ABSTRACT
The aim of this study was to investigate the association between skipping meals and excess weight in adolescents. This study used a secondary database based on cross-sectional research. Weight and height were measured for the classification of nutritional status and the omission of meals was determined from the 24-hour food record. Statistical analyses were performed on a sample stratified by age from 10 to 13 years and 14 to 19 years. There was a high prevalence of excess weight (overweight and obesity) in the sample and a high frequency of meal omission among adolescents. The omission of lunch and dinner among adolescents between 14 and 19 years and those between 10 to 13 years, respectively, was directly associated with excess weight.
Keywords: Adolescent; Meals; Obesity; Overweight.

INTRODUCTION
Globally, the number of obese children and adolescents grew more than ten times, from 11 million in 1975 to 124 million in 2016, in addition to another 213 million children with overweight. These data were presented in a study of approximately 31.5 million children and adolescents aged 5 to 19 years, in which Body Mass Index (BMI) and obesity was evaluated in the last four decades.

In Brazil, analyses of adolescent nutritional status in the Family Budget Surveys (POFs) from 2002 to 2003 and 2008 to 2009 showed that the prevalence of excess weight (overweight and obesity) increased from 16.7 to 20.5% and that of obesity, from 2.3 to 4.9%. In 2015, according to the National School Health Survey, the prevalence of excess weight was 23.7%, which corresponds to an estimated total of 3 million students aged 13 to 17 years.

Excessive weight gain in adolescence is a significant risk factor for overweight and obesity in adulthood, in
The omission of meals is associated with excess weight in adolescents

The omission of meals is associated with early onset of chronic non-communicable diseases such as hypertension, cancer and type 2 diabetes.

Adolescence is a transition phase between childhood and adulthood, where intense biopsychosocial changes occur so that excess weight may be related to common behavioral factors in this age group, such as inappropriate eating practices.

Maintaining main meals has been shown to have a protective effect for excess weight regardless of sociodemographic variables. In contrast, most research has focused only on studying the omission of breakfast and neglecting other main meals, such as lunch and dinner.

Adolescents are an important demographic group to search for strategies that favor early prevention and intervention against excess weight. As a result, this study aimed to investigate the association between skipping meals and excess weight among adolescents in the city of Fortaleza, Ceará/Brazil.

MATERIALS AND METHODS

This is a study with secondary data based on cross-sectional research, carried out in the municipal schools of Fortaleza – Ceara in 2015.

The school population was stratified as to the local division of health services into six regions called “Regional Executive Secretary ” (RES), from I to VI. The sample was calculated using a formula for a finite population, considering a sampling error of 3% and a significance level of 5%. The outcome used was from the original research considering a prevalence of 15% dyslipidemia among students. The initial sample consisted of 1022 students and 812 satisfactorily completed data collection.

Adolescents of both sexes, aged 10 to 19 years, who were at school on the day of collection and who brought the informed consent signed by a guardian were included. Adolescents who did not answer any questions or did not complete data collection and adolescents with disabilities (physical or mental) and infectious diseases were excluded from the study.

Two previously trained nutritionists collected the data. Anthropometric measurements were taken in the morning. Body weight was measured on a calibrated electronic scale (Sanny), with a maximum capacity of 150 kg, and a sensitivity of 100 g. Adolescents were instructed to stand on the center of the platform and remain in an orthostatic position, barefoot, and wearing light clothes.

Height was measured by a rigid stadiometer, with the adolescent in an orthostatic position with feet together, barefoot, in inspiratory apnea and with the head oriented at 90° according to the Frankfurt plane, remaining with the heel surfaces, pelvic girdle, scapular girdle, and occipital region in contact with the device.

Excess weight (overweight plus obesity) was determined based on Body Mass Index (BMI) values, adopting the growth curves of the World Health Organization with a cutoff point for overweight of BMI z-score for age ≥1.

The consumption or omission of meals was determined from the 24-hour food recall collected per meal: breakfast, morning snack, lunch, afternoon snack, dinner, and supper, where the individual informed whether or not each meal had been eaten. The absence of food during breakfast, lunch, and dinner was considered an omission of the meal. Sociodemographic variables were not investigated.

Statistical analyses were performed on a sample stratified by age from 10 to 13 years and 14 to 19 years, using the median, 13 (12-14) years, as the cutoff point. The Shapiro-Wilk test verified the normality of the data. The Pearson’s chi-square test was utilized to analyze associations between sex, excess weight and skipping meals stratified by age. To analyze the association between skipping meals (breakfast, lunch, and dinner) and excess weight, crude and sex-adjusted Poisson regression was used. Values of p <0.05 were considered statistically significant. Analyses were performed using Stata® version 13.

