ORIGINAL ARTICLE

Food addiction and its association with sedentary lifestyle in university students: a national cross-sectional study

Adição por alimentos e sua associação com estilo de vida sedentário em estudantes universitários: um estudo transversal nacional

Ana Debora Santos de Oliveira[1], André Eduardo da Silva Júnior[2], Nassib Bezerra Bueno[1,2]

ABSTRACT

Obesity is considered a chronic non-communicable disease, characterized by excessive accumulation of body fat at levels harmful to health. The sedentary lifestyle marked by the absence of physical exercise is considered one of the risk factors for its development. In addition, there is an increase in the consumption of foods with addictive potential, which may favor the emergence of food addiction. Physical exercise seems to reduce the desire for several substances with addictive potential, such as tobacco, alcohol and opioids, and can also be used in the treatment of these addictions. Therefore, the present study aimed to determine whether there is an association between the prevalence of food addiction and sedentary lifestyle in Brazilian university students. This is a cross-sectional study of national scope, carried out through online questionnaires. Data were self-reported, including age, sex, economic class, diagnosis of anxiety disorder, modified Yale Food Addiction Scale 2.0 (mYFAS 2.0) and physical exercise. A total of 5,946 participants were included, with a mean age of 24.1 ± 6.3 years, of which 4,371 (73.5%) were female and had a mean BMI of 24.4 ± 5.2 kg/m2. The prevalence of food addiction was 18.5%. An association was observed between food addiction and sedentary lifestyle (PR: 1.42; 95%CI [1.28 — 1.58]), even after adjustment (PR: 1.23; 95%CI [1.11 — 1.35]). In conclusion, individuals who reported not exercising were more likely to be diagnosed with food addiction.

Keywords: Food addiction, Physical exercise, Sedentary behavior.

RESUMO

A obesidade é considerada uma doença crônica não transmissível, caracterizada pelo acúmulo excessivo de gordura corporal a níveis prejudiciais à saúde. O estilo de vida sedentário é marcado pela ausência da prática de exercício físico, o que é considerado um dos fatores de risco para seu desenvolvimento. Além disso, há o aumento do consumo de alimentos com potencial aditivo, o que pode favorecer o surgimento de adição por alimentos. O exercício físico parece reduzir o desejo por várias substâncias com potencial aditivo como tabaco, álcool e opióides, e também pode ser utilizado no tratamento dessas adições. Sendo assim, o presente estudo teve como objetivo determinar se existe associação entre a prevalência de adição por alimentos e o estilo de vida sedentário em estudantes universitários brasileiros. Trata-se de um estudo

[1]Universidade Federal de Alagoas, Faculdade de Nutrição, Laboratório de Nutrição e Metabolismo, Programa de Pós-Graduação em Nutrição, Alagoas, (AL), Brazil .

[2]Universidade Federal de São Paulo, Escola Paulista de Medicina, Programa de Pós-graduação em Nutrição, São Paulo, (SP), Brazil.

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transversal de abrangência nacional, realizado através de questionários online. Os dados foram autorrelatados, sendo incluídos idade, sexo, classe econômica, diagnóstico de transtorno de ansiedade, modified Yale Food Addiction Scale 2.0 (mYFAS 2.0) e a prática de exercício físico. Foram incluídos 5.946 participantes, com média de idade de 24 ± 6 anos, sendo 4371 (73,5%) do sexo feminino e média de IMC 24,4 ± 5,2 kg/m^2. A prevalência de adição por alimentos foi de 18,5%. Foi observada associação entre adição por alimentos com sedentarismo (RP: 1,42; IC95% [1,28 — 1,58]), mesmo após o ajuste (RP: 1,23; IC95% [1,11 — 1,35]). Em conclusão, indivíduos que relataram não realizar exercícios físicos foram mais propensos a serem diagnosticados com adição por alimentos.

Palavras-chave: Adição alimentar, Exercício físico, Comportamento sedentário.

