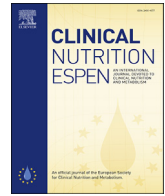ELSEVIER

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Original article

Ultra-processed and fresh food consumption and symptoms of anxiety and depression during the COVID − 19 pandemic: COVID Inconfidentes

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SUMMARY

Background & aim: Psychological disorders are an important health problem worldwide. A healthy diet is recommended as one of the measures to prevent and control mental disorders. Epidemiological studies have shown important associations between the consumption of diets rich in nutrients and a lower risk of developing anxiety and depression. Therefore, the aim of this study was to evaluate the association between the prevalence of anxiety and depression symptoms and food consumption, according to the degree of processing, during the COVID-19 pandemic.
Methods: An epidemiological household survey was conducted in two cities in Brazil. Anxiety and depression symptoms were assessed using validated scales (Generalized Anxiety Disorder 7-item/Patient Health Questionnaire-9), and food consumption was assessed using a qualitative food frequency questionnaire referring to consumption within the last 3 months. The foods were categorized according to the NOVA classification for fresh/minimally processed food and ultra-processed food, using the average weekly consumption as the cutoff. For data analysis, adjusted Poisson regression with robust variance was utilized to estimate the prevalence ratio and 95% confidence interval (CI).
Results: The consumption of fresh/minimally processed foods above the weekly average frequency was associated with a lower prevalence of symptoms of depression (PR: 0.5, 95% CI: 0.3; 0.7). Consumption above the weekly average of ultra-processed foods was associated with a higher prevalence of anxiety (PR: 1.5 and 95% CI: 1.03; 2.3) and depression symptoms (PR: 1.5, 95% CI: 1.0; 2.1, P = 0.034).
Conclusion: Increased consumption of ultra-processed foods is associated with a higher occurrence of anxiety and depression symptoms; therefore, we recommend an increase in the consumption of fresh/ minimally processed foods, as endorsed by the Dietary Guidelines for the Brazilian Population.

1. Introduction

Psychological disorders, including depressive and anxiety symptoms, are considered worldwide health problems [1]. It is estimated that depression is the biggest cause of disability, in addition to being the biggest contributor to suicide, with up to 800,000 cases per year [1,2]. Among the prevention and control measures for mental disorders, an adequate and healthy diet is recommended [3]. Epidemiological studies have shown important associations between the consumption of healthy diets and a lower

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risk of developing depression [4—6]. On the other hand, studies have observed that diets characterized by high consumption of ultra-processed foods (UPF), in general, are associated with poor mental health [3,7,8]. Such foods are characterized by the addition of synthetic substances, sugar, salt, fat, and stabilizers [9], and the consumption of these ingredients is harmful and capable of increasing inflammation, decreasing hippocampal volume, impairing cognitive function including memory, impacting psychomotor efficiency, and increasing vulnerability to depression and anxiety [10—12].

During the SARS-CoV-2 pandemic, we speculated on the possible impact of illness and social distancing on lifestyle and other health conditions [13—15], emphasizing important changes in food consumption, such as the increase in UPF consumption, as well as the global increase in the occurrence of anxiety, depression, and stress [16,17].

Considering that depression, anxiety and other mental disorders are the major diseases of the 21st century and are leading causes of disability across the globe [1], there is a strong need for scientific investigations that are capable of revealing possible associations between the consumption of foods with different degrees of processing, and the occurrence of comorbidities related to mental health [18—21]. Furthermore, it is important to consider that the nutritional transition has been characterized by an increase in the consumption of UPF as a replacement for fresh foods, resulting in important health outcomes [3,22—27], and that the COVID-19 pandemic can be a catalyst of both processes, as well as being responsible for exacerbating inequities. Thus, the aim of this study was to evaluate the association between the prevalence of anxiety and depression symptoms and food consumption, according to the degree of processing, during the COVID-19 pandemic.

2. Materials and methods

2.1. Study design and location

This study is part of a larger research effort: "Epidemiological surveillance of COVID-19 in the Inconfidentes Region/MG," conducted in two cities in the Quadrilátero Ferrífero region of Southeast Brazil. The study employed an epidemiological household survey conducted in three stages, between October and December 2020, and its methodology was previously described by Meireles [28].

According to the 2010 [29] demographic census, these urban cities have populations of 60,775 people in Ouro Preto and 47,395 people in Mariana, distributed in 17,753 and 14,078 households, respectively.

