Clinical Nutrition ESPEN 50 (2022) 101–110

Contents lists available at ScienceDirect

Clinical Nutrition ESPEN

journal homepage: http://www.clinicalnutritionespen.com

Original article

NuMoOS – COVID-19 Nutrition and Mood Online Survey: Perception about dietary aspects, stress, anxiety, and depression in the social isolation of Coronavirus Disease 2019

Leonardo Dias Negrão [a, d], Lara Cristiane Natacci [a, d], Maria Carolina Zsigovics Alfino [a], Vanderli Fátima Marchiori [b, d], Daniela Hessel Oliveti [b], Antônio Augusto Ferreira Carioca [c], Elizabeth Aparecida Ferraz da Silva Torres [a, d, *]

[a] Food Components and Health Laboratory (LACAS), Department of Nutrition, School of Public Health, University of Sao Paulo, São Paulo, Brazil
[b] Bachelor of Nutrition, São Paulo, Brazil
[c] Health Science Center, University of Fortaleza, Fortaleza, Brazil
[d] Associação Brasileira de Nutrição em Saúde Mental (ABNUSM), Brazil

ARTICLE INFO

Article history:
Received 10 May 2021
Accepted 20 June 2022

Keywords:
Coronavirus
Nutrition
Food behavior
Mood
Social isolation
Food consumption

SUMMARY

Background: COVID-19 (coronavirus disease 2019) is an infectious disease which led to a pandemic. Social isolation was therefore adopted as the main measure to prevent contamination and maintain public health. Some changes can occur in stress levels, sleep quality, dietary consumption, and mood (such as levels of anxiety and depression). The aim of this study is to describe the association and prediction between social isolation during the COVID-19 pandemic, symptoms of stress, anxiety and depression, and food consumption self-reported.
Methods: This cross-sectional, quantitative, and descriptive study, with a non-probabilistic sample design for convenience, was carried out with 1,004 Brazilians, aged between 18 and 85 years old, from August to December 2020. A virtual questionnaire was applied on socioeconomic and lifestyle data, changing in food consumption, and Depression, Anxiety and Stress Scale (DASS-21) self-reported. The data were analyzed applying the chi-square test for comparison between male and female, and a linear regression was applied to explore associations and predictions of variables that may be strongly associated, using anxiety, depression and stress as dependent and self-reported changes in food consumption. The strength of association of each category of independent variables on the levels of change in food consumption was estimated using β coefficient and 95%CI, in the SPSS software (version 26.0).
Results: Although most declared that consumption remained the same, a small important increase was detected in some groups such as bread, pasta, potatoes, cassava. The consumption of plant-based foods remained unchanged according to the data collected. An increase of 13.25% of sugar sweetened beverages, 23.51% of alcoholic beverages, 37.25% of added of sugar, and 20.42% of fast foods was self-reported, and 52.7% stopped or reduced the practice of physical activity. The self-reported level of stress, anxiety, and depression reached 38.8%, 40.90% and 32.90. Changes in food consumption to predict stress, anxiety or depression symptoms were observed in relation to decrease red meat, fish, chicken, eggs, dairy, vegetables, legumes, and fruits, to increased consumption were associated to dairy, fats, sugar sweetened beverages, and fast foods.
Conclusions: A remarkable increase in Fast foods and alcoholic beverages were observed. Carbohydrate-rich foods was associated to stress, and anxiety symptoms. The same was observed in increase of caloric foods such as fats, sugar sweetened beverages, and fast foods. Besides the decrease of proteins, vitamins, and fibers sources foods had a strength association with stress, anxiety, and depression symptoms.

* Corresponding author. Food Components and Health Laboratory (LACAS), Department of Nutrition, School of Public Health, University of Sao Paulo, 01246-904, Sao Paulo, Brazil.
E-mail address: eatorres@usp.br (E.A.F.S. Torres).

https://doi.org/10.1016/j.clnesp.2022.06.017
2405-4577/

1. Introduction

The COVID-19 (Coronavirus Disease 2019) is an infectious disease characterized by severe respiratory system impairment causing diseases such as pneumonia and lung failure. The city of Wuhan, capital of Hubei (China), registered the first cases in December 2019. From that day forward the number of cases spread around the world [1–4] with the outbreak of the disease emerging from severe acute respiratory syndrome by coronavirus 2 (SARS-CoV-2). On March 11, 2020, the World Health Organization (WHO) declared COVID-19 a pandemic [5].

After spreading across the world in more than 70 countries [6], the COVID-19 pandemic has become a worldwide public health chaos. Social detachment was the most widespread strategy to prevent the contamination and try to control the disease. This new situation has been known by media and population as social isolation [7,8]. Outcomes frequently reported, and observed, from social isolation were stress [8], anxiety, depression symptoms [9] and insomnia [10].

The increased emotional stress is directly associated with global health, sleep quality, emotions and mental health [9,11–15]. The influence of social isolation, enhanced the perception of stress, danger, discomfort, uncertainty, fear of virus transmission, massive negative news from the media and social networks, anxiety and depression [16]. Stress may raise uncertainty about health, personal finances, work and unemployment, higher risk of support services loss, increased consumption of tobacco and/or alcohol, impaired mental health, changes in sleep and eating patterns [17,18].

Different eating habits or patterns are directly associated with an increased level of stress. The pandemic higher stress levels have been associated with social isolation and excessive news about the new coronavirus, leading to a “food craving” that includes emotional, behavioral, cognitive and physiological processes [19]. Such changes can modify eating patterns, especially considering younger people who may have their health compromised in the future [20]. Anxiety and depression are associated with increased consumption of carbohydrates and fats, mainly referred as “comfort foods”. These nutrients are directly involved in an increased production of serotonin, which is one of the most important neurotransmitters involved in mood balance [19].