INTRODUCTION

Obesity is considered a chronic non-communicable disease, characterized by excessive accumulation of body fat at levels that are harmful to health[1]. In recent years, Brazil has shown an increase in the prevalence of overweight and obesity by approximately three and two times for men and women, respectively[2]. According to data from the Surveillance of Risk and Protective Factors for Chronic Diseases by Telephone Survey (VIGITEL), the country had a prevalence of obesity of around 21.5%[3]. Among the modifiable risk factors for development of obesity, there is a sedentary lifestyle marked by the absence of physical exercise[4]. Furthermore, increased caloric intake and/or consumption of foods said to be hyperpalatable, or foods with addictive potential, have also been associated to the accumulation of body fat.[5]

The term food addiction is characterized by excessive consumption of energy-dense, hyperpalatable, and processed foods whose characteristics are similar to addictive substance[6]. This term has been widely used after analyzing the diagnostic criteria for addiction. substance use from the Diagnostic and Statistical Manual of Mental Disorders-IV, which included symptoms such as the need to consume larger amounts than desired, unsuccessful attempts to reduce consumption and tolerance[7].

Physical exercise seems to play an important role in appetite regulation. This is because the insufficient practice of physical exercise is associated with higher levels of disinhibition, that is, a greater tendency to eat excessively and impulsively in an obesogenic environment, when compared to individuals who practice higher levels of physical exercise[8-9]. According to the Diagnostic and Statistical Manual of Mental Disorders-5 (DSM-5), cravings and disinhibition are associated with addictive behavior, which indicates a probable relationship between addiction to food and physical exercise[10].

A meta-analysis conducted by Wang et al.[11] (2014) indicated that physical exercise can increase the rate of abstinence, as well as symptom relief and reduce anxiety disorders in individuals with substance use disorder. This seems to be possible due to the ability of physical exercise, more specifically running, to cause neurochemical and morphological adaptations in the reward system and hippocampus, which are also activated in substance use with addictive potential such as opioids, cocaine, and tobacco[12]. Moreover, physical exercise

seems to influence the functional improvement of the nervous system, causing sensations of pleasure and relaxation, which positively impacts the prevention and treatment of substance use disorders[13]. Moreover, in animal models, it seems to reduce the functional impairment of the prefrontal cortex, commonly observed in periods of withdrawal, which may decrease the chances of relapse and the desire to use substances such as cocaine[14]. A systematic review conducted by Taylor et al.[15] (2007), included 14 studies, showed a reduction in withdrawal symptoms and cravings for cigarette smoking when subjected to physical exercise, and may be related to the release of dopamine, serotonin, opioid peptides, and cortisol during and immediately after exercise [15].

In recent decades, evidence on food addiction has grown[16-17]. University life seems to be related to variations in students' habits and lifestyle, being a period of adaptation to healthy eating and physical activity[17]. A study conducted in Brazil with university students showed a high frequency (75.7%) of inappropriate eating habits[19]. A meta-analysis conducted with 55 studies indicated that the weighted average prevalence of diagnosis of food addiction in university students was 11% (95% CI: 10%; 13%)[16], which is similar to the prevalence for tobacco addiction among Brazilian university students, also of 11%[20]. However, there are few studies that have proposed to evaluate the relationship between food addiction and sedentary lifestyle in university students. Therefore, the present study aimed to determine whether there is an association between food addiction and sedentary lifestyle in university students.

METHOD

Ethical aspects

The present study was submitted and approved by the Research Ethics Committee of the xxxxxxxxxx (protocol number: 4,410.403). All participants had access to the Free and Informed Consent Form on the first page of the online questionnaire, being necessary to accept it to access the questionnaire.

Study design

Cross-sectional study

Location and sample

The Federative Republic of Brazil is the largest country in Latin America, with continental dimensions. Administratively, the country is divided into 27 federative units that make up the five macro-regions of Brazil: North, Northeast, Midwest, Southeast, and South.