2.2. Study population

Residents of households in the urban areas of Ouro Preto and Mariana, over 18 years old, were considered eligible for this study.

Sample calculation was performed using the OpenEpi tool, using the 2010 population estimate [29] for the urban areas, 95% confidence level, design effect equal to 1.5, estimated proportion of infection, and precision. In addition, a 20% re-composition percentage was added to the sample size of each city, accounting for any losses.

A stratified and clustered sampling design was adopted in three stages as follows: census sector (probability proportional to the number of households), household (systematic sampling), and resident (randomly). For each city, four strata were defined according to the average monthly incomes available in the 2010 census [29], with the objective of guaranteeing the representation of the different socioeconomic statuses in the sample. This study included 1693 individuals as shown in Fig. 1.

2.3. Data collection

The data collection process included identifying and approaching households, randomly choose a participant by drawing lots, and conducting face-to-face interviews. Data collection occurred on weekends, with the purpose of enhancing and increasing the participation of residents who work during the week. During the week before the collection, the research team recruited and registered households in pre-selected census sectors and raised awareness among the population, which included 5252 households.

Interviews were conducted by trained undergraduate and graduate students. During data collection, the entire team underwent health monitoring through periodic evaluation prior to the beginning of each stage of the survey by serological testing for anti-SARS-CoV-2 antibodies (immunochromatography reaction). All recommendations from national protocols against coronavirus were consistently implemented, with an emphasis on hand washing, use of personal protective equipment (apron, cap, disposable surgical mask, and goggles), and conduction of interviews in an open and ventilated area. Interviewers maintained a minimum distance of 1.5 meters from the interviewees, and physical contact was restricted to solely biological material collection.

Interviews lasted between 30 and 45 min. Using the DataGoal® application, the geographic coordinates (latitude and longitude) of the respondent's residence were captured. Participant questionnaires contained registration data, sociodemographic and economic variables, lifestyle variables, medical history, and food and nutrition information.

2.4. Anxiety and depression

The presence of anxiety and depression symptoms was assessed using two scales validated for use in adults. The Generalized Anxiety Disorder 7-item (GAD-7) [30] assessed anxiety symptoms, and the Patient Health Questionnaire-9 (PHQ-9) [31] assessed depression symptoms.

The scales include questions that assess the frequency of situations that triggered symptoms of anxiety and depression in the last two weeks, with answer options as follows: i) none; ii) several days; iii) more than half of the days; and iv) almost every day. Each of the answer options equals 0 to 3 points.

The final score was classified as described by Kroenke [31] and Lowe [30]. Scores below 10 points on the GAD-7 scale were considered as indicating minimal or mild anxiety symptoms, while a score of 10 points or more was considered as indicating moderate or severe anxiety symptoms. Regarding the PHQ-9 scale, scores lower than 10 points indicated minimal or mild symptoms of depression, and scores ≥10 indicated moderate, moderately severe, and severe depression symptoms.

