varimax rotation. We performed logistic regression analyses between breakfast patterns and weight status, considering the complexity of the survey sample design. Three breakfast patterns were identified explaining 44·8 % of data variability: (1) the Cereal, protein, fruit beverages and Northern/Northeastern pattern, characterised by high consumption of cookies, meats, dairy products, preparations with maize, eggs, fruit juices/fruit drinks/soya-based drinks, tubers/roots/potatoes and cereals, and negative adherence to cold cut meat and savoury snacks/crackers; (2) the Protein-based pattern, characterised by positive loadings for cold cut meat, milk and cheese, and negative for cookies, fruit juices/fruit drinks/soya-based drinks, tubers/roots/potatoes and cereals; and (3) the Mixed pattern, with positive loadings for cakes, coffee/tea, bread, fruit juices/fruit drinks/soya-based drinks, chocolate/desserts and savoury snacks/crackers. No association was found between skipping and weight status. Overweight adolescents had lower adherence to the Cereal, protein, fruit beverages and Northern/Northeastern pattern (OR = 0·67; 95 % CI 0·47, 0·96). This is the first study to address dietary patterns at the meal level with adolescent population-based data, which requires further investigation.

Key words: **Adolescent: BMI: Breakfast: Dietary pattern: Population-based**

Childhood obesity is a global challenge due to its increasing global prevalence that will overwhelm health systems and economies in Brazil and other countries[1,2]. Without an effective public policy to manage the problem, Brazil is expected to become the fifth country in the number of obese aged 5–19 years old, representing 7·7 million children[3]. Only behind Mexico, Brazil assumes the second position of the highest gross domestic product loss due to obesity among Organization for Economic Cooperation and Development countries[4]. With a higher risk to persist to adulthood[5,6], obesity negatively affects school development. It is related to weight-related stigma, which can impair the quality of life[7,8]. Childhood obesity has also been associated with higher blood pressure, lower levels of HDL-cholesterol[9] and higher fasting glucose[10].

Identifying dietary patterns is relevant due to its higher capacity to predict overall disease risk than assessment based on individual food or nutrient intake[11,12]. People consume meals that consist of synergistic and complex combinations of several foods and nutrients[12]. The Brazilian Population Dietary Guidelines state that the diet should consider meals and eating patterns more than nutrients and foods and provide guidance on food combinations for breakfast and other main meals (lunch and dinner)[13]. The Brazilian Dietary Guide is an international reference due to its scope and accessibility in the approach of healthy eating and sustainability, besides the clear recommendations of the Brazilian diet to be plant-based and based on fresh and processed foods, thus avoiding the ultra-processed products[14,15].

Research on the role of breakfast skipping and breakfast composition on obesity remains inconclusive[16] despite the importance of breakfast's composition for healthy eating[17–19]. This is partially due to unstandardised methodological breakfast definitions between studies and variations considering the local context[20,21]. *A posteriori* identification of breakfast patterns

Abbreviation: NDS, National Dietary Survey.

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according to the correlations between food items could contribute to understand dietary patterns at the meal level further. Despite most commonly consumed food groups by Brazilian adolescents at breakfast are coffee and tea, breads, butter/margarine, milk, cakes and cookies, packaged snacks, maize-based dishes, cheese, processed meats and fruit juice, with SFA, Na and free sugar exceeding the recommended maximum limits of daily energy intake,[22] understanding how the composition of the breakfast relates to obesity is a further gap to be evaluated.

Few studies have focused on dietary patterns at the meal level[23,24]. In Brazil, while one in every four adolescents is overweight[25], the relationship between dietary breakfast patterns and weight status in adolescents is a gap that must be evaluated. Thus, this study aims to address breakfast patterns and investigate the relationship with weight status among Brazilian adolescents using population-based data.