This study is a secondary analysis of a larger study that aimed to determine the prevalence of food addiction in Brazilian college students. Students from 94 public and private Brazilian universities, distributed in all states of the federation, were invited. We included students of both genders and aged between 18 and 59 years. Individuals undergoing bariatric surgery, pregnant and lactating women were not included. Individuals who did not complete the questionnaire and those who reported improbable values for variables such as self-reported weight and height were excluded.

Sample size

To calculate the sample size of the primary study, 95% confidence and 1% acceptable margin of error were adopted. A population size of 8,449,521 individuals was considered, corresponding to the number of students enrolled in universities in Brazil in 2018[21]. The expected frequency of food dependence was 10%. This value was based on the expectation that measures of social distancing, and the consequent impact on depression and anxiety in the population, would present a higher prevalence than that observed in a study conducted in Brazil that evaluated 7,639 individuals and observed a prevalence of food dependence of 4.32%[22]. With these parameters, 3,456 college students were needed to compose the sample. Given the important heterogeneity in the geographical distribution of the population in the country, the sample was weighted by the number of university students in each of the macro-regions. Thus, 283 (8.2% of the sample) were needed in the North, 736 (21.3%) in the Northeast, 317 (9.2%) in the Center-West, 1,536 (44.4%) in the Southeast, and 584 (16.8%) in the South.

Recruitment and procedures

The online questionnaire for data collection was developed and tested in a pilot study to assess possible difficulties in accessing the form, understanding the questions, and estimating the time data collection. The pilot study was conducted with 50 participants who met the inclusion criteria for this study and were affiliated with one of the participating institutions. These individuals were included in the final database because no difficulties were reported with the evaluated questionnaire. The average questionnaire response time in the pilot study was 9 min and 24 s.

Data collection occurred by completing an online questionnaire through the Google forms® platform between October 27 and December 11. The recruitment of participants occurred through e-mail invitations sent to university leaders, students, institutional websites, and social networks. Thus, the participants knew the theme (food addiction in Brazilian college students) and the research objectives.

Demographic and clinical variables

Information was collected on age (in years), date of birth, gender, educational institution, the federative unit, drinking habits, smoking habits, physical exercise, and anxiety disorder.

Economic class

The Critério de Classificação Econômica Brasil (CCEB) was used to determine the economic class of individuals. This instrument consists of a series of questions about ownership of assets, the number of bathrooms in the home, the level of education of the head of the family, and access to public services such as piped water. Scores for questions are added up and can range from 0 to 100 points; higher scores correspond to higher estimated monthly household income. Individuals are classified into one of six possible economic classes: “A” (45-100 points), “B1” (38-44), “B2” (29-37), “C1” (23-28), “C2” (17-22), and “D-E” (0-16)[23].

Anthropometry

Body weight (in kilograms) and height (in meters) were self-reported, and collected during the completion of the electronic questionnaire. The Body Mass Index (BMI) (kg/m2) was calculated and classified according to the World Health Organization into underweight (BMI < 18.5 kg/m2), eutrophic (BMI between 18.5 and 24.9 kg/m2), overweight (BMI between 25.0 and 29.9 kg/m2), and obese (BMI ≥ 30 kg/m2)[24].

Signs and symptoms of anxiety disorder

The Generalized Anxiety Disorder Scale (GAD-7) was developed to diagnose generalized anxiety disorder, with validation in Brazil[25-26]. The scale is composed of seven items, presented in four points from 0 to 3, where 0 represents “never” and 3 “almost every day”, the summed score can range from 0 to 21 points, and scores equal to or greater than 10 were considered an indicator of signs and symptoms of anxiety disorder[25].

Sedentary lifestyle

To evaluate the sedentary lifestyle, the participants were asked whether they performed at least 150 minutes of moderate exercise or 75 minutes of intense or vigorous exercise per week, according to the recommendations of the World Health Organization[27]. Individuals who reported values lower than these were considered sedentary in the present study. Examples of physical exercises were also presented to facilitate the participants’ understanding.

