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Food consumption and depression among Brazilian adults: results from the *Brazilian National Health Survey*, 2013

Consumo alimentar e depressão entre adultos brasileiros: resultados da *Pesquisa Nacional de Saúde*, 2013

Consumo alimentario y depresión entre adultos brasileños: resultados de la *Encuesta Nacional de Salud*, 2013

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Abstract

Our study aimed to evaluate the association between food consumption and depression. We used data from the Brazilian National Health Survey*; a cross-sectional study carried out in 2013 among 46,785 Brazilian adults. The exposures were regular consumption (≥ 5 times/week) of the markers of healthy (beans, vegetables, fruits, and natural fruit juices) and unhealthy food (sugar sweetened beverages; sweets and the substitution of lunch or dinner for snacks); and a nutritional score elaborated by combining the frequency of consumption of markers of healthy and unhealthy food, the higher the value, the better the diet. The outcome was depression, assessed through the PHQ-9 questionnaire answered by the participants. Those with PHQ-9 scores greater than or equal to 10 were classified as presenting depression. We performed logistic regression models adjusted for potential confounders. Regular consumption of sweets (OR = 1.53; 95%CI: 1.33-1.76) and regular replacement of meals for snacks (OR = 1.52; 95%CI: 1.21-1.90) were positively associated with depression. Regular consumption of sugar sweetened beverages was positively associated with depression among women (OR = 1.27; 95%CI: 1.10-1.48). Regular consumption of beans was negatively associated with depression (OR = 0.74; 95%CI: 0.65-0.84), consistent for both sexes. Comparing the top quintile of the nutritional score (healthier diet) to the bottom quintile (less healthy) we found a negative association with depression (OR = 0.63; 95%CI: 0.52-0.75). Our results add evidence on a possible role of food consumption in depression; future longitudinal studies should explore the mechanisms of these associations.*

Food Consumption; Depression; Nutritional Epidemiology

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Introduction

Currently, depression is a public health problem, with severe depression reaching a global prevalence of 4.7% in 2013 [1]. Depression is defined as a mental disorder that may be chronic or acute, affecting the physical and emotional health [1]. A study carried out by the World Health Organization (WHO) in 60 countries has shown that, during the life, the probability of a person developing this disease is 15 to 20% [2]; moreover, between the years 1990 and 2010, there was a 37% increase in the prevalence of this disease [3]. In Brazil, population-based studies on the prevalence of depression and other mental disorders are relatively scarce [4,5,6]. Studies published in 2016, assessing data from the *Brazilian National Health Survey* (PNS, in Portuguese) identified a general prevalence of depression of 4.1% [5] and 7.9% [7] in the Brazilian population in 2013, respectively using an algorithm with high specificity and a validated cutoff for clinically relevant symptoms of depression.

The increase in depression prevalence has been explained by the adoption of a modern lifestyle, represented by sedentarism, sleep deprivation, and dietary changes, as well as the fact of living in a stressful environment, such as those where the urbanization occurred at an accelerated pace and with large social inequalities [8,9,10].

Low dietary quality is a strong predictor of depression [11,12,13]. One possible explanation for this association is the existence of high interconnection between the organic systems that influence food choices and those other ones which trigger depressive symptoms. That is, the feeding activates the hormonal and neurotransmitter pathways, and signalling modulates cerebral functions such as appetite, sleep, energy consumption, reward mechanisms, cognitive function, and mood. This modulation, in turn, alters the eating behavior, evidencing the possibility of bidirectional relationship [14].

Studies suggest that foods with antioxidant and anti-inflammatory effects would produce neuro-protection, aiding in the regulation of the hypothalamic-pituitary-adrenocortical axis, which is responsible for the mechanism of depression [15,16,17]. In this sense, fruits and vegetables, being rich in these nutrients, could play a role in reducing depression. On the other hand, other studies demonstrate that foods rich in sugars, trans-fats, and saturated fats would be related to a higher probability of occurrence of depression. This phenomenon can occur due to the endothelial dysfunctions and inflammation that sugar, trans-fat, and saturated fat can cause. Also, these nutrients can lead to low levels of brain neurotrophic factor and hypoglycemia due to exaggerated insulin production – influencing the individual's hormonal levels and mood [18,19,20,21].

The literature on food consumption and depression is sparse. Two studies have found that individuals with regular fruit and vegetable consumption (≥ 5 times/week) had a lower incidence of depressive symptoms [22,23], whereas one study has found that individuals with regular consumption of sugar-sweetened beverages, sweets, sugars, and fast foods had higher depression scores [24]. Despite that, two other studies have failed at observing the association between healthy eating (rich in fruits and vegetables and poor in food sources of saturated fat and cholesterol) and depression [25,26].