2.5. Food consumption

Food consumption was assessed using a qualitative food frequency questionnaire (FFQ), which was used to assess food consumption of the Brazilian population in a national survey [32], referring to consumption in the last 3 months (Fig. 1). The frequency of food consumption was reported on weekdays, with five possible answers: i) never; ii) 1—2 days/per week; iii) 3—4 days/week; iv) 5—6 days/week v) Every day, including Saturday and
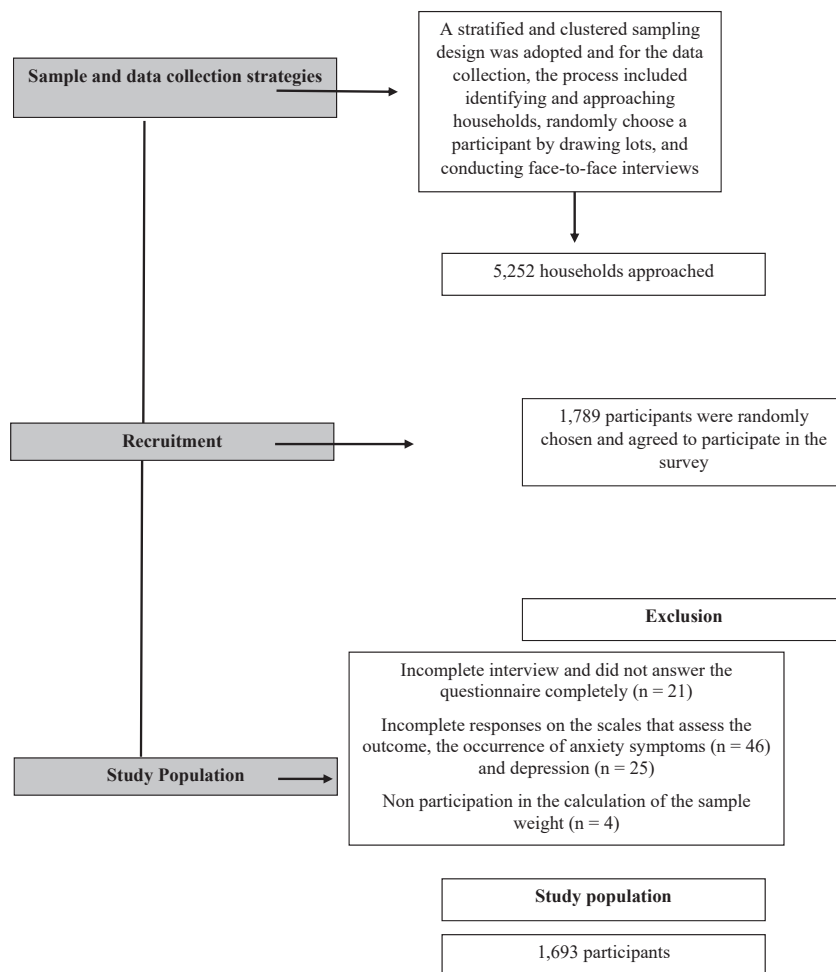
Fig. 1. Flowchart of sample and data collection strategies and exclusion criteria, COVID Inconfidentes, 2021.

Sunday. Daily food consumption was considered as a descriptive analysis variable.

The FFQ foods were used to create the two explanatory variables: fresh/minimally processed foods and ultra-processed foods, according to the Dietary Guidelines for the Brazilian Population [9] and the NOVA classification [33,34] (Fig. 2).

The NOVA classification was first documented by Monteiro et al., in 2010 [33], and is an important tool for describing foods based on the extent and purpose of industrial processing and its implications of food processing on food systems and dietary patterns, and how these may affect health and well-being patterns and the risk of disease. The Dietary Guidelines for the Brazilian Population (2014) [9] was the first worldwide guideline to be established that considered the NOVA classification system as a way to assess food processing. NOVA classifies foods into four major groups: i) fresh or minimally processed foods prepared with minimal processing techniques for preserving the food and making it suitable for storage; ii) culinary ingredients that are substances obtained industrially from natural foods and used to prepare, cook, and season food; iii) processed foods that are fresh/minimally processed foods modified by the addition of salt, sugar, oils or fats; iv) ultra-processed foods, e.g. foods with the highest degree of industrial processing, formulated using several industrial techniques and many ingredients, including salt, sugar, oils, fats, and substances exclusively for industrial use [9].

To evaluate the association between the prevalence of anxiety and depression symptoms and the food consumption according to the degree of processing, we used the NOVA categories of fresh/minimally processed and ultra-processed foods. These two variables were assessed as the sum of the weekly frequency of consumption of all foods in each respective group.

2.6. Descriptive variables

The sociodemographic variables investigated were sex, age (grouped: 18–34 years old, 35–59 years old, and 60 years old or more) [35], marital status (having a partner or not), and family income (up to two minimum wages, two minimum wages, four minimum wages, and more than four minimum wages at the time of the study).

The Presence of a medical diagnosis of anxiety disorder or depression was assessed through medical history.