Food addiction

Food addiction was measured using the modified Yale Food Addiction Scale 2.0 (mYFAS 2.0)[28].This scale is already translated and cross-culturally validated into Portuguese, showing adequate internal consistency and factor structure[29]. Basically, it is a self-report questionnaire with 13 questions, of which 11 represent symptoms concerning the individual’s eating behavior that relate to aspects of the Diagnostic and Statistical Manual of Mental Disorders-5 (DSM-V) substance use disorders model and 2 refer to clinical distress/compromise. The questions involve questions such as “I ate to the point where I felt physically ill” and are scored from 0 (Never) to 7 (Every day), with a threshold for each of the symptoms. Individuals with 1 or fewer symptoms have no food addiction, 2 or 3 symptoms with clinical distress/compromise have mild addiction, 4 or 5 symptoms with clinical distress/compromise have moderate addiction, and 6 or more symptoms with clinical distress/compromise have severe addiction. It was considered addiction by food, the symptom criteria - yes or no - without severity categorization [29].

Statistical analysis

In descriptive analysis, data are presented as mean and standard deviation for continuous variables and frequencies for categorical variables. To identify the association between food addiction and sedentary lifestyle, in univariable and multivariable analysis. The multivariable model included age (in years), sex, economic class, generalized anxiety disorder, and BMI class as adjustment variables. Prevalence ratios

(PR) and their confidence intervals are presented. α equal to 5% was adopted. All statistical analyses were conducted with the aid of R v 3.6.1 software (R Foundation for Statistical Computing, Vienna, Austria).

RESULTS

6,532 questionnaires were answered and sent to the online platform. After data checking, removal of duplicates, and application of the inclusion and exclusion criteria, 586 were excluded, leaving 5,946 individuals in the final sample of this study (Figure 1).

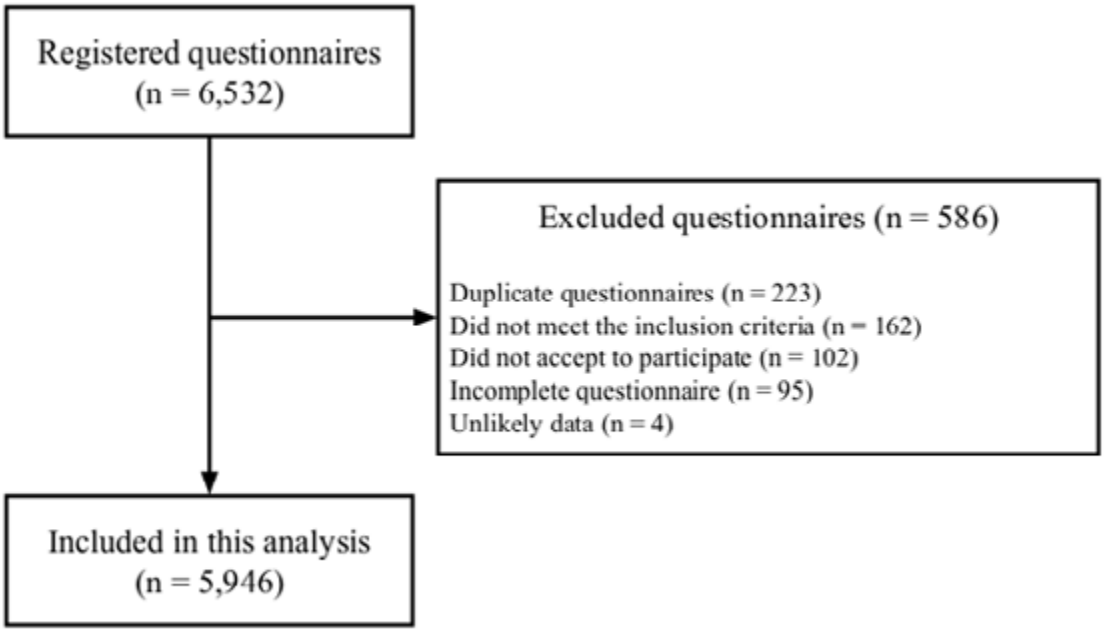

Figura 1. Participant selection flowchart.