Higher stress during the pandemic led to depression and anxiety (due to altered sleep, which has a fundamental role in regulating emotions) [9]. The large number of chemokines [5] and cytokines released may also be related to neuroinflammation. This, caused by COVID-19 [12], is a possible reason for increased anxiety [21] and depression [22] and certainly negatively associated with mental health [12]. In a current study carried out in Wuhan, the first city in which COVID-19 was detected, people under the age of 35, who were exposed to more than 3 h of media news, showed increased anxiety when compared to individuals over 35 and less exposed to news [15]. On the other hand, children and teenagers are more likely to develop anxiety and depression during and after social isolation [23]. Some individuals who had COVID-19 and were admitted to the intensive care unit may experience, from severe to mild, malnutrition despite an adequate diet [24]. Considering all these facts it is important to register and describe the changes of food consumption, perception of stress, anxiety, and depression during social isolation in COVID-19 pandemic in Brazilians.

2. Methods

2.1. Study design

This is a cross-sectional, quantitative, and descriptive study, with a non-probabilistic sample design for convenience.

2.2. Location, recruitment and data collection

Recruitment and invitation to participate in research and data collection were carried out. The elaborated questionnaire has been applied in a virtual environment through Google Forms (https://docs.google.com/forms) from August to December 2020. At first the participants had access to an online Free and Informed Consent Term (ICT), in which they declared the reading and acceptance to enroll the research. After acceptance of the term, they answered the questionnaire, with 60 questions divided into three sections: (1) Socioeconomic and lifestyle data; (2) self-reported assessment of changes related to food consumption; (3) self-reported assessment of anxiety, depression, and stress.

Participants were not identified and all the answers were taken anonymously. Data were collected using a questionnaire online prepared on Google Forms (Google LLC, Menlo Park, CA, USA), and stored at the School of Public Health, University of São Paulo (FSP/USP), followed by complete data analysis. Due to the online application of the questionnaire, the study showed a potential selection bias revealing the participation of people with a higher level of education and family income, who have access to internet.

2.3. Participants

A total of 1,236 responses were obtained, 232 were excluded for being duplicated, considering the last answer of each individual. 1,004 responses were eligible, with adults of both biological sexes (Fig. 1), from all regions of Brazil (2% North; 12% Northeast; 1% Midwest; 79% Southeast; 5% South). Disclosure was made on social networks (Facebook, Instagram, Twitter, and WhatsApp) and by email to capture individuals. The researchers involved in the project contributed to the research dissemination.

2.4. Inclusion criteria

Adults (18 years and over); both biological sexes; residents in Brazil.

2.5. Exclusion criteria

Age under 18 years old; Duplicated data (participants with two or more responses, the last one sent was considered); Do not wish to participate.

2.6. Variables

The scores of symptoms of depression, anxiety and depression were defined as outcomes. The exposures were defined the

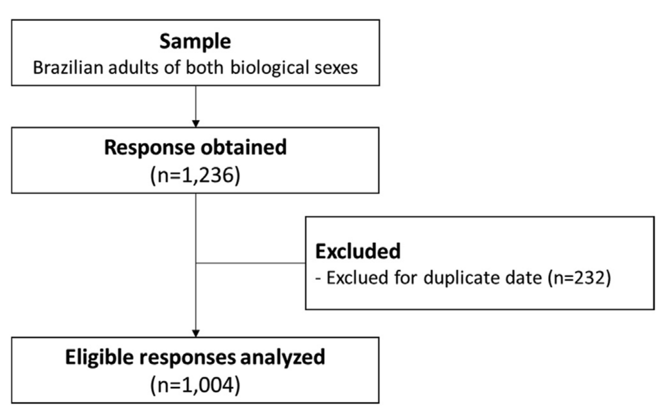

Fig. 1. Flow chat of sample collection.

consumption changes of each food group. All analysis were adjusted by potential confounders as sex, age, education and sleep hours.

2.7. Measurement

2.7.1. Socioeconomic and lifestyle data

The predetermined socioeconomic data was collected by (Appendix 1) as follows: age, biological sex (male, female or other), state, city, color skin or race (white, brown, black, yellow, indigenous, without declaration and others), marital status (single, married, separated, divorced or widow(er)), education (no education, incomplete elementary school, complete elementary school, incomplete high school, complete high school, incomplete college degree, complete college degree, incomplete post-graduate and complete post-graduate degree), occupation/profession, family income (from unemployed to above 11 minimum wages), number of people living in the residence and contact email.

Following section one and exploring lifestyle, another online questionnaire was predetermined and applied, focusing on sleep disorders and physical activity. The collected data basis of physical activity practice was the World Health Organization recommendation, which is a minimum of 150 min of physical activity per week. The interviewee was asked to inform the actual practice of physical activity (never practiced, stopped, decreased, no changes, increased or started), the type of activity, weekly frequency, and duration (in minutes) per practice. As to sleep: sleep hours (less than 5 h per night, 5–7 h per night, 7–9 h per night and more than 9 h per night), and perception of changes in the pandemic moment (more, no changes, less or using sleeping medicine). Considering social isolation, two questions were asked: staying home in social isolation and the number of days in isolation. Validated questionnaires were not used in this section, due to the total size (60 questions) and the self-application time of these questions, which could be unfeasible for the participants.

