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# Fruits, vegetables and greens and overweight in adolescents: data from the National School Health Survey (PeNSE, 2015)

## Consumo de frutas, legumes e verduras e excesso de peso em adolescentes: dados da Pesquisa Nacional de Saúde do Escolar (PeNSE, 2015)

## Abstract

*Introduction*: Healthy eating habits and physical activity are associated with protection against weight gain during adolescence. *Objective*: To evaluate the association between the consumption of fruits, vegetables, and greens and overweight in Brazilian adolescents. *Methods*: This is a cross-sectional study in which data from the National School Health Survey (2015) were analyzed. Socioeconomic variables, food consumption, physical activity, and sedentary behavior were evaluated. Weight and height were used to assess nutritionalstatus through BMI and classified as overweight and not overweight. For food consumption, the frequency of consumption in the seven days prior to the survey was classified as regular and less frequent. Multivariate analysis was performed using the logistic regression technique and backward procedure; odds ratios and their respective 95% confidence intervals were calculated using the Wald method. Statistical analyses had a significance level of 5% and were performed using the SPSS program. *Results*: Of the 16,328 adolescents included in the study, 40% had frequent consumption of vegetables or greens and 33.7% of fresh fruits. The association between vegetable or green consumption was positive and statistically significant (OR: 0.85; 95% CI: 0.75-0.93). *Conclusion*: The presented evidence suggests that regular consumption of vegetables and greens is an important protective factor in preventing overweight in adolescents, providing important data to encourage the development of actions aimed at preventing this condition in this and other life stages.

**Keywords:** Adolescents. Food consumption. Overweight. Fruits. Obesity. Vegetables

## Resumo

*Introdução*: Hábitos alimentares saudáveis e a prática de atividade física estão associados à proteção no desenvolvimento do ganho de peso na adolescência. *Objetivo*: Avaliar a associação entre o consumo de frutas, legumes e verduras e excesso de peso em adolescentes brasileiros. *Métodos*: Trata-se de um estudo transversal em que foram analisados dados da

Pesquisa Nacional de Saúde do Escolar (2015). Variáveis socioeconômicas, consumo alimentar, prática de atividade física e sedentarismo foram avaliados. Peso e altura foram utilizados para avaliar o estado nutricional por meio do IMC/I e classificado em com e sem excesso de peso. Para o consumo alimentar, utilizou-se a frequência de consumo nos sete dias que antecederam a pesquisa, que foi classificado em consumo regular e menos frequente. Realizou-se a análise multivariada empregando a técnica de regressão logística e procedimento *backward,*; calcularam-se *odds ratios* e seus respectivos intervalos de confiança de 95% pelo método de Wald. As análises estatísticas tiveram 5% de significância e foram realizadas utilizando o programa SPSS. *Resultados*: Dos 16.328 adolescentes incluídos no estudo, 40% apresentaram consumo frequente de legumes ou verduras e 33,7% de frutas frescas. A associação entre o consumo de legumes ou verduras apresentou-se positiva e estatisticamente significante (OR:0,85;IC95%:0,75-0,93). *Conclusão*: As evidências apresentadas levam a supor que o consumo regular de legumes ou verduras constitui um fator de proteção importante na prevenção do excesso de peso em adolescentes, fornecendo dados importantes para encorajar o desenvolvimento de ações voltadas para a prevenção dessa doença nessa e em outras fases de vida.

**Palavras-chave:** Adolescentes. Consumo alimentar. Sobrepeso. Frutas. Obesidade. Verduras.

## INTRODUCTION

Overweight is considered a significant public health problem in developed and developing countries[1] and presents a high prevalence among adolescents, showing a notable increase in recent years.[2] The lifestyle, mainly physical inactivity and sedentary behavior combined with unhealthy eating habits,has contributed to weight gain in individuals of this age group.[3]

Data from the National Health and Nutrition Examination Survey (NHANES 2015 and 2016) showed that the prevalence of overweight increased from 33.5% to 41.5% among American adolescents aged 12 to 19 years, while the prevalence of obesity increased from 18% to 20.6%.[4] In Brazil, the National School Health Survey (PeNSE), conducted with students aged 13 to 15 years, showed a prevalence of overweight of 23.2% and 25.1% in 2009 and 2015, respectively.[5,6] In the city of Salvador (Brazil), overweight accounted for 15.7% in a representative survey of public school adolescents. Of these, 9.3% were overweight and 6.4% obese.[7]