The mean age of the participants was 24.1 ± 6.3 years and 4,371 (73.5%) were female. The mean BMI of the sample was 24.4 ± 5.2 kg/m^2.The prevalence of sedentary lifestyle was 47.2% (n=2.805), most participants (49.2%) identified themselves as white and 40.4% belonged to classes C1-C2-D-E. Table 1 presents some other characteristics of the population. The prevalence of food addiction was 18.5% (n=1,100).

Table 1. Sample characteristics according to demographic, social, economic, clinical and anthropometric variables.

Variables	Sample (n=5,946)	
	N	%
Sex		
Female	1,575	26.5
Male	4,371	73.5
Region		
North	378	6.4
North East	2,621	44.1
Midwest	379	6.4
Southeast	1,707	28.7
South	861	14.5
Race/Color		
White (Caucasian)	2,924	49.2
Black (Afro-descendant)	745	12.5
Brown	2,174	36.6
Yellow (Asian)	71	1.2
Indigenous	32	0.5
Economic class		
A	817	13.7
B1	944	15.9
B2	1,785	30
C1	1,229	20.7
C2	837	14.1
D-E	334	5.6
Alcohol consumption		
No	2,562	43.1
Yes	3,384	56.9
Smoking		
No	5,333	89.7
Yes	448	7.5
Ex-smoking	165	2.8
Sedentary		
No	3,141	52.8
Yes	2,805	47.2
Body mass index		
Underweight	453	7.6
Normal weight	3,313	55.7
Overweight	1,353	22.8
Obesity	827	13.9

Indicative of anxiety disorder		
No	3,429	57.7
Yes	2,517	42.3
Diagnosis of food addiction		
No	4,846	81.5
Yes	1,100	18.5

Food addiction and sedentary lifestyle

A significant association was observed between sedentary lifestyle and food addiction diagnosis (Table 2). Sedentary college students were more likely to be diagnosed with food addiction when compared to those who exercised (PR: 1.42; 95%CI [1.28 - 1.58], p < 0.01). After adjustment for age, sex, economic class, BMI, and anxiety disorder, the association remained significant (PR: 1.23; 95% CI [1.11 - 1.35], p < 0.01).

Table 2. Prevalence ratio of univariable and multivariable analysis for the diagnosis of food addiction in Brazilian college students according to sedentary variable.

Variables	**Univariable analysis**			**Multivariable analysis***		
	PR	*IC95%*	*p*	*PR*	*IC95%*	*p*
Sedentary						
No	1,00	-	-	1,00	-	-
Yes	1,42	1,28; 1,58	< 0,01	1,23	1,11; 1,35	< 0,01

PR: Prevalence ratio by Poisson regression with robust variance adjustment; CI 95%: 95% confidence interval; *Multivariable model included the variables age, sex, economic class, BMI, and anxiety disorder as adjustment variables.

DISCUSSION

This study aimed to determine if there is an association between food addiction and sedentary lifestyle in college students. Food addiction was positively associated with sedentary behavior, that is, being sedentary increases the chance of the individual being diagnosed with food addiction. These findings remain even after statistical adjustment for the variables age (in years), sex, BMI, economic class, and anxiety disorder.

These variables were used to adjust the multivariable model, as they have been related to a sedentary lifestyle. Sedentary behavior has also been positively associated with anxiety disorder[16]. The level of sedentary lifestyle tends to increase with increasing age, as well as the increase in BMI. Assitionally, physical activity levels can be influenced by gender. Furthermore, individuals who live in countries with lower income tend to have less access to leisure spaces and sports facilities, and thus have higher levels of sedentary lifestyle[30].