2.8. Perception of behavior changes in food consumption

In order to be accurate in the analysis of food consumption behavior modifications, we designed a questionnaire (Appendix 2), where foods were divided into groups, with adaptations, according to the guidelines proposed by the Dietary Guidelines for the Brazilian Population: promoting healthy eating, material prepared by the Ministry of Health in 2005 [25]. As follows: Group 1 - rice, bread, pasta, potatoes, and manioc; Group 2 – legumes (soy, peas, chickpeas or lentils); Group 3 - meat and eggs; Group 4 – dairy (milk, cheese, and yogurt); Group 5 - vegetables; Group 6 - fruits; Group 7 – fats (oils and fats); Group 8 - sugar. Fast foods, alcoholic drinks, sugar sweetened beverages, and water intake were included. Options for changes in self-reporting consumption during social isolation: Never consumed; Decreased (slightly or a lot); No changes; Increased (slightly or a lot); And unchanged (never consumed and no changes) for linear regression.

2.9. Depression, anxiety and stress scale (DASS)

Anxiety, depression and stress were measured according to the DASS with 21 items (DASS-21) [26,27]. The scale aims to present an accurate instrument from a psychometric perspective and with the ability to simultaneously measure and distinguish depression, anxiety, and stress. It was developed in English with 42 items distributed in three factors (depression, anxiety, and stress). However, considering the occurrence of situations in which a shorter version of the instrument is desirable, the authors presented a reduced version of the DASS with 21 items, called DASS-21 in Portuguese [28].

The score was obtained by the following calculation: depression = [Q3 + Q5 + Q10 + Q13 + Q16 + Q17 + Q21]*2; Anxiety = [Q2+Q4+Q7+Q9 + Q15 + Q19 + Q20]*2; Stress = [Q1 + Q6 + Q8 + Q11 + Q12 + Q14 + Q18] *2. Levels were classified according to the cutoff ranges for depression (0–9: normal; 10–12: mild; 13–20: moderate; 21–17: severe; 18–42: extremely severe), anxiety (0–6: normal; 7–9: mild; 10–14: moderate; 15–19: severe; 20–42: extremely severe).

2.10. Ethical consideration

The project was approved by the Ethics Committee for the Analysis of Research Projects at the School of Public Health at the University of São Paulo (No. 4,232,731).

2.11. Statistical analysis

The data were presented with all conclusions presumed at a significance level (alpha) less than or equal to 5%. The complete analysis was performed using SPSS software (Statistical Package for the Social Sciences) for Windows Version 26.0. Absolute (f) and relative (%) frequencies were determined for qualitative variables. In the bivariate analysis, for the quantitative variables, the mean and 95% confidence intervals (95%CI) were presented, using the Student's t test for independent samples and chi-square ($\chi 2$) for the difference between male and female. A linear regression was applied to explore associations and predictions of variables that may be strongly associated, using anxiety, depression and stress as dependent and self-reported changes in food consumption were taken as independent variables, adjusted for the continuous variables age, sex, schooling and hours of sleep. The strength of association of each category of independent variables on the levels of change in food consumption was estimated using β coefficient and 95%CI.

3. Results

The great majority of the participants was female (84.4%). There was no significant difference in racial identity/skin color and Marital Status. But there was a statistically significant difference (p-value < 0.05) on education. There were fewer male participants (3.2%) with incomplete higher education than female participants (10.4%). In general, most study participants report complete college degree (28.1%) and complete post-graduate degree (44.0%), and education of minimum complete high school (1.1%) (see Table 1).

Regarding occupation, 87.9% were employed participants and 12.1% unemployed, considering both sexes. Considering unemployment, 10.4% were female and 1.7% male with no relevant statistic difference. Most participants (32.1%) reported having a family income over 11 minimum wages (MW), which would be equivalent to R$ 11,495.01 (US$ 2086,00) or more. However, there was a statistically significant difference (p-value < 0.05) between male and female. A greater percentage of women (4.0%) reported having no income, rather than men (0.2%). Considering the number of people in the same residence, 50.4% reported having 4 people living at home and the average age was 39.57 years. The average women reported having spent 97.59 days in isolation whereas men reported 97.01 days, with no statistical difference between the groups, as shown in Table 1.

Regarding people's behavior during social isolation, it was observed that most part of women (49.11%) left isolation only to buy food while men (53.50%) left sporadically for other reasons, as shown in Fig. 2.

Table 2 refers to physical activity practice. Regarding the practice of physical activity, although there was no statistical difference, it is clear that 12.0% reported that frequency increased, 31.4% reduced, 21.3% stopped, and a small number (7.6%) started to practice physical activity during this period. These reports show that the pandemic isolation impacted directly on the frequency of physical activity and the overall is that 52.7% stopped or reduced the frequency. Nevertheless, it can be observed a statistically significant difference (p-value < 0.05) between the groups where the male sample reported practicing a longer period of physical activity than female, 64.76 min, and 40.96 min, respectively. Considering the weekly frequency of physical activity, there were no significant difference (p-value < 0.05) It was noticed, however, that 27.8% never practiced and 21.5% practiced three times a week. Also, regarding lifestyle, there was no statistically significant difference (p-value = 0.476) in perception of sleep changes in the pandemic. Even considering a statistically significant difference (p-value < 0.05), it has been noticed that in the self-reported hours of sleep per day, the males reported sleeping fewer hours than females. Most males (9.4%) reported sleeping 5–7 h per night, followed by sleeping 7–9 h per night (5.2%).

Among males and females, a statistically significant difference (p-value < 0.001) was noticed in males and it has been shown low consumption of fruits and vegetables per day. Just one serving of fruits and vegetables (5.0%), and a small sample reported consuming 4 servings per day (0.9%).