Methods

Study population and variables' measurement

Brazilian representative study data on the cross-sectional *National Dietary Survey* (NDS) with a 25 % representative subsample (*n* 34 003 individuals) of 10-year-old or above household members from the Brazilian Household Budget Survey 2008–2009 (*n* 55 970) coordinated by the Brazilian Institute of Geography and Statistics (IBGE) with a representative sample of Brazilian households[26]. A two-stage cluster sampling was conducted for the Brazilian Household Budget Survey. Primary sampling units were census tracts from 550 sampling strata. This stage considered geographical and socio-economic homogeneity. Private permanent households composed the secondary sampling units. Adults and elderly, pregnant women, and breast-feeding mothers were excluded from the NDS study, resulting in a subsample of 7425 adolescents aged 10–19 years.

Data on two non-consecutive days' food records were collected from NDS participants. Participants were asked to record all foods and beverages consumed each day (food items, amount consumed, time and place). Usual energy intake for each food was obtained from NDS food composition and food portion tables[27,28]. More information on training and validation of the food records can be found elsewhere[26].

Despite giving useful information on dietary intake, food records capture short-term intake and, as a consequence, fail to estimate the day-to-day variation. To overcome this limitation, we obtained usual food, daily and breakfast energy intakes with the National Cancer Institute method, which consider within person variability, zero intakes and inclusion of covariates to improve intake prediction (age, sex and country region).

First, food records were analysed to evaluate which food item was consumed in each hour of the day. As definition of eating occasion was not available in the food records, every hour with any food consumption was defined as an eating occasion. We then calculated the energy intake for each eating occasion. Second, each food record between 05.00 and 10.00 hours was examined. Third, we classified as breakfast eaters were those who consumed at least 50 energy content (209·2 kJ) in the breakfast usual energy intake between 05.00 and 10.00 hours. When more than one eating occasion occurred in the delimited interval, the most energetic meal was chosen as breakfast. Breakfast-skippers were the adolescents with usual energy intake below 50 energy content and zero energy consumption in both food records in the delimited period. The criteria to define the breakfast by time clock and energy intake were based on the previous literature and other studies applied the same breakfast frequency criteria[11,23].

BMI (weight/(height)^2) was calculated on measured weight (with a portable electronic scale with 150 kg capacity and graduations of 100 g) and height (with a portable stadiometer with a retractable treadmill measuring up to 200 cm and 0·1 cm precision). Imputation procedures were applied for erroneous or missing responses at the critical review stage. Detailed information is available and published elsewhere[29].

Weight status was evaluated using BMI-for-age *z*-score cutoff points based on the reference population aged 5–19 years, proposed by WHO[30]. BMI-for-age *z*-scores were estimated with WHO-Anthro Plus, version 3.2.2[31]. WHO classifies (1) thinness when BMI-for-age < -2 *z*-scores; (2) adequate BMI-for-age > -2 and $< +1$ *z*-scores; (3) overweight when BMI-for-age $> +1$ and $< +2$ *z*-scores; and (4) obesity when BMI-for-age $> +2$ *z*-scores.

Anthro-Plus WHO child's age limits the BMI-for-age analysis to 228 completed months. Since there were 570 (7·68 %) non-classified data for participants older than 228 months, their weight status was based on adult BMI classification. Criteria for 19-year-old individuals used in this study were consistent with the definitions set forth by the WHO, where: BMI $< 18{\cdot}5$ kg/m^2 is classified as underweight; BMI 18·5–24·9 kg/m^2 as normal weight; BMI 25–30 kg/m^2 as overweight (which is equivalent to BMI-for-age $> +1$ and $< +2$ *z*-scores) and BMI ≥ 30 kg/m^2 as obese (which is equivalent to BMI-for-age $> +2$ *z*-scores)[30]. Weight status was classified as a binary variable for the final models of this study. As underweight/thinness (*n* 297; 3·6 %) and obesity (*n* 346; 5·3 %) frequencies were low in this study, those classified as thinness/underweight were added to adequate BMI-for-age/normal weight, and obese adolescents were incorporated into overweight classification.