Considering the scarcity of studies assessing the association between both healthy and unhealthy food consumption and depression in the literature and the lack of consistency in the associations, the present study aimed to evaluate the association between food consumption and depression in Brazilian adults.

Methods

We used data from the PNS of 2013, a cross-sectional study which comprised a representative sample of residents in private households in Brazil. The sample studied by the PNS is a sub-sample of the Master Sample of the Integrated Household Survey System (SIPD, in Portuguese) from the Brazilian Institute of Geography and Statistics (IBGE, in Portuguese), whose geographic coverage is made up of the census sector from the Geographic Operational Base of the 2010 Demographic Census, except for those with very small numbers of households and special sectors such as barracks and long-term institutions. The sample size was calculated to enable the estimation of precise prevalence rates and 95% confidence intervals (95%CI) for the behaviors of interest, taking into account also the clustered sample in multiple stages. The sample size also considered 20% of non-response rate and aimed to

warrant a significant two-sided level of 5% and a statistical power of 80%. The methodology used for sampling, as well as the form of data collection are described, in greater detail, in the PNS report [27].

For the analysis of this study, we selected adults aged between 20 and 59 years who have answered the questionnaire of the selected resident of the PNS, therefore comprising a population of 46,785 individuals.

The depression was the dependent variable, assessed through the *Patient Health Questionnaire-9* (PHQ-9) [28] applied to the participants. PHQ-9 was translated to Portuguese and validated for the screening of depressive episodes for the Brazilian population [29]. PHQ-9 evaluates the following symptoms: depressed mood, anhedonia (loss of interest or pleasure in doing things), sleep problems, fatigue or lack of energy, appetite change, guilt or uselessness, feeling, concentration problems, slow or restless feeling, and suicidal thoughts. The frequency of each symptom in the last two weeks was classified as 0-3, corresponding to the "any day" (0), "less than half of the days" (1), "more than half of the days" (2) and "almost every day" (3), respectively. The score could vary from 0 to 27 points, and the individual was classified as depressed when the sum of the score was greater than or equal to 10, following the cutoff recommended to identify clinically relevant symptoms of depression [28], and previously applied to the Brazilian population [7].

Participants reported the frequency of consumption, through the *Food Frequency Questionnaire* (FFQ) in the last week (0 to 7 days) of the following groups of foods: (i) beans; (ii) raw and cooked vegetables; (iii) fruits; (iv) natural fruit juice; (v) sugar sweetened beverages (sugar sweetened beverages and artificial juice); (vi) sweets (cake or pie, sweets, chocolates, candies, cookies or sweet biscuits); and (vii) the substitution of lunch or dinner for sandwiches, snacks or pizzas. The first four food groups were considered markers of a healthy diet and the remainder of the items markers of an unhealthy diet. The frequencies were subsequently grouped in a dichotomous variable (< 5 times/week or ≥ 5 times/week), which is an indicator of regular consumption, previously described [27,30].

Also, we created a nutritional score based on the frequency of intake of the seven food markers. The total score was calculated by adding the partial scores corresponding to the weekly frequency of food intake: for the healthy markers, the scale ranged from 0 (did not consume) to 7 (every day); and for the unhealthy markers, the scale ranged from 7 (did not consume) to 0 (every day). Therefore, the total score could vary from 0 to 49, and the higher the score, the better the nutritional quality of the diet. We divided the score into quintiles. The regular consumption (≥ 5times/week) of each of these groups of foods and the quintiles of the nutritional score were the independent variables.

The models were adjusted for the following variables: marital status (whether living with partner or not), age range (20-29, 30-39, 40-49 and 50-59 years old), gender (male or female), education (incomplete Elementary School, complete Elementary School/incomplete High School, complete High School and complete Higher Education), race/color (white, black, yellow, brown and indigenous), physical activity (yes or no – created from the question: "In the last 3 months have you practiced any kind of exercise or sport?"), tobacco use (yes or no – created from the question: "Do you currently smoke any kind of tobacco product?" –, those who answered "yes, daily" or "yes, less than daily" were classified as yes; and those who answered "do not smoke presently" were classified as not), and ingestion of alcoholic beverage (yes or no – created from the question: "How often do you drink alcoholic beverages?" –, those who answered "less than once a month" or "once or more a month" were classified as yes; and those who answered "never drink" were classified as not). Figure 1 refers to the proposed model analyzed. The elaboration of this model was based on literature in the area of depression and food consumption. The objective of this model is to facilitate the identification of possible confounders and intervening variables; and guide the data analysis.