The association between food addiction and sedentary lifestyle (PR: 1.23; 95% CI [1.11 - 1.35]; p < 0.01) corroborates with the findings of Romero-Blanco et al.[12] (2021) in which the presence of food addiction was associated with prolonged sedentary behavior, the study was conducted with 536 college students of both genders through self-reported questionnaires and used the YFAS 2.0. A previous study,

also suggests this association, where individuals diagnosed with food addiction have less time in moderate exercise and use more time in sedentary behaviors[10]. The relationship between exercise and other eating disorders has already been reported. Low levels of physical activity in healthy young adults have been associated in the literature with increased cases of binge eating and eating behavior in relation to emotional, cognitive, and social stimuli[8].

Low and moderate intensity physical exercise has begun to be considered as a form of complementary treatment in mood disorders and substance use disorders[31,32]. This is especially if physical exercise is included in the treatment of the individual before the attempt to stop addictive habits, as in the case of smoking, because it can facilitate the reduction of anxiety in acute periods, having an important anxiolytic role[32]. A meta-analysis of 49 randomized clinical trials found that there was a greater reduction in anxiety among groups who practiced physical exercise as part of the treatment compared to those who did not receive any type of treatment (-0.48 CI: 95%; -0.63; -0.33), as well as a greater reduction in anxiety levels compared to groups who received other forms of treatment for anxiety[33]. The possible mechanism for this effect in reducing anxiety seems to be by increasing the concentration of certain neurotransmitters induced by physical exercise, such as beta-endorphins, adrenaline, norepinephrine, serotonin and dopamine, which contributes to the feeling of reward caused by physical exercise, in addition to influencing the serotonergic system by increasing resistance to stress present in psychiatric disorders such as anxiety and depression[13,34].

Physical exercise seems to influence the functional improvement of the nervous system, causing sensations of pleasure and relaxation, which positively impacts the prevention and treatment of substance use disorders[14]. Moreover, in animal models, it seems to reduce the functional impairment of the prefrontal cortex, commonly observed in periods of withdrawal, which may decrease the chances of relapse and the desire to use substances such as cocaine[34]. A systematic review conducted by Taylor et al.[15] (2007), included 14 studies, showed a reduction in withdrawal symptoms and cravings for cigarette smoking when subjected to physical exercise, and may be related to the release of dopamine, serotonin, opioid peptides, and cortisol during and immediately after exercise [15,36].

These findings point to the inclusion of physical exercise in the treatment of food addiction. This is because the diagnosis of food addiction, according to the YFAS scale, follows DSM-V criteria, which included symptoms such as the need to consume larger quantities than desired, unsuccessful attempts to reduce consumption and tolerance, with characteristics similar to those of substance use disorders[5]. Thus, more studies are needed on the subject to consider the use of physical exercise as one of the ways to treat food addiction.

The present study has limitations. First, the exercise was self-reported. It is suggested that further research be conducted with more objective forms of measurement, such as the use of accelerometers. Just like the mYFAS questionnaire - and collected through a direct question, just like the anthropometric measurements. In addition, students knowing that the study was about food addiction may have interfered with the responses, related to social desirability bias. Therefore, the findings should be interpreted with caution. The sample calcu-

lation was not matched by region. However, we collected the minimum necessary from each region. Furthermore, the objective of the present study is to test an association between AF and sedentary lifestyle, so that the representativeness of each region is not strictly necessary, since it would be necessary if a descriptive analysis of the Brazilian population was carried out, which was done in another article[29]. Regarding the strengths of the study, we have the large sample size of university students with nationwide coverage. In the scope of current scientific studies on food addiction, there are few papers that have set out to evaluate food addiction and sedentary lifestyle. In addiction, we included age (in years), sex, economic class, generalized anxiety disorder, and BMI class as adjustment variables in multivariable analyses, variables known to be associated with food intake.

CONCLUSION

The present study found a positive association between food addiction and sedentary lifestyle. Individuals who reported being sedentary were more likely to be diagnosed with food addiction when compared to those who practiced some physical exercise. These findings corroborate other current evidence and should be considered in the treatment of individuals with addiction. It is necessary to conduct intervention studies with sedentary lifestyle to verify possible causal relationships.

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Corresponding author:
Nassib Bezerra Bueno
nassib.bueno@fanut.ufal.br

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