The report of sugar sweetened beverages, alcoholic beverages, added sugar and fast foods participants consumption, according to sex (Fig. 3), shows significant increase of sugar sweetened beverages consumption (p-value < 0.05) by the female group, despite not obtaining a statistically significant difference. It has been noticed an increase in water consumption (female: 31.52%; male: 36.94%; supplementary data 1), alcoholic beverages (female: 22.90%; male: 26.75%; supplementary data 1), added sugar (female: 39.20%; male: 26.75%; supplementary data 1) and fast foods (female: 20.78%; male: 18.47%; supplementary data 1).

Figure 4 presents data on the reported perception of food consumption changes by group (female and male). The increase in self-reported fat consumption by females indicate a statistically significant difference (p-value < 0.05) when compared to males. The majority stated that consumption remained the same, but clearly some increases in different groups were definitely smaller, such as bread, pasta, potatoes and cassava, reaching 38.25% for female and 32.48% for male and this worth highlighting.

Considering plant food origins (Fig. 4), most participants reported no change in consumption, although, we can notice an increase of 30.18% in fruits, 23.80% in legumes and 30.98% in vegetables (Supplementary data 1 and 3). It is important to bear in mind that the fruits and vegetables servings reported were small, suggesting that despite the reported increase, the quantities remain below the recommendation from the WHO [29,30] of 400 g of fruits and vegetables per day for the prevention of non-communicable diseases, equivalent to 5 servings per day.

Important data were obtained in the present study in relation to the self-reported consumption of sugar sweetened beverages, with an increase of 13.25%, 23.51% in alcoholic beverages, 37.25% in added sugar, and 20.42% in fast foods (Fig. 3; Supplementary data 1). Furthermore, it has been shown an increase of 37.35% in bread, pasta, potatoes and cassava, 11.85% in red meat, fish, and chicken, and 14.64% in fats (Fig. 4. Supplementary data 3). Apart from the higher results, it is worth noticing that there was also a reduction or non-consumption of several food groups such as 24.60% in fruits, 40.24% in chestnuts/oilseeds, and 22.61% in vegetables (Fig. 4; Supplementary data 3).

The level of stress, anxiety and depression reported showed no significant difference (p-value > 0.05). However, moderate to extremely severe depression level observed in the participants was expressed as 32.90%, anxiety 40.90%, and stress 38.8% as shown in the data presented in Table 3.

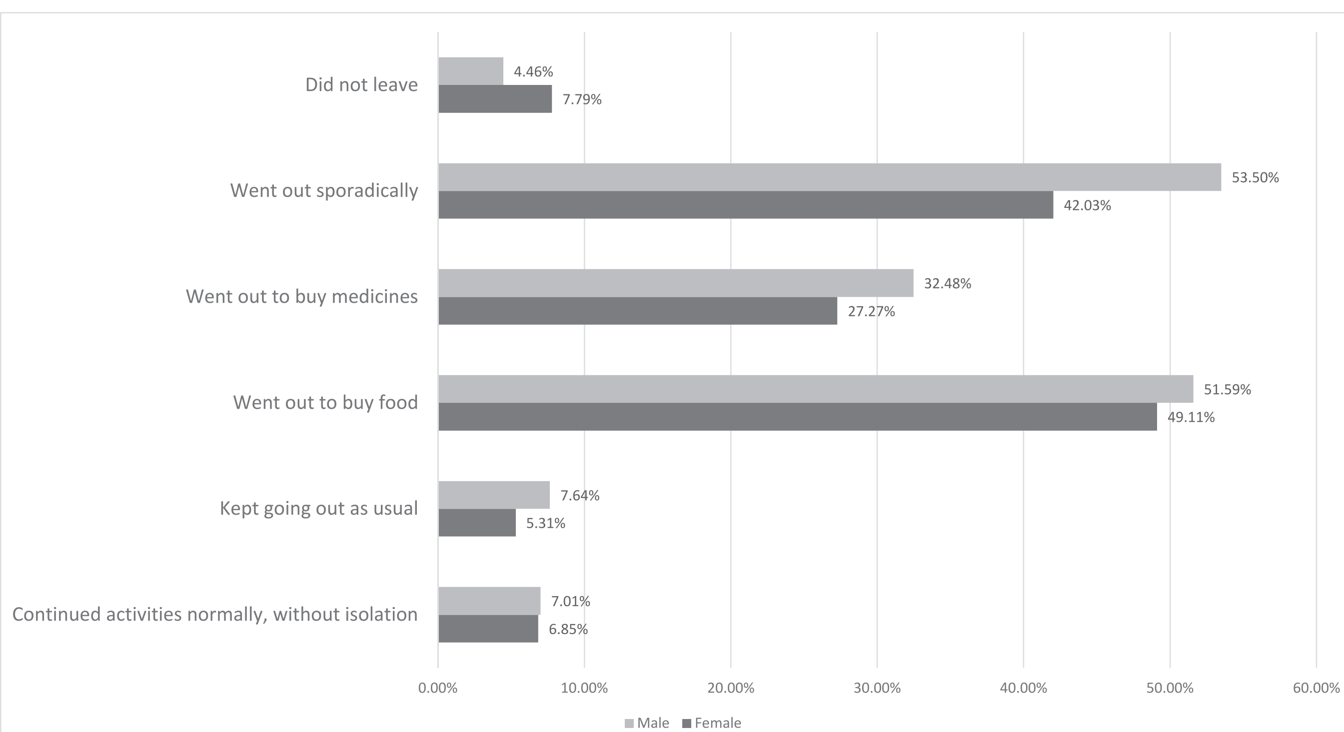

Fig. 2. Behavior during social isolation according to sex.