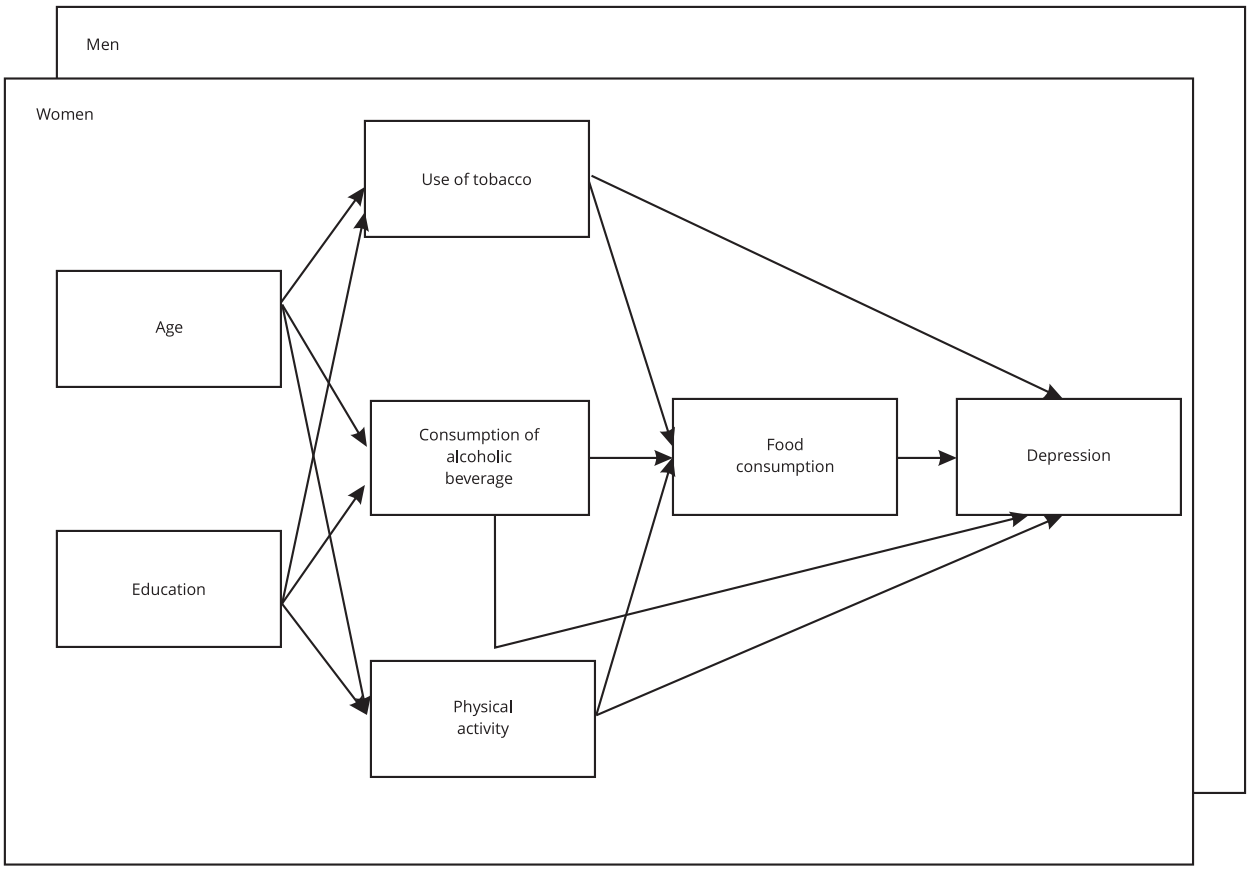
All analyses were performed considering the weighting for the complex sample structure, in order to represent the Brazilian population, according to the research sample. First, the sociodemographic categorization of the population was performed, with frequency values for each of the studied variables; then the prevalence and the respective 95%CI of depression were calculated as a function of all co-variables. Simple logistic regression models were performed to obtain crude odds ratios (OR). Finally, models were adjusted for all variables to obtain adjusted OR.

All statistical analyses were performed on Stata SE software, version 13.1 (https://www.stata.com).

The PNS project was approved by the National Research Ethics Committee (CONEP, in Portuguese) of the Brazilian National Health Council (CNS, in Portuguese) (number 328.159) in June

Figure 1

Propositive model of the relation between food consumption and depression.



2013, and this study follows the guidelines established in the *Declaration of Helsinki*. The PNS micro-data were made available on the IBGE website without information that could identify the evaluated individual.

Results

The majority of individuals were female (52.1%), white (46.2%), between 20 and 29 years old (34.6%) and presented a low level of education (42% with complete High School). The prevalence of depression was 7.6%, according to the cutoff ≥ 10 points in the PHQ-9 scale (Table 1). In relation to food consumption, most of the interviewees reported regular consumption of beans (71.8%) and vegetables (53.6%). For the other evaluated foods, the majority of subjects reported non-regular consumption (Table 1).