2.7. Statistical analysis

The sample weight of each selected unit (census sector, household, and individual) was calculated according to the methodology described by Silva et al.[38], separately for each city, as demonstrated by Meireles and collaborators [28].
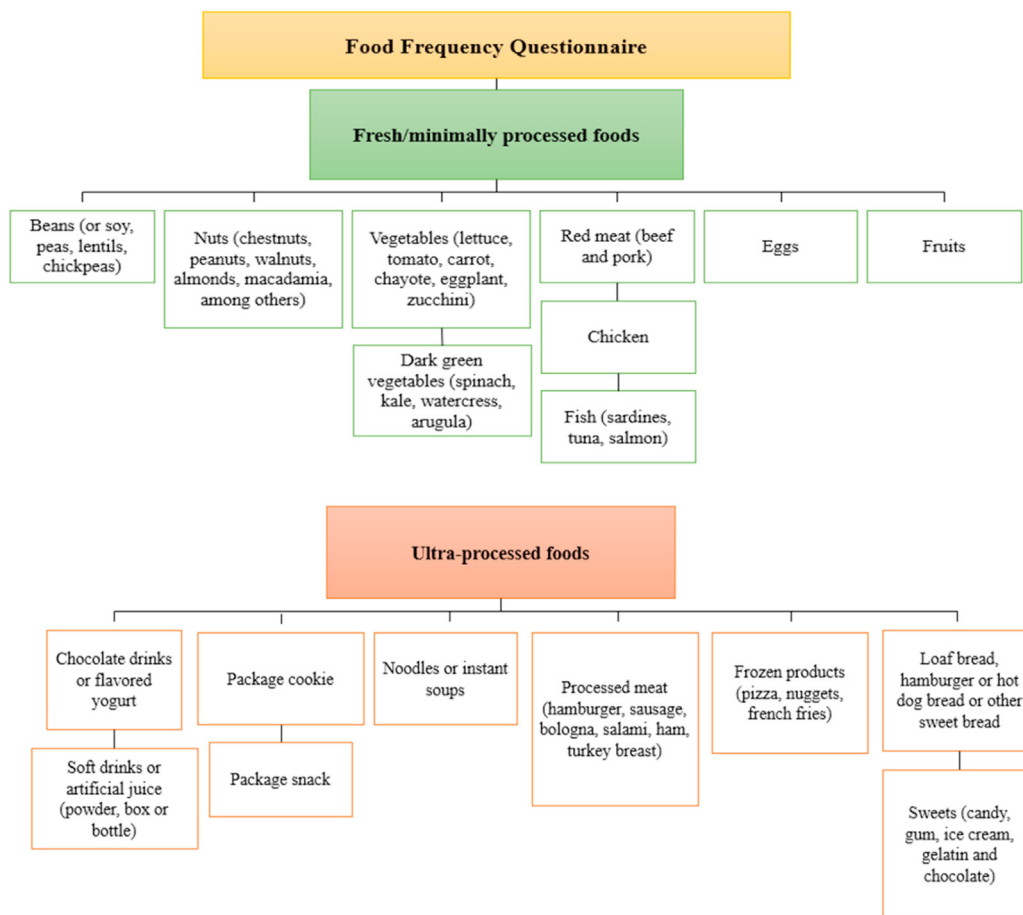
Note: Figure designed by the authors based on the Dietary Guidelines for the Brazilian Population and NOVA classification

Fig. 2. Fresh/minimally processed and ultra-processed foods, based on the Food Frequency Questionnaire.

The analyses were performed using Stata software version 15.1 (Stata Corporation, College Station, Texas), using the "svy" command, which considers a complex sample design.

For sample description, the proportion and 95% confidence interval (95% CI) were used for comparison analyses using Pearson's chi-square test.

To verify the association between the consumption of fresh/minimally processed and ultra-processed foods, and symptoms of anxiety and depression, multivariate analysis was performed using Poisson regression with the prevalence ratio and respective 95% CI for binary outcomes. A multivariate model was adjusted for sex, age, marital status, educational background, family income and medical diagnosis of depression or anxiety disorders. Furthermore, the parameters for model evaluation were appreciated (Prob > F < 0.001), indicating that the variables comprising the model were appropriate for the analysis.

2.8. Ethical considerations

The project was approved by the Research Ethics Committee of the Federal University of Minas Gerais (Protocol No. 4.135.077).

3. Results

Among the 1693 individuals evaluated, most (45.9%) were 35–59 years old and were female (51.1%). Anxiety and depression symptoms were present in 23.3% and 15.6% of the participants, respectively.

The sociodemographic characteristics and medical history, according to the presence of anxiety and depression symptoms, are shown in Table 1. It was observed that being female was related to both outcomes (Table 1) and a medical diagnosis of anxiety disorder or depression was related to a higher prevalence of depression symptoms.

When we analyzed the participants' food consumption (Table 2), we observed non-daily consumption of some fresh/minimally processed foods such as: vegetables, dark green vegetables, and red meat, among individuals with depression symptoms, as well as reduced fruit consumption among those with anxiety symptoms. Regarding the consumption of ultra-processed foods, we observed higher daily consumption of instant noodles among those with symptoms of anxiety or depression, and higher daily consumption of soft drinks or artificial juice drinks among those with symptoms of anxiety.