Table 1
Socioeconomic and pandemic data description by biological sex.

Data	Biological sex (% by group)		Total, f (%)	p-value
	Female, f (%)	Male, f (%)		
Sex	847 (84.4%)	157 (15.6%)	1004 (100.0%)	–
Racial identity/skin color				
White	642 (63.9%)	113 (11.3%)	755 (75.2%)	0.709
Brown	12 (1.2%)	3 (0.3%)	15 (1.5%)	
Black	161 (16.0%)	45 (3.5%)	196 (19.5%)	
Yellow	22 (2.2%)	5 (0.5%)	27 (2.7%)	
Indigenous	–	–	–	
No declaration	7 (0.7%)	–	7 (0.7%)	
Others	3 (0.3%)	1 (0.1%)	4 (0.4%)	
Marital status				
Single	391 (38.9%)	84 (8.4%)	475 (47.3%)	0.214
Married	364 (36.3%)	64 (6.4%)	428 (42.6%)	
Separated	18 (1.8%)	3 (0.3%)	21 (2.1%)	
Divorced	66 (6.6%)	5 (0.5%)	71 (7.1%)	
Widowed	8 (0.8%)	1 (0.1%)	9 (0.9%)	
Education				
No education	–	–	–	0.007
Incomplete elementary school	–	–	–	
Complete elementary school	–	–	–	
Incomplete high school	10 (1.0%)	1 (0.1%)	11 (1.1%)	
Complete high school	40 (4.0%)	7 (0.7%)	47 (4.7%)	
Incomplete College	104 (10.4%)	32 (3.2%)[a]	136 (13.5%)	
Complete College	230 (22.9%)	52 (5.2%)	282 (28.1%)	
Incomplete post-graduate	70 (7.0%)	16 (1.6%)	86 (8.6%)	
Complete post-graduate	393 (39.1%)	49 (4.9%)	442 (44.0%)	
Occupation				
Unemployed	104 (10.4%)	17 (1.7%)	121 (12.1%)	0.608
Employed	743 (74.0%)	140 (13.9%)	883 (87.9%)	
Family income				
0	40 (4.0%)	2 (0.2%)[a]	42 (4.2%)	0.370
Less than 1 MW[a]	15 (1.5%)	0 (0.0%)	15 (1.5%)	
1–3 MW	128 (12.7%)	25 (2.5%)	153 (15.2%)	
3–5 MW	123 (12.3%)	22 (2.2%)	145 (14.4%)	
5–7 MW	100 (10.0%)	21 (2.1%)	121 (12.1%)	
7–9 MW	92 (9.2%)	17 (1.7%)	109 (10.9%)	
9–11 MW	79 (7.9%)	18 (1.8%)	97 (9.7%)	
More than 11 MW	270 (26.9%)	52 (5.2%)	322 (32.1%)	
People in house				
1	118 (11.8%)	16 (1.6%)	134 (13.3%)	0.449
2	221 (22.0%)	33 (3.3%)	254 (25.3%)	
3	31 (3.1%)	6 (0.6%)	37 (3.7%)	
4	418 (41.6%)	88 (8.8%)	506 (50.4%)	
5	44 (4.4%)	11 (1.1%)	55 (5.5%)	
More than 5	15 (1.5%)	3 (0.3%)	18 (1.8%)	
	Mean (IC 95%)	Mean (IC 95%)	Mean (min – max)	p-value
Age	39.82 (38.89–40.76)	38.20 (35.83–40.56)	39.57 (18–82)	0.067
Days of isolation	97.59 (92.80–102.38)	97.01 (84.87–109.16)	97.50 (0–314)	0.248

MW: minimum wage (1 mw equals R$1,044.99 or $190,12).
[a] Statistically significant difference between female and male (p-value<0.05).

Regarding changes in food consumption in Table 4, values were obtained with a statistically significant difference to predict stress symptoms in relation to decreased or increased consumption of carbohydrates foods sources, such as bread, pasta, potatoes, cassava, eggs, dairy, fruits, alcoholic beverages, and sugar sweetened beverages, but a statistically significant difference was observed only for the decreased consumption of red meat, fish, chicken, legumes, and vegetables. On the other hand, a statistically significant difference was observed only for the increase in rice, beans, fats and fast foods consumption.

The values to anxiety symptoms obtained a statistically significant difference in decreased and increased consumption of bread, pasta, potatoes, casava, dairy, fats, and sugar sweetened beverages, whereas red meat, fish, chicken, eggs, vegetables, legumes, and fruits were observed only for decreased consumption, while fast foods had a statistically significant difference for increased consumption.

As showed in Table 4, changes such as decreased and increased consumption of eggs, dairy, and sugar sweetened beverages had a statistically significant difference for depression symptoms. Besides, significant values were obtained in the decrease of red meat, fish, chicken, vegetables, legumes, and fruits, while the increase was associated with fats, and fast foods.

4. Discussion

4.1. Socioeconomic and lifestyle characteristics

The role of education in eating behavior is remarkable. The research shows that most of the participants (44.0%) had a complete post-graduate degree, a positive fact considering that level of education is associated with eating behavior. This is seen as protective due to the greater changes in dietary patterns recognition and greater ability to be self-aware [18]. In addition, the low level of education is

Table 2
Self-report health, behavior and food intake by biological sex.