Table 2 shows that depression was more frequent among women, over 50 years old and with incomplete Elementary Education. About food consumption markers, the depression prevalence was slightly higher among those who regularly consumed sweets (9.64%) and replaced lunch or dinner for snacks (10.05%), when compared to their pairs who did not adopt these behaviors regularly (7.06% and 7.46%, respectively) (Table 2).

Table 1

Socioeconomic, demographic, consumption and depression characteristics among Brazilian adults. *Brazilian National Health Survey* (PNS), 2013 (N = 46,785).

Characteristics	% (95%CI)
Sex	
Male	47.9
Female	52.1
Age (years)	
20-29	34.8 (34.1-35.0)
30-39	25.9 (25.4-26.4)
40-49	22.0 (21.5-22.6)
50-59	17.4 (16.9-18.0)
Education	
Incomplete Elementary School	12.3 (11.7-12.8)
Complete Elementary School	29.2 (28.4-30.0)
Complete High School	42.0 (41.2-42.8)
Complete Higher Education	16.6 (15.7-17.4)
Race/Color	
White	46.1 (45.3-47.0)
Black	9.2 (8.7-9.7)
Yellow	0.9 (0.7-1.0)
Brown	43.3 (42.4-44.1)
Indigenous	0.5 (0.4-0.6)
Lives with spouse	
Yes	63.3 (62.5-64.1)
No	36.7 (35.9-37.5)
Tobacco use	
Yes	15.6 (14.9-16.0)
No	84.5 (83.9-85.1)
Alcoholic beverage intake	
Yes	44.5 (43.7-45.4)
No	55.5 (54.6-56.3)
Physical activity practice	
Yes	33.1 (32.2-34.1)
No	66.9 (66.0-67.7)
Depression	
Yes	7.6 (7.2-8.0)
No	92.4 (91.9-93.7)
Regular beans consumption *	71.8 (71.0-71.6)
Regular vegetables consumption *	53.6 (52.8-54.4)
Regular fruit consumption *	38.5 (37.6-39.4)
Regular natural juice consumption *	24.9 (24.1-25.6)
Regular sugar sweetened beverages consumption *	25.7 (24.9-26.5)
Regular sweets consumption *	22.0 (21.3-22.8)
Regular replacement of meals for snacks *	6.5 (6.1-7.0)

95%CI: 95% confidence interval.

* Regular consumption corresponds to consumption ≥ 5 times/week.

Table 2

Prevalence of depression according to socioeconomic, demographic and food consumption characteristics. *Brazilian National Health Survey* (PNS), 2013.