Inadequate eating habits (e.g., high intake of ultra-processed foods, long intervals between meals, eating out of home, replacing traditional meals with snacks, and low consumption of fruits, vegetables, and greens) are prevalent among adolescents.[8] Data from the PeNSE 2009 and 2015 revealed that, despite the increase in the consumption of fruits, vegetables, and greens, this result still indicates low adherence to consuming these foods. Results from the same period regarding foods that are markers of less healthy eating indicated an improved dietary profile of students: although the consumption of fried snacks increased by 16%, the consumption of candies and soft drinks reduced by 17.9% and 22.6%, respectively.[5,6]

The short- and long-term effects of such behaviors are concerning because they contribute to weight gain, a significant risk factor for the development of non-communicable diseases (NCDs), which may persist in adulthood. Among adolescents, the most prevalent NCDs are dyslipidemia, hypertension, and type 2 diabetes mellitus.[9]

Preventing youth obesity by focusing on reducing the main risk factors for overweight and other NCDs is an important strategy to avoid illnesses in adolescents.[10] Therefore, the Ministry of Health launched the Dietary Guidelines for the Brazilian Population. The recommendations of these new guidelines were based on the NOVA food classification system according to food processing (i.e., physical, biological, and chemical processes after the separation of foods from nature and before consumption or use for preparing dishes and meals)and divided into four categories.[11]

The first category includes unprocessed foods (fruits, vegetables, greens, eggs, and milk) and minimally processed foods (MPF), which are unprocessed foods that have undergone minimal alterations before being acquired (washed grains, roots, tubers, refrigerated or frozen cuts of meat, and pasteurized milk). The second category comprises culinary ingredients (oils, fats, sugar, and salt), whilethe thirdincludes processed foods, which are made by adding salt or sugar to an unprocessed or MPF (canned vegetables, fruits in syrup, cheeses, and breads). The last category comprises ultra-processed foods (UPF), such as soft drinks, filled cookies, packaged snacks, and instant noodles.[11]

Although the relationship between the consumption of UPF and the development of overweight is well-established,[12] studies showing the relationships between irregular consumption of fruits, vegetables, and greens are still in the early stages. A study conducted in the northeast region of Brazil showed that the prevalence of irregular consumption of fruits and vegetables was 88.6%, while the probability of low fruit and vegetable consumption was higher among overweight girls (OR = 1.63, 95%CI: 1.19 to 2.23).[13] Considering that this is a relatively unexplored field, the present study aimed to assess the association between the consumption of fruits, vegetables, and greens and overweight in Brazilian adolescents

## METHODS

This cross-sectional study was conducted using secondary data from the PeNSE 2015, a national survey conducted every three years since 2009 by the Brazilian Institute of Geography and Statistics (IBGE) in collaboration with the Ministry of Health to identify and assess the risk and protective factors for health among Brazilian adolescents. PeNSE data are public and can be accessed for free on the IBGE website (http://www.ibge.gov.br).

PeNSE is a school-based epidemiological survey performed with students from public and private Brazilian schools.[5,6,14] The PeNSE 2015 survey consisted of two independent probabilistic samples (1 and 2). In the present study, only the sample 2 was included, which comprised students aged 13 to 17 years from public and private schools (6th grade to the last grade of high school) located in the 26 states of the five Brazilian macroregions and the capital of Brazil.[6]

The sampling plan of the survey involved a cluster sampling. All students from classes of the schools selected in each considered region were asked to respond to the survey questionnaires. The sample size in each stratum considered a maximum sampling error of approximately 3% to estimate a proportion of 50% of adolescents with a 95% confidence level and average design effect of 3 in the first stage. Additional methodological details are described in the survey report.[6]

Data were collected through a self-administered questionnaire, which was answered using smartphones distributed to students by IBGE researchers on the day of the interview. Anthropometric measurements (weight and height) were collected to calculate the body mass index (BMI), along with sociodemographic data (gender, age, race or ethnicity, country region, economic dependency, and maternal education) and information on the dietary intake of the adolescents. Additional details are available in the PeNSE reports.[6]

Weight and height were used to assess the nutritional status through the BMI-for-age, and the z-scores proposed by the World Health Organization for children and adolescents aged 5 to 19 years were used as reference.[15] Data were calculated using the WHO AnthroPlus software. BMI-for-age was classified into no overweight (z-score ≤ +1) (reference category) and overweight (z-score > +1).