The research is part of a project called “Dyslipidemia and eating practices in adolescents in Fortaleza”, which was approved by the Ethics Committee of Hospital Infantil Albert Sabin, number 327851. The authorization for data collection was provided through the signature of the person responsible for the adolescent in the Free and Informed Consent Form, which detailed the stages of the study, as well as its objectives, risks and benefits.

RESULTS

The primary sample contained 812 adolescents, and 56.8% were girls. The group had a median age of 13 years, with 62.9% were 10 to 13 years of age. Excess weight was observed in 32% of adolescents, which was higher between 10-13 years (p=0.001) and did not differ by sex (p = 0.297). The meal that was most frequently omitted was breakfast (42.6%), followed by dinner (13.7%), and finally lunch (9.6%) (Table 1).

Table 2 shows the crude and sex-adjusted Poisson regression analysis. Between 10 and 13 years old, adolescents who skipped dinner showed a higher prevalence of excess weight, even after adjusting for sex (PR= 1.1; 95% CI: 1.01-1.20; p = 0.034). In the group 14 to 19 years old, the association occurred with the omission of lunch. Adolescents who omitted this meal presented a 1.15 times higher prevalence of excess weight compared to those who consumed lunch (PR= 1.15; 95% CI: 1.01-1.31; p= 0.037).
### Table 1. Sex distribution, excess weight and omission of meals, stratified by adolescent age group. Municipal Schools of Fortaleza, CE, 2015.

| Variables       | Total sample (N= 812) | 10 to 13 years (N= 511) | 14 to 19 years (N= 301) | p   |
|-----------------|------------------------|-------------------------|-------------------------|-----|
|                 | N    | %  | N    | %  | N    | %  |       |
| Sex             |      |    |      |    |      |    |       |
| Female          | 461  | 56.8| 283  | 55.4| 178  | 59.1| 0.297 |
| Male            | 351  | 43.2| 228  | 44.6| 123  | 40.9|
| Excess weight   |      |    |      |    |      |    |       |
| Without excess  | 552  | 68.0| 326  | 63.8| 226  | 75.1| 0.001*|
| With excess     | 260  | 32.0| 185  | 36.2| 75   | 24.9|
| Omission of meals |     |    |      |    |      |    |       |
| Breakfast       |      |    |      |    |      |    |       |
| Consumed        | 466  | 57.4| 294  | 57.5| 172  | 57.1| 0.913 |
| Omitted         | 346  | 42.6| 217  | 42.5| 129  | 42.9|
| Lunch           |      |    |      |    |      |    |       |
| Consumed        | 734  | 90.4| 462  | 90.4| 272  | 90.4| 0.983 |
| Omitted         | 78   | 9.6 | 49   | 9.6 | 29   | 9.6 |
| Dinner          |      |    |      |    |      |    |       |
| Consumed        | 701  | 86.3| 448  | 87.7| 253  | 84.1| 0.147 |
| Omitted         | 111  | 13.7| 63   | 12.3| 48   | 16.0|

N: frequency of participants; %: percentage; p: p-value (p<0.05). Pearson’s chi square test.

### Table 2. Association, crude and adjusted by sex, between meal omission and excess weight among adolescents. Municipal Schools of Fortaleza, CE, 2015.

| Meals     | 10 to 13 years | Excess Weight | 14 to 19 years |
|-----------|----------------|---------------|----------------|
|           | Crude          | Adjusted      | Crude          | Adjusted      |
| Breakfast |                |               |                |               |
| Consumed  | Ref.           | Ref.          | Ref.           | Ref.          |
| Omitted   | p 0.116        | 0.088         | 0.969          | 0.788         |
| PR        | 1.05           | 1.05          | 1.00           | 0.99          |
| CI 95%    | 0.99-1.12      | 0.99-1.12     | 0.91-1.09      | 0.91-1.07     |
| Lunch     |                |               |                |               |
| Consumed  | Ref.           | Ref.          | Ref.           | Ref.          |
| Omitted   | p 0.694        | 0.962         | 0.031          | 0.037*        |
| PR        | 1.01           | 1.00          | 1.08           | 1.15          |
| CI 95%    | 0.96-1.06      | 0.91-1.11     | 1.00-1.17      | 1.01-1.31     |
| Dinner    |                |               |                |               |
| Consumed  | Ref.           | Ref.          | Ref.           | Ref.          |
| Omitted   | p 0.044        | 0.034*        | 0.149          | 0.112         |
| PR        | 1.06           | 1.10          | 0.94           | 0.92          |
| CI 95%    | 1.00-1.11      | 1.01-1.20     | 0.87-1.01      | 0.83-1.02     |

Ref.: Reference; p: p-value (p<0.05); PR: Prevalence Ratio; CI: Confidence Interval. Poisson’s Regression analysis was used with robust variance estimation.
DISCUSSION

The results of the present study showed a high prevalence of excess weight (32%) in adolescents, higher than that found in the Macro-regions of Brazil: North (20.7%), Northeast (19.1%), Southeast (23.5%), South (25.6%) and Midwest (22.8%), according to data from the National School Health Survey (2015)4. According to Santos and collaborators14, changes in the pattern of eating and sedentary behavior, resulting from the epidemiological and nutritional transition, resulted in an accelerated increase in overweight and obesity among Brazilian adolescents.