Through multivariate regression analysis of the relationship between food consumption according to the degree of processing and the presence of anxiety and depression symptoms (Fig. 3), it was observed that those with above-average weekly consumption of fresh and minimally processed foods had a lower prevalence ratio for depression symptoms (PR: 0.5 and 95% CI: 0.3–0.7). Above average consumption of ultra-processed foods was associated with a higher prevalence of anxiety and depression symptoms, respectively (PR: 1.5 and 95% CI: 1.03; 2.3/PR: 1.5 and 95% CI: 1.1; 2.1).

Table 1
Sociodemographic characteristics and medical history according to the presence of anxiety and depression symptoms, *COVID Inconfidentes, 2021.*

	Total	Anxiety symptoms[a] 23.3% (95% CI: 19.5; 27.6)	P-value[b]	Depression symptoms[a] 15.6% (95% CI: 12.5; 19.4)	P-value[b]
Sociodemographic characteristics					
Sex			0.009*		<0.001*
Male	48.90 (41.67; 56.18)	35.90 (23.48; 50.57)		25.12 (17.35; 34.89)	
Female	51.10 (43.82; 58.33)	64.10 (49.43; 76.52)		74.88 (65.11; 82.65)	
Age			0.126		0.218
18—34 years old	36.52 (31.92; 41.38)	41.25 (28.69; 55.06)		42.12 (29.94; 55.34)	
35—59 years old	45.87 (41.34; 50.47)	49.76 (37.95; 61.60)		47.15 (36.27; 58.30)	
≥60 years old	17.61 (14.46; 21.28)	8.98 (5.71; 13.86)		10.74 (6.68; 16.81)	
Marital status			0.412		0.036*
Married	46.59 (40.66; 52.62)	49.77 (37.87—61.69)		41.57 (30.68; 53.35)	
Not married	53.41 (47.38; 59.34)	50.23 (38.31; 62.13)		58.43 (46.65; 69.32)	
Family income			0.420		0.664
≤2 minimum wages	40.59 (35.20; 46.21)	34.26 (24.69; 45.32)		38.42 (27.23; 50.98)	
>2 to ≤4 minimum wages	31.99 (26.81; 37.64)	32.78 (23.89; 43.11)		29.60 (20.63; 40.49)	
>4 minimum wages	27.42 (22.41; 33.08)	32.96 (19.67; 49.67)		31.98 (21.00; 45.39)	
Medical history					
Diagnosis of anxiety disorder or depression			<0.001*		<0.001*
No	77.25 (72.82; 81.15)	55.30 (44.30; 65.79)		48.80 (38.05; 59.67)	
Yes	22.75 (18.85; 27.18)	44.70 (34.21; 55.70)		51.20 (40.33; 61.95)	

[a] Proportion and 95% confidence interval (95% CI).
[b] Probability values.
* P-values < 0.05.

4. Discussion

This study revealed that the higher weekly frequency of consumption of fresh/minimally processed food, the lower the prevalence of depression symptoms, and the higher the weekly frequency of consumption of UPF, the higher the prevalence ratio of anxiety and depression symptoms. Moreover, a high prevalence of anxiety (23.3%) and depression (15.6%) symptoms were identified in the study population.

The prevalence identified by these results is close to the reported in studies conducted in other populations. Choi and colleagues [39] observed similar prevalence for both anxiety (19.8%) and depression (14.0%) in a sample of 500 adults in Hong Kong. Gao [17] found a 22.6% prevalence of anxiety symptoms in a sample of 4827 Chinese, while a study conducted by Solomou et al. [40] in the Mediterranean region, found that 23.1% of their sample had anxiety symptoms and 9.2% had depression symptoms. In Brazil, at the beginning of the pandemic, Barros [41] observed that 35.2% of the participants often felt depressed, while 41.3% felt anxious. The difference observed in the prevalence of anxiety and depression symptoms in this study, compared to a study conducted by Barros et al., both conducted in Brazil, may be attributed to the respective evaluation periods of each study. Barros and collaborators collected data concerning anxiety and depression at the beginning of the COVID-19 pandemic from April to May 2020, a period when fear, anguish, and insecurity were reported by most people [42,43]. Furthermore, the sampling method used in their study corresponds to a non-probability sample based on the snowball method using online interviews, while the present study used a stratified and conglomerate sample using face-to-face interviews. Additional longitudinal studies are necessary to fully understand this phenomenon.