Characteristics	Total (N = 46,785) % (IC95%)	Male (n = 20,324) % (IC95%)	Female (n = 26,461) % (IC95%)
Sex			
Male	4.37 (3.91-4.88)		
Female	10.64 (9.99-11.32)		
Age (years)			
20-29	5.90 (5.27-6.61)	3.08 (2.47-3.84)	8.66 (7.61-9.83)
30-39	7.38 (6.69-8.12)	4.31 (3.54-5.23)	10.13 (9.10-11.28)
40-49	8.93 (8.02-9.95)	4.97 (3.98-6.19)	12.32 (10.88-13.92)
50-59	9.81 (8.76-10.97)	6.33 (5.08-7.86)	12.99 (11.40-14.76)
Education			
Incomplete Elementary School	11.96 (10.66-13.40)	7.16 (5.83-8.77)	16.36 (14.31-18.63)
Complete Elementary School	9.09 (8.24-10.01)	5.07 (4.18-6.14)	13.40 (12.05 -14.88)
Complete High School	6.25 (5.58-6.85)	3.39 (2.82-4.06)	8.78 (7.91-9.75)
Complete Higher Education	5.39 (4.61-6.29)	3.26 (2.28-4.64)	6.99 (5.89-8.29)
Race/Color			
White	7.11 (6.53 -7.75)	4.30 (3.60-5.13)	9.64 (8.75-10.61)
Black	8.70 (7.46-10.14)	5.16 (3.74-7.08)	12.38 (10.41-14.68)
Yellow	6.74 (4.02-11.07)	3.11 (1.10-8.49)	9.37 (5.09-16.27)
Brown	7.97 (7.35-8.64)	4.24 (4.64-4.95)	11.40 (10.44-12.44)
Indigenous	8.43 (4.89-14.15)	6.78 (2.25-18.68)	9.75 (5.41-16.96)
Lives with spouse			
Yes	7.49 (6.97-8.05)	4.07 (3.52-4.72)	10.61 (9.80-11.47)
No	7.88 (7.26-8.55)	4.87 (4.12-5.73)	10.69 (9.74-11.72)
Tobacco use			
Yes	10.64 (9.50-11.90)	6.01 (4.98-7.22)	17.97 (15.62-20.59)
No	7.08 (6.65-7.54)	3.96 (3.47-4.51)	9.68 (9.05-10.36)
Alcoholic beverage use			
Yes	5.85 (5.36-6.38)	3.71 (3.17-4.33)	9.54 (8.56-10.62)
No	9.07 (8.45-9.72)	5.30 (4.51-6.21)	11.14 (10.34-11.99)
Physical activity practice			
Yes	5.34 (4.75-5.99)	2.84 (2.30-3.49)	8.61 (7.51 -9.86)
No	8.77 (8.23-9.34)	5.35 (4.69-6.09)	11.41 (10.67-12.18)
Regular beans consumption			
No	9.06 (8.28-9.92)	5.09 (4.19-6.16)	11.62 (10.50-12.85)
Yes	7.07 (6.59-7.59)	4.15 (3.63-4.74)	10.15 (9.38-10.98)
Regular vegetable consumption			
No	7.88 (7.30-8.50)	4.99 (4.33-5.74)	11.15 (10.24-12.13)
Yes	7.43 (6.86-8.03)	3.70 (3.09-4.42)	10.27 (9.41-11.19)
Regular fruit consumption			
No	7.62 (7.08-8.19)	4.45 (3.89-5.09)	11.14 (9.17-12.09)
Yes	7.66 (7.06-8.30)	4.18 (3.45-5.04)	10.00 (9.17-10.89)
Regular natural juice consumption			
No	7.85 (7.33-8.40)	4.31 (3.78-4.42)	11.15 (10.36-11.99)
Yes	6.98 (6.29-7.74)	4.52 (3.71-5.51)	9.13 (8.11-10.26)
Regular sugar sweetened beverages consumption			
No	7.63 (7.14-8.15)	4.62 (4.03-5.29)	10.17 (9.47-10.92)
Yes	7.63 (6.90-8.43)	3.75 (3.10-4.52)	12.22 (10.90-13.69)
Regular sweets consumption			
No	7.06 (6.60-7.56)	4.12 (3.64-4.67)	9.88 (9.16-10.65)
Yes	9.64 (8.67-10.71)	5.30 (4.17-6.72)	13.09 (11.66-14.67)
Regular replacement of meal for snack			
No	7.46 (7.03-7.93)	4.23 (3.77-4.75)	10.47 (9.80-11.19)
Yes	10.05 (8.33-12.09)	6.47 (4.26-9.70)	12.79 (10.45-15.56)

95%CI: 95% confidence interval.

Regular consumption of sweets (OR = 1.53; 95%CI: 1.33-1.76) and regular replacement of meals for snacks (OR = 1.52; 95%CI: 1.21-1.90) were positively associated with depression, while the regular consumption of beans was negatively associated with depression (OR = 0.74; 95%CI: 0.65-0.84) (Table 3). In the analysis stratified by sex, we have found consistent associations for regular sweets consumption and regular replacement of meals for snacks with depression for both sexes (sweets: men: OR = 1.42; 95%CI: 1.07-1.88; women: OR = 1.58; 95%CI: 1.34-1.85; replacement of meals for snacks: men: OR = 1.77; 95%CI: 1.11-2.81; women: OR = 1.45; 95%CI: 1.13-1.85). For regular sugar sweetened beverages consumption, we have found a positive association with depression only among women (OR = 1.27; 95%CI: 1.10-1.48).

Regarding the markers of healthy food consumption, regular beans consumption was negatively associated with depression among women (OR = 0.75; 95%CI: 0.65-0.87) and men (OR = 0.72; 95%CI: 0.56-0.92) (Table 3).

Table 4 presents the results of the association between quintiles of the nutritional score and depression. Comparing the top quintile of the nutritional score (healthier diet) to the bottom quintile (less healthy) we have found a negative association with depression (OR = 0.63; 95%CI: 0.52-0.75) in the total sample and among women (OR = 0.58; 95%CI: 0.47-0.73).

Table 3

Association between food consumption markers and depression in Brazilian adults. *Brazilian National Health Survey* (PNS), 2013.