To estimate equivalent per capita monthly income, the total income for the household (self-reported) was equivalised according to the Organization for Economic Cooperation and Development modified equivalence scale, which assigns weights according to the number and age of household members[33–35]. We used relative poverty to describe the study sample. Relative poverty considers individuals' position concerning the overall living standards and lifestyles of their society[36]. A household income 60 % below the mean or median is considered as relative poverty[37]. We defined relative poverty as the adolescents with equalised income below 60 % of the Brazilian median[33–35].

Statistical analyses

We conducted an exploratory factor analysis with principal components estimation and Varimax rotation to derive dietary breakfast patterns. We initially identified eighteen food groups of usual intakes. We considered eigenvalues over 1·5 and

adequate communalities equal to or above 0·10 to select the number of factors to be retained. After identifying the number of factors (breakfast patterns), the Varimax rotation was performed to maximise higher and minimise lower factor loadings, which simplifies interpretation. The cutoff point over 0·25 (in the module) for the factor loadings after rotation was established for each food group to compose the breakfast patterns. Then, factor scores were estimated by regression analyses[38]. For this study, food items were grouped considering their nutritional value, the Brazilian population's intake and scientific literature on food grouping to estimate dietary patterns[23,39,40]. The food items that were mentioned by less than 2·5 % of the study sample were excluded from the analyses.

The National Cancer Institute method was applied to estimate usual food and breakfast energy intakes to consider between and within person variability among food records, episodically consumed foods, and asymmetric amount distribution[41].

The associations between breakfast skipping and breakfast patterns factor scores with weight status were estimated by logistic regression modelling, crude and adjusted for potential confounders (sex, age, equivalent monthly per capita income, the region of the country and daily energy intake). Weight status was applied as a binary variable for these analyses. Regression analyses considered the survey sample design's complexity using SAS OnDemand for Academics® (SAS Institute Inc.). This study was conducted according to the Declaration of Helsinki, and all procedures involving human subjects were approved by the local ethics committee.

Results

On average, adolescents were 14·5 years old, 35·3 % were breakfast-skippers, 21·4 % were overweight and 17·1 % were living in relative poverty. The highest proportion was from the Southeast area (39·4 %). About 16·1 % of adolescents in this study were overweight, and 5·3 % were obese. More girls than boys were thin. Adolescents who were younger, relatively poor and from the Southeast were more likely to be overweight or obese. Adolescents from the Northeast were less likely to be overweight or obese, and those from the North were less likely to be obese only (Table 1).

We identified three breakfast patterns of Brazilian adolescents, which explained 44·8 % of data variability. We named the patterns following the food groups with higher factor loadings. The Cereal, protein, fruit beverages and Northern/Northeastern pattern had positive loadings for cookies, meats, dairy products, preparations with maize, eggs, fruit juices, fruit drinks or soya-based drinks, tubers, roots or potatoes, cereals, and negative loadings cold cut meat, and savoury snacks or crackers. The Protein-based diet pattern had positive loadings for cold cut meat, milk, cheese, and negative for cookies, fruit juices, fruit drinks or soya-based drinks, tubers, roots or potatoes and cereals. The Mixed pattern was characterised by the intake of cakes, coffee or tea, bread, fruit juices, fruit drinks or soya-based drinks, chocolate or desserts, savoury snacks or crackers (Table 2).

Table 3 shows the logistic regression analyses for breakfast frequency, breakfast patterns and binary weight status, the response variable. There was no significant association between skipping breakfast, Protein-based or Mixed breakfast patterns with binary weight status. The Cereal, protein, fruit beverages and Northern/Northeastern pattern was inversely associated with weight status (OR = 0·67, *P*-value = 0·028).