The recent spread of the SARS-Cov-2 virus and its evolution into a pandemic, seems to be associated with an increase in the prevalence of mental illness [44]. Data suggest that infected individuals can be afflicted with symptoms of insomnia, anxiety, and depression [45]. Moreover, sudden changes in routine and lifestyle are associated with mental illness. Such changes, present in the context of a pandemic, are characterized by the imposition of social distancing with consequent reduction of social interaction [46—48],

feelings of insecurity and fear [48—50], changes in the work routine [51], food insecurity, and changes in food consumption [14,48,52].

The results presented in this study should be interpreted in light of the current epidemiological and nutritional scenario of the Brazilian and global population, which shows a trend towards lower consumption of food sources of nutrients capable of mitigating the symptoms of anxiety and depression [53], with a significant increase in the consumption of ultra-processed foods that are poor in micronutrients [54,55]. In Brazil, the lower consumption of traditional Brazilian food was observed through the Family Budget Survey, and there was an observed increase in consumption of UPF [56]. This reversal in food consumption is related to maladaptive health outcomes, which are described as public health problems, including depression [3,27].

Recent scientific evidence suggests that food consumption plays an important role in the occurrence of mental illness [3,8,57,58]. Epidemiological data related food consumption to poor mental health through inflammatory reactions and deficiency of nutrients and neurotransmitters [59—61]. It is noteworthy that excessive consumption of carbohydrates and sugar has been described as a risk factor for mental illness due to being related to an increase in neuroinflammation within the hippocampus [62]. In contrast, the consumption of complex carbohydrates, such as vegetables, fruits, and fibers, is encouraged because they are sources of vitamins and polyphenols, and are metabolized into short-chain fatty acids, which are important anti-inflammatory agents [62,63].

Furthermore, fatty acids have been widely studied for their anti-inflammatory properties [59] and neuroendocrine modulation of neurotransmitters, such as serotonin and dopamine [64,65]. Complex B, D, and E vitamins, which are richly present in fresh/minimally processed foods, are important in modulating brain functions related to cognitive performance, prevention of neurodegenerative disorders, protection against oxidative stress, and myelination of neurotransmitters [66—68].

Therefore, it is understood that a diet rich in fresh foods and nutrients is important in promoting health, while a diet rich in UPF, deficient in vitamins, minerals, and proteins, and high in saturated fat, sugar, salt, strongly flavored ingredients, and chemical additives, is capable of disrupting natural satiety mechanisms and acting on hyper stimulation of reward-related brain regions (i.e.,

Table 2
Daily food intake according to the presence of anxiety and depression symptoms, *COVID Inconfidentes, 2021.*