Food consumption was measured using a self-administered food frequency questionnaire for cooked vegetables and fresh fruits over seven days before the survey.[6] The consumption of these foods was expressed according to the proportion of adolescents with regular consumption (at least five of seven days before the study) (reference category) and less frequent consumption (between zero and four days before the study).[16]

Physical activity level was assessed using the accumulated physical activity indicator[6] and classified as active (≥ 300 minutes of physical activity per week) (reference category) or insufficiently active (1 to 299 minutes of physical activity per week).[17] Sedentary behavior was evaluated based on the time spent (in hours) per dayin sedentary activities, such as watching television, using computers, playing video games, and engaging in other sedentary activities. Participants who reported a screen time of two or more hours per day were considered exposed to sedentary behavior. Those with less screen time were considered not exposed to sedentary behavior (reference category).[18]

The following variables were also considered: sex (male as reference category), age (10 to 14years), race or ethnicity (non-white), region of the country (north), maternal and/or household head education level (lower education), and school administration (public).

Descriptive analyses were conducted to characterize the study population using proportions and means (standard deviation) for categorical and continuous data, respectively. To assess the independent effect of fruit and vegetable consumption on overweight, a multivariate analysis was performed using backward logistic regression. Odds ratios (OR) and their respective 95% confidence intervals were calculated using the Wald method. Statistical tests were one-tailed with a significance level of 5%. All analyses were performed using the SPSS version 21.0.

## RESULTS

Of the 16,328 adolescents (50.1% males) included in the study, 56.9% were aged between 10 and 19 years; mean age was 14.08 (2.13) years. Also,most self-identified as mixed race or ethnicity (40.6%), were from the northeast region (21.1%), and attended public schools (75.3%). A total of 28.4% of mothers had no formal education or did not complete elementary school. Regarding lifestyle, 68.1% of participants were insufficiently active, and 63% were sedentary. Moreover, 40% of the samplepresented a frequent consumption of cooked vegetables or greens, while 33.7% frequently consumed fresh fruits (Table 1).

**Table1.** Demographic, Socioeconomic, Anthropometric, Nutritional, and Lifestyle Characteristics of Brazilian Adolescents. Brazil, 2015.

| Variables | n | % |
|---|---|---|
| Sex | | |
| Female | 8175 | 49.9 |
| Male | 8208 | 50.1 |
| Age | | |
| 10-14 years | 9327 | 56.9 |
| 15-19 years | 7056 | 43.1 |
| Race/Color | | |
| Yellow | 700 | 4.3 |
| White | 6503 | 39.7 |
| Indigenous | 577 | 3.5 |
| Brown | 6651 | 40.6 |
| Black | 1929 | 11.8 |
| Region of the Country | | |
| Central-West | 3247 | 19.8 |
| Northeast | 3465 | 21.1 |
| North | 3188 | 19.5 |
| Southeast | 3276 | 20.0 |
| South | 3207 | 19.6 |
| Administrative Dependence | | |
| Public | 12339 | 75.3 |
| Private | 4044 | 24.7 |
| Maternal Education | | |
| No education/Incomplete Primary | 3462 | 28.4 |
| Complete Primary/Incomplete High School | 1981 | 12.1 |
| Complete High School/Incomplete Higher Education | 3734 | 22.8 |
| Complete Higher Education | 3022 | 24.8 |
| Overweight | | |
| Overweight | 4373 | 27.3 |
| Not Overweight | 11648 | 72.7 |
| Fresh Fruit Consumption | | |
| Less frequent | 10813 | 66.3 |
| Regular | 5496 | 33.7 |
| Vegetable or green Consumption | | |
| Less frequent | 9792 | 60.0 |
| Regular | 6536 | 40.0 |
| Physical Activity | | |
| Insufficiently active | 5223 | 31.9 |
| Active | 11140 | 68.1 |
| Sedentary behavior | | |
| Sedentary | 10322 | 63.0 |
| Not sedentary | 6061 | 37.0 |

Fonte: Autores, com base nos dados da PeNSE (2015).