Discussion

Brazilian adolescents who usually have breakfast encompass the three main breakfast dietary patterns: the Cereal, protein, fruit beverages and Northern/Northeastern pattern, named as such

Table 1. Main characteristics of Brazilian adolescents. National Dietary Survey 2008–2009. Total and according to weight status (numbers and percentages)

	Total		Thinness 3·56 % (*n* 1 192 871)		Normal 75·07 % (*n* 25 151 725)		Overweight 16·05 % (*n* 5 377 664)		Obesity 5·32 % (*n* 1 781 411)	
	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*
Breakfast frequency										
Eaters	64·72	21 684 530	68·61	818 531	64·21	16 150 493	66·80	3 592 364	63·05	1 123 141
Skippers	35·28	11 819 141	31·38	374 340	35·78	9 001 232	33·20	1 785 300	36·95	658 270
Sex										
Male	52·42	17 561 125	40·36‡	481 427	52·33	13 161 783	55·88	3 005 116	51·24	912 799
Female	47·59	15 942 546	59·64	711 444	47·67	11 989 942	44·12	2 372 548	48·76	868 612
Age										
Mean	14·47		14·54		14·64		14·00‡		13·41‡	
SD	0·05		0·22		0·05		0·13		0·17	
Relative poverty										
> 60 % of median	82·89	27 771 480	82·49	984 037	81·59	20 520 905	86·51†	4 651 974	90·63†	1 614 564
≤ 60 % of median	17·11	5 732 191	17·51	208 834	18·41	4 630 820	13·49	725 690	9·37	166 847
Brazilian Regions										
North	9·51	3 185 369	8·99	107 177	10·16	2 555 494	8·17	439 267	4·68*	83 432
Northeast	30·37	10 175 204	37·56	448 063	31·83	8 005 348	25·22*	1 356 035	20·53*	365 758
Midwest	7·33	2 455 540	8·38	99 977	7·52	1 891 736	6·93	372 905	5·10	90 922
Southeast	39·36	13 187 961	36·57	436 277	37·49	9 430 424	45·73*	2 459 095	48·40*	8 621 660
South	13·43	4 499 596	8·50	101 378	13·00	3 268 722	13·95	750 363	21·28	379 133

P-values of multinomial regression models: **P*-value < 0·05; †*P*-value < 0·01; ‡*P*-value < 0·001.

Table 2. Factor loadings of eighteen food groups for three breakfast patterns among Brazilian adolescents. National Dietary Survey 2008–2009

Food groups	Factor 1 CPFBN†	Factor 2 Protein	Factor 3 Mixed	Communality estimates
Meats	0·86*	0·10	0·03	0·75
Eggs	0·82*	0·07	0·01	0·68
Preparations with maize	0·81*	0·04	–0·17	0·69
Tuber, roots or potatoes	0·75*	–0·44	0·05	0·76
Dairy products‡	0·70*	–0·02	0·04	0·49
Cereals	0·67*	–0·61*	0·00	0·82
Cookies	0·52*	–0·33*	–0·12	0·40
Fruit juices, fruit drinks or soya-based drinks	0·43*	–0·33*	0·43*	0·48
Cold cut meats	–0·31*	0·74*	0·06	0·65
Cheese	0·13	0·73*	–0·14	0·57
Milk	–0·19	0·53*	0·11	0·33
Coffee or tea	0·13	0·10	0·64*	0·44
Savoury snacks or crackers	–0·40*	0·11	0·47*	0·39
Cakes	–0·01	–0·09	0·45*	0·21
Chocolate or desserts§	–0·09	0·07	0·44*	0·21
Bread	0·06	0·15	0·38*	0·17
Oil or butter	0·03	0·15	0·02	0·02
Fruits	0·03	0·06	–0·09	0·01
Eigenvalues	4·89	1·74	1·44	
% of accumulated explained variance	27·16	36·80	44·82	

* Pointed out as loads > |0·25|.
† CPFBN: Cereal, protein, fruit beverages and Northern/Northeastern pattern.
‡ Excluding milk-based desserts and cheese.
§ Including chocolate drinks and candies.