	Total (%/95% CI)	Anxiety symptoms (%/95% CI)[a]	P-value[b]	Depression symptoms (%/95% CI)[a]	P-value[b]
Fresh/minimally processed foods					
Beans			0.702		0.044*
Daily	72.23 (67.24; 76.73)	73.68 (63.88; 81.59)		60.44 (46.76; 72.67)	
Not daily	27.77 (23.27; 32.76)	26.32 (18.41; 36.12)		39.56 (27.33; 53.24)	
Nuts			0.405		0.234
Daily	6.62 (3.96; 10.84)	5.00 (2.51; 9.70)		4.13 (1.92; 8.66)	
Not daily	93.38 (89.16; 96.04)	95.00 (90.30; 97.49)		95.87 (91.34; 98.08)	
Vegetables			0.131		0.005*
Daily	56.95 (52.44; 61.34)	48.06 (36.04; 60.31)		41.08 (30.72; 53.77)	
Not daily	43.05 (38.66; 47.56)	51.94 (39.69; 63.96)		58.20 (46.23; 69.28)	
Dark-green vegetables			0.192		0.035*
Daily	24.03 (19.74; 28.90)	18.77 (13.65; 25.25)		17.11 (11.97; 23.87)	
Not daily	75.97 (71.10; 80.26)	81.23 (74.75; 86.35)		82.89 (76.13; 88.03)	
Fruits			0.031*		0.127
Daily	43.33 (38.33; 48.48)	32.13 (23.45; 42.26)		34.73 (24.60; 46.47)	
Not daily	56.67 (51.52; 61.67)	67.87 (57.74; 76.55)		65.27 (53.53; 75.40)	
Red meat			0.201		0.031*
Daily	21.89 (18.27; 25.99)	29.03 (16.96; 45.03)		14.60 (9.72; 21.35)	
Not daily	78.11 (74.01; 81.73)	70.97 (54.97; 83.04)		85.40 (78.65; 90.28)	
Chicken			0.098		0.314
Daily	10.84 (7.47; 15.46)	18.78 (7.73; 38.95)		14.65 (8.51; 24.06)	
Not daily	89.16 (84.54; 92.53)	81.22 (61.05; 92.27)		85.35 (75.94; 91.49)	
Fish			0.429		0.979
Daily	0.84 (0.33; 2.12)	1.34 (0.42; 4.22)		0.86 (0.25; 2.93)	
Not daily	99.16 (97.88; 99.67)	98.66 (95.78; 99.58)		99.14 (97.07; 99.75)	
Eggs			0.311		0.597
Daily	17.45 (14.27; 21.16)	20.33 (13.86; 28.82)		19.34 (13.06; 27.67)	
Not daily	82.55 (78.84; 85.73)	79.67 (71.18; 86.14)		80.66 (72.33; 86.94)	
Ultra-processed foods					
Soft drinks or artificial juice			0.047*		0.110
Daily	20.32 (16.32; 25.01)	31.39 (18.87; 47.37)		29.60 (18.00; 44.59)	
Not daily	79.68 (74.99; 83.68)	68.61 (52.63; 81.13)		70.40 (55.41; 82.00)	
Chocolate drink or flavored yogurt			0.208		0.764
Daily	7.68 (5.44; 10.73)	5.67 (3.34; 9.45)		6.99 (3.74; 12.70)	
Not daily	92.32 (89.27; 94.56)	94.33 (90.55; 96.66)		93.01 (87.30; 96.26)	
Package cookie			0.098		0.184
Daily	20.06 (16.12; 24.69)	25.71 (18.13; 35.10)		25.41 (18.01; 34.56)	
Not daily	79.94 (75.31; 83.88)	74.29 (64.90; 81.87)		74.59 (65.44; 81.99)	
Package snack			0.174		0.082
Daily	0.87 (0.45; 1.68)	1.62 (0.57; 4.51)		2.13 (0.66; 6.66)	
Not daily	99.13 (98.32; 99.55)	98.38 (95.49; 99.43)		97.87 (93.34; 99.34)	
Noodles or instant soups			0.014*		0.017*
Daily	1.24 (0.70; 2.19)	3.14 (1.31; 7.35)		3.65 (1.35; 9.50)	
Not daily	98.76 (97.81; 99.30)	96.86 (92.65; 98.69)		96.35 (90.50; 98.65)	
Processed meat			0.409		0.892
Daily	2.82 (1.93; 4.08)	2.14 (0.98; 4.63)		2.97 (1.26; 6.83)	
Not daily	97.18 (95.92; 98.07)	97.86 (95.37; 99.02)		97.03 (93.17; 98.74)	
Frozen products			0.364		0.836
Daily	1.45 (0.44; 4.69)	0.80 (0.31; 2.01)		1.72 (0.46; 6.13)	
Not daily	98.55 (95.31; 99.56)	99.20 (97.99; 99.69)		98.28 (93.87; 99.54)	
Sweet bread			0.068		0.134
Daily	10.37 (7.93; 13.45)	13.79 (9.22; 20.12)		13.97 (9.36; 20.35)	
Not daily	89.63 (86.55; 92.07)	86.21 (79.88; 90.78)		86.03 (79.65; 90.64)	
Sweets			0.125		0.432
Daily	7.97 (5.31; 11.80)	10.94 (6.64; 17.51)		9.82 (5.78; 16.21)	
Not daily	92.03 (88.20; 94.69)	89.06 (82.49; 93.36)		90.18 (83.79; 94.22)	

[a] Proportion and 95% confidence interval (95% CI)
[b] Probability values.
* P-values < 0.05.

striatum and orbitofrontal medial cortex), leading to binge eating and food addiction [69—73], as well as being related to all causes of mortality [74,75].