Food consumption markers	Total OR (95%CI) *	Men OR (95%CI) **	Women OR (95% CI) **
Regular beans consumption			
No	1.00	1.00	1.00
Yes	0.74 (0.65-0.84)	0.72 (0.56-0.92)	0.75 (0.65-0.87)
Regular vegetable consumption			
No	1.00	1.00	1.00
Yes	0.93 (0.83-1.04)	0.79 (0.61-1.00)	0.99 (0.86-1.13)
Regular fruit consumption			
No	1.00	1.00	1.00
Yes	0.99 (0.89-1.12)	1.01 (0.78-1.30)	0.99 (0.87-1.13)
Regular natural juice consumption			
No	1.00	1.00	1.00
Yes	0.93 (0.81-1.06)	1.11 (0.86-1.42)	0.86 (0.74-1.01)
Regular sugar sweetened beverages			
No	1.00	1.00	1.00
Yes	1.13 (0.99-1.29)	0.86 (0.67-1.10)	1.27 (1.10-1.48)
Regular sweets consumption			
No	1.00	1.00	1.00
Yes	1.53 (1.33-1.76)	1.41 (1.07-1.88)	1.58 (1.34-1.85)
Regular replacement of meals for snack			
No	1.00	1.00	1.00
Yes	1.52 (1.21-1.90)	1.77 (1.11-2.81)	1.45 (1.13-1.85)

95%CI: 95% confidence interval; OR: odds ratio.

Note: statistical test: logistic regression.

* Model adjusted by age, sex, race/color, education, living with spouse, physical activity, alcohol consumption and tobacco use;

** Model adjusted by age, race/color, education, living with spouse, physical activity, alcohol consumption and tobacco use.

Table 4

Association between the quintiles of the nutritional score and depression among Brazilian adults. *Brazilian National Health Survey* (PNS), 2013.

Nutritional score (quintiles)	Total		Men		Women	
	OR (95%CI) *	p-value	OR (95%CI) **	p-value	OR (95%CI) **	p-value
1	1.00	< 0.001	1.00	0.069	1.00	< 0.001
2	0.86 (0.74-1.01)		0.80 (0.59-1.07)		0.89 (0.73-1.07)	
3	0.68 (0.57-0.81)		0.85 (0.61-1.19)		0.61 (0.50-0.74)	
4	0.60 (0.50-0.72)		0.67 (0.45-1.01)		0.56 (0.46-0.69)	
5	0.63 (0.52-0.75)		0.73 (0.49-1.07)		0.58 (0.47-0.73)	

95%CI: 95% confidence interval; OR: odds ratio.

Note: statistical test: logistic regression.

* Model adjusted by age, sex, race/color, education, living with spouse, physical activity, alcohol consumption and tobacco use;

** Model adjusted by age, race/color, education, living with spouse, physical activity, alcohol consumption and tobacco use.

Discussion

Our results suggest that healthier foods are negatively associated with depression among Brazilian adults. Specifically, regular sweets consumption and replacement of meals for snacks were positively associated with depression, while the regular beans consumption was negatively associated with depression. We have found a positive association between sugar sweetened beverages and depression only among women.

A similar result was observed in the French prospective study with adults of Adjibade et al. [31], in which individuals with eating patterns rich in ultra-processed food (rich in sugar and fat) had major incidence of depressive symptoms, where a 10% increase in ultra-processed food in the diet was associated with a 21% (95%CI: 15%-27%) higher risk of depressive symptoms.

Bean consumption in Brazil represents a traditional pattern of consumption of the Brazilian diet and is associated with lower industrial processing, besides supplying considerable amounts of fiber and micronutrients (iron, potassium, and magnesium) that are important for the individuals' health [32]. Food rich in these nutrients has antioxidant and anti-inflammatory effects, such as beans, and second studies produce neuroprotection, aiding in the regulation of the hypothalamic-pituitary-adrenocortical axis, which is responsible for the mechanism of depression [15,16,17]. This is the main explanation of the causal relationship between diet and depression, evidencing that there is an interconnection between the organic systems that influence the food choices and the factors that trigger the depressive symptoms, causing the feeding to activate hormonal and neurotransmitter pathways, which later signals the brain for modulating functions like appetite, sleep, energy consumption, reward mechanisms, cognitive function, and mood [14].

A study that has evaluated the binge eating of sweets, sugar sweetened beverages, through the online filling of the *Yale Food Addiction Scale Version 2.0* (YFAS 2.0), and different degrees of depression, by evaluating the self-report of the *Stress and Depression Scale*, found stronger associations than our study [12]. The compulsion for these foods was associated with odds ratios of 6.6, 13.2, and 15.6 higher probability of moderate, severe, and very severe depression, respectively, with no association for mild depression [12]. As this study used food dependence to evaluate feeding, and our study used regular food consumption, it was expected that the strength of the association found in our study would be lower.

Consumption of sugar sweetened beverages positively was associated with depression among women in our study. These results were similar to those found in the cross-sectional study with women carried out by Ruiz-Cabello et al. [33] in Spain, which used a FFQ to evaluate the participants' diet, and that has shown an association between the consumption of sugary drinks and the occurrence of depression, diagnosed through a questionnaire that evaluates the depressive symptomatology.