Table 3. Breakfast frequency and usual breakfast dietary patterns in Brazilian adolescents for the outcome binary weight status. National Dietary Survey 2008–2009
(Odds ratios and 95 % confidence intervals, *n* 4991)

	OR	95 % CI
Model 1 – Breakfast frequency*	1·10	0·89, 1·36
Model 2 – Breakfast dietary patterns*		
CPFBN†	0·67	0·47, 0·96
Protein-based	1·02	0·90, 1·17
Mixed	1·01	0·82, 1·25

* Logistic regression analysis was adjusted for sex, age, equivalent monthly per capita income, region of the country and daily energy intake.
† CPFBN: Cereal, protein, fruit beverages and Northern/Northeastern pattern.

due to higher adherence to cookies, meats and dairy, accompanied by beverages, but also to food groups that represent usual breakfast from North and Northeast Brazilian regions, such as tubers, roots and potatoes, preparations with maize and eggs, as observed in previous research using the same data of the present study[22]; the Protein-based pattern, characterised as such by the inclusion of milk, cheese and processed meats; and a third breakfast pattern named Mixed, because bread and coffee, fruit juices and cakes were the main breakfast-consumed food items among Brazilian adolescents[22]. We also found that adolescents with overweight or obesity had lower adherence to the Cereal, protein, fruit beverages and Northern/Northeastern pattern. Nevertheless, our study showed no relationship between skipping breakfast and weight status.

In common, the three patterns of the study were composed of food items that represent both a healthy and an unhealthy diet. On the one hand, the Cereal, protein, fruit beverages and Northern/Northeastern pattern was characterised by a healthier diet due to the higher adherence to traditional Brazilian food groups mostly consumed at breakfast among adolescents from Northern (roots and tubers) and Northeastern regions (maize-based dishes and eggs)[22]. On the other hand, this pattern presented higher adherence to cookies, and fruit and soya-based drinks. In common, both food groups are composed of home-made and processed cookies and beverages as well as ultra-processed unhealthy cookies and sugar-sweetened beverages. The named Mixed pattern includes healthy food items usually consumed by the Brazilian adolescents[42], such as coffee and bread, and also unhealthier ones, as some sugar-sweetened beverages, chocolate, desserts, savoury snacks and crackers. In the same sense, the protein-based includes both cold cut ultra-processed food items and in natural or processed foods, such as cheese and milk.

Comparing our findings to overall dietary patterns for Brazilian adolescents, the Study of Cardiovascular Risk in Adolescents (ERICA), a nationwide school-based survey with adolescents aged 12–17 years, the authors also found three overall dietary patterns for most Brazilian geographic regions. The labelled Mixed pattern was partially characterised by most eaten food items usually consumed in Brazilian lunch and dinner, which are rice, meat and beans[42]. Despite ERICA dietary patterns being evaluated on the overall daily basis, the authors labelled a Bread-and-coffee pattern which had similarities to the Mixed breakfast pattern from our study. Their Unhealthy pattern also has similarities with some foods of our Mixed pattern which includes cakes and cookies, sugar-sweetened beverages and sweets/desserts. In the North region, the authors observed a fourth overall dietary pattern characterised by typical regional foods, consisting of tubers, fruits and vegetables, which resembles the present study's Cereal, protein, fruit beverages and Northern/Northeastern pattern[43]. Other studies have shown that North and Northeast Brazilian consume traditional local foods like fish with flours and starches, cassava and maize-based preparations, such as tapioca and maize couscous[44–46].

Another study with Brazilian adolescents that gathered data from the National School-Based Health Survey (PeNSE)[47] with ninth-graders from private and public schools identified three overall dietary patterns by cluster analysis. They labelled a Healthy pattern characterised by a higher intake of cooked vegetables, fruits, milk, raw vegetables and beans and a lower intake of cookies, crackers, candy, soda, fried snacks, cold cuts and French fries[47]. Showing opposed frequencies, the authors found an overall dietary pattern named Unhealthy, and a named Mixed pattern due to lower level of discrepancy between consumption of the target foods. Through factor analysis of at-home and away-from-home overall dietary patterns of adolescents aged 10–19 years from the NDS 2008–2009, Cunha *et al.*[48] observed three overall dietary patterns for both places chosen for food consumption: (1) Traditional, due to higher adherence to meat, rice and beans; (2) Bread-and-Butter, similar to our Mixed breakfast pattern; and (3) the Western pattern, unhealthier, with some food items commonly observed within

our Protein-based pattern. Despite differences among studies, partially explained by different methods applied to analyse food patterns and diverse study population, what the studies showed in common is that Brazilian adolescents share both healthy and unhealthy dietary patterns, in particular, at breakfast, which is of concern due to increasing consumption of ultra-processed products and a reduction of traditional food items at this stage of life[43,49,50].