Data	Biological sex		Total (N = 1004)	p-value
	Female (n = 847)	Male (n = 157)		
Practice of physical activity	f (%)	f (%)	f (%)	
Never	120 (90.2%)	13 (9.8%)	133 (13.2%)	0.101
Stopped	186 (86.9%)	28 (13.1%)	214 (21.3%)	
Decreased	260 (82.5%)	55 (17.5%)	315 (31.4%)	
No changes	121 (82.9%)	25 (17.1%)	146 (14.5%)	
Increased	94 (78.3%)	26 (21.7%)	120 (12.0%)	
Started	66 (86.8%)	10 (13.2%)	76 (7.6%)	
Physical activity Time	Mean (IC 95%)	Mean (IC 95%)	Mean (IC 95%)	
Minutes	40.96 (33.12–48.79)	64.76 (35.02–104.49)	44.77 (35.64–53.90)	0.048
Frequency	f (%)	f (%)	f (%)	p-value
Never	242 (86.7%)	37 (13.3%)	279 (27.8%)	0.377
1/week	38 (86.4%)	6 (13.6%)	44 (4.4%)	
2/week	132 (88.6%)	17 (11.4%)	149 (14.8%)	
3/week	178 (82.4%)	38 (17.6%)	216 (21.5%)	
4/week	87 (83.6%)	17 (16.4%)	104 (10.4%)	
5/week	107 (81.7%)	24 (18.3%)	131 (13.0%)	
6/week	41 (78.8%)	11 (21.2%)	52 (5.2%)	
7/week	22 (75.9%)	7 (24.1%)	29 (2.9%)	
Sleep during pandemic	f (%)	f (%)	f (%)	p-value
More now	260 (83.9%)	50 (16.1%)	310 (30.9%)	0.476
Same way	355 (82.9%)	73 (17.1%)	428 (42.6%)	
Less now	191 (87.6%)	27 (12.4%)	218 (21.7%)	
Using sleep medicines	41 (85.4%)	7 (14.6%)	48 (4.8%)	
Sleep hours	f (%)	f (%)	f (%)	p-value
<5 h	38 (92.7%)	3 (7.3%)	41 (4.1%)	0.012
5–7 h	420 (81.7%)	94 (18.3%)[a]	514 (51.2%)	
7–9 h	367 (87.6%)	52 (12.4%)[a]	419 (41.7%)	
>9 h	22 (73.3%)	8 (23.7%)	30 (3.0%)	
Fruit and vegetable consumption				
0	13 (81.2%)	3 (18.8%)	16 (1.6%)	0.000
1	172 (77.5%)	50 (22.5%)[a]	222 (22.2%)	
2	248 (81.6%)	56 (18.4%)	304 (30.5%)	
3	222 (88.1%)	30 (11.9%)	252 (25.3%)	
4	133 (93.7%)	9 (6.3%)[a]	142 (14.2%)	
5 or more	55 (88.7%)	7 (11.3%)	62 (6.2%)	
Food made in home				
No	40 (88.9%)	5 (11.1%)	45 (4.5%)	0.392
Yes	807 (84.2%)	152 (15.8%)	959 (95.5%)	

[a] Statistically significant difference between female and male (p-value<0.05).

also associated with a higher risk for the psychological impact of COVID-19 on individuals, as well as the low socioeconomic status [12]. Higher socioeconomic level can ease management and assure better diversity of food options and psychological and/or emotional distractions. Mental issues related to anxiety, depression, stress, sleep disorders, and alcohol dependence are related to the higher level of stress at work, the fear of being infected and being a vector for the family, and discrimination in contracting the disease [31]. Due to the high level of education, the study participants may have had better management of eating and emotional behaviors, however, the higher number of working hours may have contributed to increased stress.

In average, participants reported being 97 days (approximately 3 months) in isolation. Social isolation can lead people to a chronic stress and perception of loneliness state, and as a consequence, these feelings can compromise the proper function of the neuroendocrine and immune system, leading to higher levels of systemic inflammation, causing a higher release of pro-inflammatory cytokines, impaired immune system and higher risk of chronic diseases, especially inflammatory diseases [32]. The long periods of quarantine and isolation, the exploitation of labor rights, and the uncertainty of the future can contribute to boost stress, anxiety, and depressive symptoms in younger and higher educated individuals [31]. The reported increase in stress and inflammation related to mental health, such as anxiety and stress symptoms, is widely shown and discussed in the scientific community.

Stress can lead to increased cortisol release, thus being a trigger to carbohydrates craving, specifically sugar, which perpetuates the cycle of increased cortisol release [33]. Food choices to reduce inflammation and/or activity of the hypothalamic–pituitary–adrenal (HPA) axis, directly reducing cortisol release as well, are strategies to be adopted in order to guarantee the ability to reduce stress and make better food consumption choices.

Individuals who were exposed to COVID-19 virus were found in the minimum physical exercise group in the study by Mohseni et al. [34]. Although the importance of regular physical activity is widely known, 52.7% of the participants reported stopping or reducing the practice of physical activity (Table 2) during the pandemic. The reduction in the practice of physical activity was also observed in studies with 700 Chileans [35], with 7,514 Spanish [36], 2,447 Lithuanians [37], and a percentage of 61.4% in a review study by Chew et al. [38].