Regarding the replacement of meals for snacks, the cohort of 3,483 English adults of Akbaraly et al. [11] observed a positive association between high consumption of processed foods, assessed by FFQ, and depression, assessed by the *Depression Scale* (CES-D) (OR = 1.58; 95%CI: 1.11-2.23).

The association between the quintiles of the nutritional score and depression supports the hypothesis that healthier diets in a broad way are negatively associated with depression. In this sense, not only regular consumption of unhealthy foods can lead to the occurrence of depression, but also the reduction of consumption of this type of food can protect against the occurrence of this disease, as shown in other studies [11,12,34]. This is because food markers of unhealthy eating habits cause endothelial dysfunctions and inflations that can lead to the occurrence of depression [18,19,20,21]. In contrast, the decrease in the consumption of these kinds of food can reduce the inflammatory process, therefore reducing the risk of the disease [18,19,20].

When stratified by sex, we observed that among women, the association was maintained for sweets consumption, sugar sweetened beverages consumption, and the replacement of meals for snacks. For men, it happened only for sweets consumption and for the substitution of meals for snacks. The results of the Camilleri et al. [35] study of the NutriNet-Santé cohort (France, 2009-2013) has also shown differences in the associations between dietary intake and depression between men and women, with an association between energy-dense snacking and depressive symptoms only among women (OR = 1.81; 95%CI: 1.45-2.26). In a study carried out with men in Finland, it was observed that those who presented a western diet pattern represented by the consumption of fast foods and fatty foods (evaluated by FFQ) were 41% more likely to present depressive symptomatology (evaluated by *Human Population Laboratory Depression Scale*) [36].

In our study, vegetable, fruit, and natural fruit juice consumption were not associated with depression. A study carried out in three Asian countries (Bangladesh, India, and Nepal) have shown a similar result, with association only in one country and yet only for fruit consumption (OR = 3.10; 95%CI: 1.57-6.10) [18]. Two other cohorts found no association between healthy food consumption and depression [14,34]. In contrast, Canadian researchers have evaluated the quality of diet and other lifestyle habits and mental health, and then it was shown that regular consumption of fruits and vegetables was inversely associated with the occurrence of depressive symptoms [23]. Merrill et al. [12] found a positive association between a diet rich in vitamins and minerals and low in fat and the occurrence of depressive symptoms. It is important to emphasize the literature shows that the relationship between dietary choices and depression can occur in a bidirectional way, that is, food leading to the occurrence of depression, and depression itself leading to worse food choices, this reverse direction can be due to the modulation of the cerebral pathways (appetite, sleep, humor, among others) caused by the adoption of good habits of life that in turn lead to altered eating behavior [14].

It is noteworthy that our study has found a prevalence of depression of 7.6% among Brazilian adults, which is lower than the prevalence reported by Bromet et al. [37] (11.1%) in 2011, although higher than the prevalence reported by the WHO (5.8%), in 2017 [38]. Our prevalence is in accordance with another study using the PNS and the same cutoff for depression (7.9%). The slightly different prevalence was due to the exclusions of adolescents and elderly from our analyses, justified by the distinct patterns of food consumption in these age groups from the adult population [39].

Some limitations of this study need to be considered. The cross-sectional design of the study does not allow causal inference of the associations. Moreover, since the association between depression and food consumption seems to occur bi-directionally and the fact that for some foods, the food consumption was measured only by weekly frequency rather than daily frequency and quantity consumed, it might not have been possible to identify more precisely differences. This may have contributed to the lack of association between some food markers and depression. Also, information on food consumption has been self-reported, so there is still a possibility of information bias. Regardless of that, it was not possible to adjust for caloric intake, since this measure was not performed by PNS. Although analyses have been adjusted for the confounding variables, due to the observational nature of our study, we cannot exclude the possibility of residual confounding, as for example the not adjustment to the energy consumption, in this study, there was no isolated food analysis, which could identify more precise associations of the variables. In addition, despite the adjustment for education level, the income was not measured by the PNS, and therefore not adjusted for, possibly remaining

socioeconomic confounding. Nonetheless, it is unlikely that residual confounding could explain entirely the associations found.

In contrast to the limitations, this study is one of the few that evaluated the association between healthy and unhealthy food consumption markers (covering various food groups) and depression in a Brazilian population sample. Also, the use of PHQ-9, which is a validated instrument for the Brazilian population for the diagnosis of depression, minimizes the possibility of classification errors of individuals regarding the status of depression. This instrument is recognized as an important tool for the identification and monitoring of depression, as well as used in population epidemiological studies [28]. Thus, our results compose important evidence about the possible role of diet in depression, suggesting that nutritional aspects should be considered in both prevention and care in depression.