Our findings of overweight adolescents related with lower adherence to the Cereal, protein, fruit beverages and Northern/Northeastern pattern may reflect the role of a higher dietary fibre intake on excess body weight, as shown in two systematic reviews[51,52]. In the present study, the higher-fibre intake can be due to the consumption of cereals, tubers and roots. Moreover, the lower glycaemic index of the meat, dairy products and eggs as sources of protein from this pattern could be associated with low daily energy intake and, thus, a lower chance of being overweight[53,54]. Examining 1102 individuals aged 20 years and above from São Paulo, Brazil, a cross-sectional population-based survey revealed associations between dietary patterns and metabolic CVD risk factors[55]. A pattern with high positive loadings on rice and beans and low-to-moderate loadings on red meats, eggs, whole milk, butter/margarine and sugar was related to lower body weight and waist circumference, and was mediated by serum leptin. These findings suggest a potential protective role of dietary patterns based on higher dietary fibre intake and lower glycaemic index against weight gain.

We did not identify another study in Brazil assessing the relationship between breakfast patterns and overweight among adolescents, which make comparisons more difficult. However, results in the same direction for Brazilian adults using NDS data were found by Baltar *et al.*[23]. The authors revealed a positive association between BMI and the Northern Brazilian pattern, characterised by high consumption of meats, preparations with maize, eggs, tubers/roots/potatoes, dairy products, savoury snacks/crackers, fruit juices/fruit drinks/soya-based drinks. The Southeastern Brazilian pattern was inversely associated with BMI, characterised by cold cut meat, milk, cheese, coffee/tea and bread[23], which resembles a combination of the Mixed and Protein-based patterns of our study. Healthier, the Traditional Lebanese pattern (positive loadings for vegetables, legumes, bread, rice, fruits, fish and vegetable oils) was negatively associated with overweight[56]. Longitudinal studies are needed to further understand the role of breakfast composition on weight gain.

The cross-sectional survey in a nationally representative sample of 2019 Swiss adults derived dietary patterns using principal component analysis based on the intake of twenty-two breakfast-specific food groups[57]. Of the three breakfast patterns, the Prudent breakfast, characterised by fruit, unprocessed and unsweetened cereal flakes, nuts/seeds, yogurt, was negatively associated with abdominal obesity, and the authors explained that the association was partly due to a healthier diet in the rest of the day[57]. No association was observed between Traditional – white bread, butter, sweet spread – or Western breakfasts – processed breakfast cereals and milk – and adiposity outcomes[57].

At the meal level, a study on 933 participants from the Health Survey of São Paulo, Brazil, found greater adherence only to the Traditional lunch pattern associated with lower BMI in insufficiently active individuals[24]. This pattern was characterised by higher contributions for rice, beans, cassava, flour, milk and sugar. Besides the Traditional pattern, four other lunch patterns were derived from twenty-two food groups by factor analysis (Western, Sweetened juice, Salad and Meats) but none of them were significantly associated with the outcome[24]. Other studies showed an inverse association between the Traditional pattern (both overall and at the meal level) and weight outcomes such as waist circumference and BMI[40,56,58]. It is important to emphasise that the comparison between studies is hampered by diverse findings and lack of studies at the meal level.

This study observed no association between skipping breakfast and weight status. The scientific literature on the subject has mixed findings[59–66]. While cross-sectional studies consistently showed skipping breakfast related to overweight and obesity, contrary to our findings, cohort and intervention studies have mixed observations[59–63]. Thus, systematic reviews and meta-analyses recommend further investigation of the role of breakfast frequency on body weight and adiposity outcomes[64–66].