Based on logistic regression, the association between the consumption of cooked vegetables or greens and overweight remained positive and statistically significant in the final model(OR = 0.85; 95%CI: 0.75 to 0.93), indicating that individuals were less likely to be overweight. The association between fruit consumption and overweight was not statistically significant (Table 2).

**Table 2.** Final model of logistic regression for the association between fruit, vegetable and green consuptionand anthropometric status in Brazilian adolescents. Brasil, 2015.

| Variabel | OR | 95% IC | p-Valor |
|---|---|---|---|
| Vegetable or green consumption | | | |
| Less frequent | 1.00 | | |
| Regular | 0.85 | 0.78-0.93 | 0.000 |

\* Adjusted for sex, age, maternal education, physical actitvity and and sedentary behavior.
Source: Authors based on data from PeNSE (2015).

## DISCUSSION

The study revealed a low prevalence of adolescents with regular consumption of fruits, cooked vegetables, or greens, a high prevalence of overweight and physical inactivity (nearly one-third of the sample), and sedentary behavior in over half of the individuals evaluated. This epidemiological scenario highlights the need for implementing interventions that motivate adolescents to adopt recommendations for healthy eating and physical activity to reduce risk factors for NCDs.[4]

In this study, a low consumption of markers of healthy eating (fruits, vegetables, and greens) was observed among Brazilian adolescents aged 13 to 19 years. This finding is consistent with other studies that analyzed PeNSE data. Levy et al.,[16] using data from the 2009 survey, revealed that the consumption of markers of healthy eating was lower than official recommendations,[10] with proportions of 31.2% for vegetables and greens and 31.5% for fruits.

Furthermore, fruit consumption decreased from 31.5% to 29.8% between the 2009 and 2012 surveys. Most changes in food consumption occurred in both sexes, despite the maintenance in fruit consumption prevalence among students from public schools.[8] Evaluating PeNSE 2015 data, Maia et al.[19] highlighted that vegetables were consumed 3.43 days per week, indicating a less frequent consumption (< 5 days per week) of this food group.

Studies conducted in some Brazilian regions also demonstrated a low consumption of markers of healthy eating and a high consumption of UPF. A study conducted in Campinas (São Paulo, Brazil) revealed that 46.7% of daily calories consumed were from fresh foods and MPF. The significant contribution of UPF to daily calories underscores the poor diet quality among these adolescents and poses a risk for the development of NCDs, which may persist into adulthood.[20]

The low contribution of UPF compared with MPF corroborates with Oliveira et al.[21] and highlights a daily average energy intake from fresh foods or MPF of 48.2% (e.g., meats, offal, rice, fruits, unsweetened fruit juices, milk, pasta, cereals, roots, tubers, greens, vegetables, eggs, and fish) and UPF of 31.9% (e.g., cookies, candies, soft drinks, artificial juices, packaged snacks, processed meats, sausages, ready-to-eat snacks, industrialized bread, cakes, and dairy products) among rural adolescents. Despite this result, processed

products have become more accessible and included into the daily consumption of adolescents from rural areas, in which fresh food is more available[21].

The frequency of regular fruit consumption found in this study was similar to that reported by Monticelli, Souza & Souza[22]in Curitiba (Paraná, Brazil) (28.9%) and higher than observed by Martins et al.[23] in the state of Maranhão (15.1%) and Silva et al.[24] in Salvador (Bahia, Brazil) (19%). The study conducted by Teo et al.[25] showed an average fruit consumption of 2.4 servings per day, with adequate consumption observed in 33.3% of adolescents.

Less than half of the adolescents in this study reported a regular consumption of vegetables and greens. Similar results were found by Martins et al.[23] (36.1%); however, this proportion was higher than observed by Monticelli, Souza & Souza[22] (9.9%) and Silva et al.[24] (16%), and lower than the results of Fulco et al. (28.3%). Teo et al.[25] showed an average vegetable consumption of 0.67 servings per day, with only 1.7% of adolescents meeting an adequate consumption.