4.2. Perception of consumption modification

Our study shows clearly a reduction or non-consumption of 23.61% and 23.57% of dairy products, respectively, by females and males (Fig. 4). It is an important finding since dairy products are excellent vitamin D source and the adequate serum level of this vitamin has been proven to be protective against COVID-19 and if there is no adequate consumption, the protection may not occur properly [34]. Vitamin D deficiency is related to higher disease morbidity and mortality in individuals with severe COVID-19, especially in older people [39]. That is why the consumption of vitamin D food sources is emphasized. On the other hand, high consumption of fats can induce and raise anxiety feelings [40] and possibly increase depression symptoms, due to an increment in inflammatory processes, alteration of intestinal microbiota [41] and consequently serotonin reduction [42]. This fact occurs as the low consumption of food sources of vitamin D can contribute to increase depression symptoms [43]. Higher consumption of sugar and/or sugar sweetened beverages must be strongly noticed, due to likely being a major contributor in the perception of stress [33], anxiety and depression. And stress can lead to increased food consumption, associated with body weight gain, as observed by Zachary et al. in a quantitative descriptive/correlational study with 173 subjects [44]. One important finding of the study is the significantly higher consumption of added sugar.

An Italian study which analyzed 3,533 participants, aged 12–86 years, reported the increased consumption of carbohydrate-based meals such as pasta, pizza, homemade desserts, cereals, and bread during the isolation of COVID-19 in Italy [45]. However, changes in eating behavior during the COVID-19 pandemic could be noticed as well, due to the “new normality” status, leading to the increased purchase of eggs, milk, fresh vegetables, bread, meat and pasta [46]. The increase in global food consumption was observed by Chew et al. [38] in 67.4% people, and in Spanish by Kriaucioniene et al. [37]. In the present study, consumption of bread, pasta, potatoes, cassava, eggs, vegetables and greens, fruits, and added sugar was observed in higher levels than in the previous behavior, when there was no isolation and pandemic (Figs. 3 and 4). Flavonoids are phytochemicals with proven potential adjuvant therapy for COVID-19, as they bind to receptors used by the coronavirus, attenuating inflammatory processes [47]. Although the consumption of fruits and vegetables is beneficial to health [48,49] due to its phytochemical levels, the

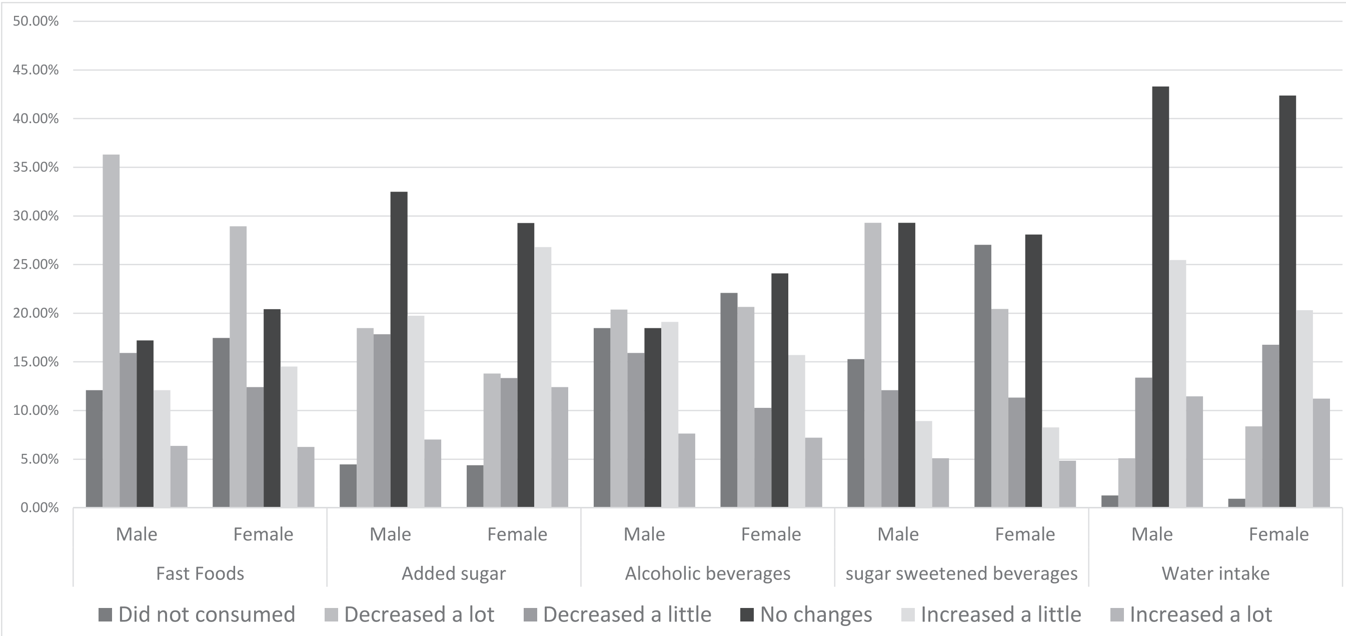

Fig. 3. Beverages, sugar sweetened beverages, added sugar and fast foods consumption by sex.

increase reported by the participants (Fig. 4), when compared to the daily portion, is still below the World Health Organization recommendations [29], equivalent to 2 portions, by 30.5% of the participants, followed by 3 portions (25.3%) and 1 portion (22.2%).