The practice of skipping meals was higher during breakfast, followed by dinner and lunch. Estima et al.15 found similar results, and the prevalence of excess weight among adolescents was higher in the stratum with unsatisfactory meal consumption patterns, that is, in those who omitted more meals throughout the week.

The prevalence of omission of lunch was less than 10%; however, in the group aged 14 to 19 years, it was directly associated with excess weight. Although it is one of the main meals, there are few studies investigating its omission and association with nutritional status. This is probably due to the low prevalence found15,16,17.

At dinner, omission was the second biggest, and in the 10 to 13 age group, skipping lunch was associated with excess weight. A study carried out in Belgium found the same association18. A study with Iranian teenagers found that skipping dinner increased the chance for cardiovascular risk factors, such as excess weight and abdominal obesity, which remained significant after adjusting for sex, age, socioeconomic status, physical activity and smoking19. Dinner consumption is often neglected, and few studies have investigated its omission concerning other variables.

It is possible that some teenagers eat small meals that they do not recognize as dinner. Teixeira and other authors20 found a high prevalence of substituting dinner for snacks in obese adolescents. Most of the substitutes had a high energy density and low nutritional value.

According to Leal et al.17, the omission of lunch and dinner can compromise the adequate intake of iron, since the foods present in the groups of beans and meats, commonly consumed in these meals are important sources of iron, and would not be eaten at other times of the day.

Excess weight contributes to iron deficiency due to the circulating increase in hepcidin levels that restricts the intestinal absorption of iron and its release by macrophages21.

In adolescence, there is an increased need for iron, and its deficiency causes short and long-term damage to neuropsychomotor development, learning capacity, appetite, growth, in addition to compromising immune system response22.

In the present study, a high percentage (42.6%) of breakfast omission stands out, higher than that found in other cities in Brazil15,17,23,24,25,26,27, but it is worth mentioning that no studies have been conducted in the North and Northeast regions.

A study using data from the National School Health Survey (2012) found that 38% of adolescents did not eat breakfast regularly, which was associated with a higher likelihood of having other inappropriate eating habits, such as a diet low in fruits and vegetables and rich in sugars and fried foods28. Worldwide, as shown in a review of 39 studies with 286.804 children and adolescents from 33 countries, the prevalence of breakfast omission ranged from 10 to 30%, with an increasing trend in adolescents29.

Regarding the contribution of energy and nutrients, breakfast is irrefutably important30. Regular breakfast consumption is associated with an increased likelihood of ingesting key food groups, such as fruits, dairy products, and dietary fiber, which are usually eaten for breakfast; besides, they are more likely to meet recommendations for micronutrients and have other positive health-related behaviors, such as physical activity and sleeping more than 8 hours/night30,31,32.

In the present study, no association was found between breakfast omission and excess weight. According to Affenito33, the relationship between breakfast and BMI may vary according to the methodology used in each study. Analyses adjusted for lifestyle and food habits, in addition to multiple measurements of food consumption, are necessary to investigate this association further. Breakfast can be composed of food of low nutritional quality and can be consumed by overweight adolescents. According to the 2017-2018 Family Budget Survey34, the consumption of fruits, vegetables and dairy products in our region is deficient and therefore breakfast consumption may not provide a protective effect. This cross-sectional study aimed at relating meal omission to excess weight does not allow us to state the causes of the associations investigated.

The present study has as limitations the impossibility of establishing a causal relationship due to the cross-sectional nature of the design. A single food record was used, but that did not weaken the study, given the large sample size and dietary qualitative analysis. No other socioeconomic and lifestyle variables were investigated, however models were adjusted for sex and age, which are directly associated with food consumption.

Finally, the study made a significant contribution to elucidating the eating profiles of adolescents in Northeast Brazil, demonstrating the importance of large meals such as lunch and dinner and their influence on excess weight for this population.

CONCLUSIONS

There was a high prevalence of excess weight in the sample and a high frequency of omission of meals among adolescents. The omission of lunch and dinner among
adolescents 14-19 years and 10-13 years, respectively, was directly associated with excess weight.

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