One issue that deserves attention is the inconsistent definitions of breakfast and breakfast-skipping[11,23,24,67]. Prevalence levels vary greatly considering mixed definitions of breakfast and skipping combined with different populations[11,23,24,67]. While the prevalence of skipping breakfast was 35·3 % in our study, higher and lower values can be found for Brazilian adolescents[11,23,24,67]. Another study using the same data found 6·9 % of adolescents as skippers, but they only considered breakfast as the first meal of the day eaten between 04.00 and 11.00 hours[22]. In this study, breakfast definition considered the time (05.00–10.00 hours) plus a minimum of 50 kcal of usual energy intake. A study evaluating high school students from technical schools of São Paulo, Brazil, found a high breakfast-skipping prevalence (51 %)[68]. The question 'with whom the participants had breakfast' implies the need for companionship at the meal and could explain skippers' high frequency. Baltar *et al.*[23] found similar skipping breakfast prevalence (33·1 %) for Brazilian adults. The authors applied the same breakfast definition as our study. Hassan *et al.*[21] observed only 9·6 % breakfast-skippers among sixth-graders from a study sample of students from private and public schools of the metropolitan region of Rio de Janeiro, Brazil. The authors observed that the prevalence increased to 26·1 % when they changed the definition to categorise irregular breakfast. The participants were asked how often they had breakfast; those who responded less than five times a week were classified as having irregular breakfast, and those who responded 'never or almost never' were classified as skippers. Consequently, comparisons between findings are hindered, and a consistent method to evaluate breakfast is required.

Our study's first limitation is the cross-sectional design that prevents causal inference of the associations and, thus, our findings must be confirmed in prospective studies. Second, residual confounding might have biased the associations between breakfast patterns and weight status despite the adjustment for potential confounders. Third, the three identified

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breakfast patterns explained 44·8 % of the total variance, which explains most variance but is imperfect and reveals the complexity of breakfast patterns among Brazilian adolescents. Other studies, however, showed some values around our estimated variance. Baltar *et al.*[23] found that the three Brazilian adult's breakfast patterns explained 47·7 % of the total variance. A Swiss study on adults found the three main identified dietary patterns, which explained only 26 % of the total variance[52]. Fourth, as the foods and beverages we analyzed as breakfast were not directly presented by the study participants as belonging to this meal and, therefore, the component foods of breakfast were defined based on the time and total calories, some participants may have had breakfast in a broader period than the settled by the researchers and might be labelled as skippers. Fifth, as we observed only one meal, we cannot affirm whether the associations were related to breakfast eating alone or in combination with other eating occasions along the day; however, the analysis was adjusted by daily energy intake. Sixth, because we used secondary data there was no information on physical activity. Since weight gain depends on the balance between the energy expenditure and dietary intake[69], adjustment for physical activity should be taken into account in further studies.

The strengths of this study recall on data from a large, representative sample of the Brazilian adolescent population. Furthermore, we derived a breakfast composition pattern based on the usual food intake applying the National Cancer Institute method. Adolescents' daily food items consumed may not be well represented because of data collection of only two non-consecutive days' food records. However, the National Cancer Institute method's application enables regular food consumption. Despite secondary data, our analyses were adjusted for most recognised confounders. Finally, this is the first study examining adolescents' breakfast patterns and their association with weight status in Brazilian nationally representative data.

Breakfast contribution to almost 1/5 (17·7 %) of Brazilian adolescent's daily energy intake[22] and our study's national representativeness point out the need for health and food policies to improve and value the breakfast eating at the age group. Dietary breakfast patterns are still a blind spot despite studies focusing on the role of breakfast on several health outcomes. Our study mainly adds to previous research given dietary patterns' approach capacity to examine breakfast composition.

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B. K. H. contributed to study design, data analysis and manuscript writing. D. B. C. and R. O. S. contributed to data analysis and manuscript revision. V. T. B. contributed to study design and supervising, data analysis, manuscript conception and final revision.

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