The consumption of fruits, vegetables, and greens observed in this study and in the national literature is concerning because it is lower than recommended in national and international guidelines.[10] The daily consumption of this food group is essential, as they are considered regulatory foods, sources of micronutrients, fibers, and bioactive compounds.[26] Literature establishes that consuming 400 grams of fruits, vegetables, and greens per day (equivalent to 5 servings per day) is associated with a low incidence of cardiovascular disease and certain types of cancer besides preventing obesity and diabetes.[27]

A study conducted in the northeast region of Brazil revealed a high prevalence of inadequate consumption of fruits and vegetables (88.6%) and a higher likelihood of low fruit and vegetable intake among boys exposed to sedentary behavior (OR = 1.63; 95%CI: 1.18 to 2.24), who consumed soft drinks (OR = 3.04; 95%CI: 2.10 to 4.40), and had insufficient physical activity (OR = 1.98; 95%CI: 1.43 to 2.73), as well as among girls who consumed soft drinks (OR = 1.88; 95%CI: 1.43 to2.47) and were overweight or obese (OR = 1.63; 95%CI: 1.19 to 2.23).[13]

The most important causes of inadequate consumption of fruits, vegetables, and greens among adolescents may be attributed to strong cultural, familial, and peer influence on dietary habits favoring unhealthy food choices;[28] the taste of these foods, considered less palatable due to lower amounts of carbohydrates and lipids;[26] and the influence of media and marketing on the consumption of processed products and fast foods.[27]

Gomes et al.[28], in a study conducted in the metropolitan region of Vitória (Espírito Santo, Brazil), showed that high consumption of minimally processed foods was associated with high family income (OR = 1.5; 95%CI: 1.10 to 2.17) and physical activity practice (OR = 1.9; 95%CI: 1.45 to 2.63). Brown or black skin color (OR = 1.3; 95%CI: 1.02 to 1.61) and the habit of eating while browsing the internet (OR = 1.4; 95%CI: 1.02 to 1.88) increased the chances of consuming UPF. In constrast, being enrolled in private schools reduced UPF consumption by 41.7%.[29]

The findings of the present study corroborate evidence regarding the positive effects of fruit, vegetable, and greens consumption, particularly vegetables and greens, in protecting against overweight. As this is the first Brazilian study to evaluate these relationships, comparisons with other studies are limited. However, the national literature has demonstrated the association between UPF consumption and obesity.[20]

This study has several strengths. First, PeNSE is the most comprehensive survey of students in Brazil in terms of representative sample size and assessed variables. Data are considered of high quality because they were obtained using standardized procedures. The application of appropriate statistical methods also

provided reliability and consistency to the results. Furthermore, this is the first study to assess the association between the consumption of fruits, vegetables, and greens and overweight among Brazilian adolescents; thus, underscoring its importance to the scientific literature.

On the other hand, some limitations can be considered. Cross-sectional studies do not establish causality due to lack of a temporal sequence between exposure and disease development. However, several studies on the topic are still cross-sectional, which allows only for the exploration of associations between variables. Another limitation is the fact that data were self-reported by participants, resulting in possible recall and measurement bias. Additionally, the study design excluded adolescents who were not in school. Nevertheless, the survey included students from public and private schools, enhancing the representativeness of the target population.

The results of the study suggest that the regular consumption of vegetables is an important protective factor for preventing overweight in adolescents, providing crucial data to encourage the development of actions aimed at preventing this condition throughout the stages of life.

In this context, the adoption of strategies to encourage the consumption of fruits, vegetables, and greens is needed due to the benefits of these foods in preventing the development of NCDs, which are very common among adolescents. Additionally, actions aimed at adolescent health promotion are important to ensure that healthy habits during childhood and adolescence are maintained throughout life.

Although evidence indicates a significant role of fruits, vegetables, and greens in protecting against overweight, this topic is still understudied in national research conducted with adolescents. Therefore, the results of the present study should be widely disseminated to support the implementation of relevant actions. Given the relevance of this topic to public health, more studies are needed to clarify the associations found.

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## Contributors

Silva KBB and Ferraz RRN participated in the conception of the study design; data collection, analysis, and interpretation; and final review and approval of the manuscript for submission.

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