Thus, there is a strong need for the reformulation of public health policies, with the inclusion of regulatory standards for consumption of UPF and incentivization of consumption of fresh/minimally processed foods, in order to promote policies to improve food quality and health [76,77], based on the Dietary Guidelines for the Brazilian Population [9], which considers the degree of food processing and reinforces conscious consumption, considering various aspects of food. Political action is necessary to encourage healthy choices and to control the food industry that creates easily distributed products and advertising [76]. Thus, fiscal policies [78—80], mandatory warning labels [81—83], marketing restrictions [83,84], and incentives for food and nutrition education, are fundamental to controlling the UPF consumption [9].

However, the results of this study should be interpreted with caution. First, this is a cross-sectional study, which does not allow us to establish causal inferences or the bidirectionality of the data. The explanatory variables were measured from a qualitative point of view, making it impossible to analyze the precise quantities of each food group that was consumed, and food consumption was
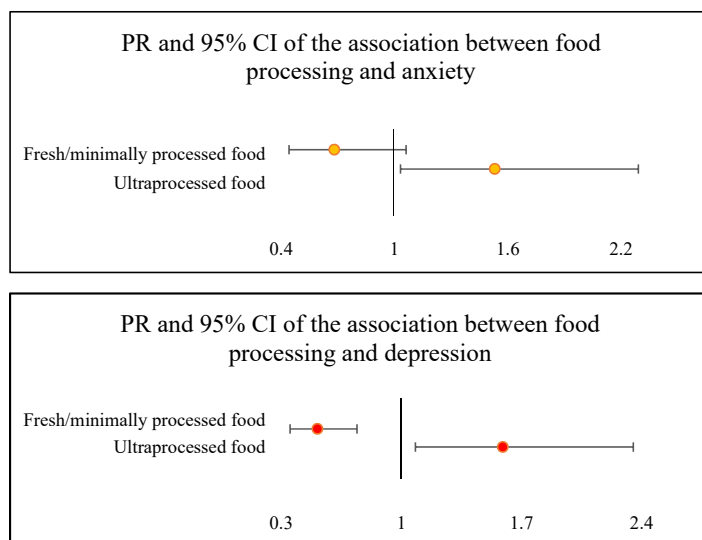
Notes: A - Poisson Regression of robust variance adjusted for sex, age and medical diagnosis of mental disorder for association between food consumption according to degree of processing and anxiety symptoms; B - Poisson Regression of robust variance adjusted for sex, age and medical diagnosis of mental disorder for association between food consumption according to degree of processing and depression symptoms

Fig. 3. Prevalence ratio (PR) and 95% confidence interval (95% CI) for the association between consumption of fresh/minimally processed and ultra-processed foods and symptoms of anxiety and depression.

measured using a non-validated questionnaire used in a national survey**.** In addition, the outcome was assessed according to the presence anxiety and depression symptoms, measured using scales, and not via medical diagnosis. However, the scales used have been validated and have good diagnostic accuracy [85,86]. It should be highlighted that face-to-face interviews allowed for greater accuracy of the information obtained and promoted methodological robustness, while probabilistic sample selection and sample weight provided statistical power to the study, as well as internal and external validity.

In conclusion, the present study revealed the existence of an inverse association between a higher frequency of consumption of fresh/minimally processed food and the prevalence of depression symptoms, as well as an association between the higher frequency of consumption of UPF and a higher prevalence ratio of depression symptoms, thus encouraging the consumption of food with a lower degree of processing, referenced by the Brazilian food culture, recommended by the Dietary Guidelines for the Brazilian Population [9]. Thus, further studies are needed to explore the consequences of food consumption, according to the degree of processing, and the development of anxiety and depression.

Ethical approval

The study was approved by the Research Ethic Committee of the Universidade Federal de Minas Gerais (Protocol no 4.135.077) and all participants signed the written informed consent.

Funding statement

Author's contributions

Hillary Nascimento Coletro – conception and study design; analysis and interpretation of data; writing the manuscript, critical review and final approval.

Raquel de Deus Mendonça – analysis and interpretation of data, critical review and final approval.

Adriana Lúcia Meireles – conception and coordination of data collection, critical review, management of financial resources and final approval.

George Luiz Lins Machado-Coelho – conception and coordination of data collection, critical review, management of financial resources and final approval.

Mariana Carvalho de Menezes – conception and study design, analysis and interpretation of data; critical review, supervision and final approval.

Declaration of competing interest

The authors declare no conflict of interest, they are fully responsible for the content and writing of the manuscript.

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