The sugar sweetened beverages consumption in adult women and replacement of meals by snacks and the sweets consumption in adults of both sexes were positively associated with depression in this study, while regular beans consumption was negatively associated with this disease, also in both sexes. A healthier diet was negatively associated with depression. Further studies with a longitudinal design are needed to better identify the direction of the association between food consumption and depression, plus studies that evaluate the mechanisms involved in this association, to provide scientific support for public health policies in the area.

Contributors

K. T. Sousa and C. M. Azeredo contributed to the study design, data analysis and interpretation, writing and approval of the final version. E. S. Marques and R. B. Levy contributed to the study conception, results interpretation, review and approval of the final version.

Additional informations

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Resumo

O estudo teve como objetivo avaliar a associação entre consumo alimentar e depressão. Utilizamos dados da Pesquisa Nacional de Saúde*, um inquérito transversal realizado em 2013 em uma amostra de 46.785 adultos brasileiros. As variáveis de exposição foram consumo regular (≥ 5 vezes/semana) de marcadores de alimentos saudáveis (feijão, verduras e hortaliças, frutas e sucos naturais) e não saudáveis (bebidas açucaradas, doces e substituição de almoço ou jantar por lanches); e uma pontuação nutricional elaborada pela combinação da frequência de consumo de marcadores de alimentos saudáveis e não saudáveis, em que valores mais altos indicam melhor qualidade da alimentação. A variável dependente foi depressão, avaliada pelo questionário PHQ-9, respondido pelos participantes. Aqueles com PHQ-9 igual ou maior que 10 foram classificados como apresentando depressão. Foram construídos modelos de regressão logística, ajustados para potenciais fatores de confusão. O consumo regular de doces (OR = 1,53; IC95%: 1,33-1,76) e substituição regular de refeições por lanches (OR = 1,52; IC95%: 1,21-1,90) mostraram associação positiva com depressão. O consumo regular de bebidas açucaradas mostrou associação positiva com depressão entre mulheres (OR = 1,27; IC95%: 1,10-1,48). O consumo regular de feijão mostrou associação negativa com depressão (OR = 0,74; IC95%: 0,65-0,84) em ambos os sexos. A comparação do quintil mais alto de pontuação nutricional (dieta mais saudável) com o quintil mais baixo (menos saudável) mostrou associação negativa com depressão (OR = 0,63; IC95%: 0,52-0,75). Os resultados fornecem evidências sobre o papel potencial do consumo alimentar na depressão. No futuro, estudos longitudinais devem explorar os mecanismos dessas associações.*

Consumo de Alimentos; Depressão; Epidemiologia Nutricional

Resumen

El objetivo de nuestro estudio fue evaluar la asociación entre el consumo de comida y la depresión. Usamos datos de la Encuesta Nacional de Salud *para llevar a cabo un estudio transversal en 2013 entre 46.785 brasileños adultos. Las exposiciones fueron: consumo regular (≥ 5 veces/semana) de los marcadores de comida saludable (frijoles, vegetables, frutas, y zumos de fruta natural) y alimentos no saludables (bebidas azucaradas; dulces y la sustitución del almuerzo o cena por aperitivos); y un marcador nutricional creado, combinando la frecuencia de consumo de los marcadores de comida saludable y no saludable, cuanto mayor era el valor, mejor era la dieta. El resultado fue depresión, evaluado a través del cuestionario PHQ-9, respondido por parte de los participantes. Aquellos con puntuaciones PHQ-9 mayores o iguales a 10 fueron clasificados como depresivos. Realizamos una regresión logística con modelos ajustados a factores potenciales de confusión. El consumo regular de dulces (OR = 1,53; IC95%: 1,33-1,76) y la sustitución regular de comidas por aperitivos (OR = 1,52; IC95%: 1,21-1,90) estuvieron positivamente asociados con la depresión. El consumo regular de bebidas azucaradas estuvo positivamente asociado a la depresión entre mujeres (OR = 1,27; IC95%: 1,10-1,48). El consumo regular de frijoles estuvo negativamente asociado a la depresión (OR = 0,74; IC95%: 0,65-0,84), consistente para ambos sexos. Comparando la puntuación nutricional más alta del quintil (la dieta más sana) con la más baja del quintil (la menos sana) encontramos una asociación negativa con la depresión (OR = 0,63; IC95%: 0,52-0,75). Nuestros resultados añaden evidencias sobre el posible rol del consumo de comida en la depresión; estudios longitudinales futuros deberían explorar los mecanismos de estas asociaciones.*

Consumo de Alimentos; Depresión; Epidemiología Nutricional

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