4.3. Stress, anxiety, depression and changes in food consumption

Social isolation is associated with eating habits modification [50,51]. A study during social isolation period observed similar results where 64% of the participants, most of them, did not refer to any change in food consumption. Factors such as loneliness, depression symptoms, being single, having a greater number of stressful events were associated with actual increased consumption, and greater chances of eating less consciously [18]. People who experience quarantine or isolation may have mental health issues, such as increased levels of stress, anxiety, depression, mood swing disorders, psychological distress, insomnia, sleep disorders, fear, and low self-esteem [52]. Social isolation, stress, anxiety and

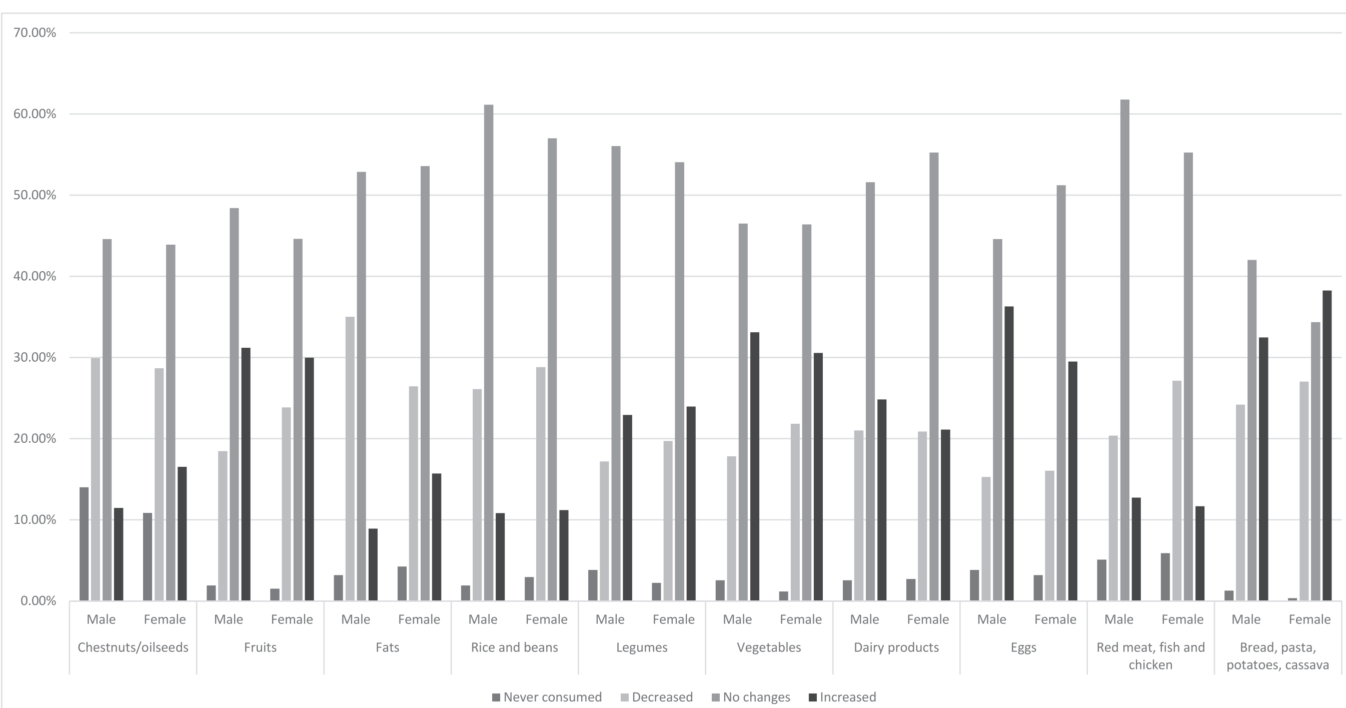

Fig. 4. Perception of food group consumption self-reported by sex.

Table 3
Depression, anxiety and stress scale (DASS-21) symptoms by biological sex.

DASS-21	Classification	Biological sex		Total, N = 1004
		Female (n = 847)	Male (n = 157)	
		f (%)	f (%)	f (%)
Depression	Normal	411 (40.9%)	78 (7.8%)	489 (48.7%)
	Mild	125 (12.5%)	24 (2.4%)	149 (14.8%)
	Moderate	140 (13.9%)	24 (2.4%)	164 (16.3%)
	Severe	65 (6.5%)	18 (1.8%)	83 (8.3%)
	Extremely severe	106 (10.6%)	13 (1.3%)	119 (8.3%)
Anxiety	Normal	430 (42.8%)	93 (9.3%)	523 (52.1%)
	Mild	59 (5.9%)	11 (1.1%)	70 (7.0%)
	Moderate	132 (13.1%)	25 (2.5%)	157 (15.6%)
	Severe	64 (6.4%)	8 (0.8%)	72 (7.2%)
	Extremely severe	162 (16.1%)	20 (2.0%)	182 (18.1%)
Stress	Normal	280 (27.9%)	64 (6.4%)	344 (34.4%)
	Mild	228 (22.7%)	43 (4.3%)	271 (27.0%)
	Moderate	150 (14.9%)	25 (2.5%)	175 (17.4%)
	Severe	104 (10.4%)	16 (1.6%)	120 (12.0%)
	Extremely severe	85 (8.5%)	9 (0.9%)	94 (9.4%)

Chi-square: Depression = 4.493 (p-value: 0.343); Anxiety = 5.933 (p-value: 0.204); Stress = 5.651 (p-value: 0.227).

boredom are proven reasons to dietary pattern modification [53]. In this study it was observed that changes in food consumption mainly for dairy, vegetables, red meat, fish, chicken, fats, fruits, sugar sweetened beverages, and fast foods had a strength association with stress, anxiety or depression symptoms (Table 4).

Stress can increase oxidative stress and inflammation in the body. Social isolation and loneliness are directly associated with stress [54], depression, anxiety, and post-traumatic stress [55]. Higher level of pro-inflammatory cytokines release can impact psychological health and immunity [56], making individuals more susceptible to infections and systemic inflammations [57]. Managing the psychological changes caused by COVID-19 pandemic is therefore crucial. That is why some techniques, such as yoga, can contribute substantially to reduce levels of stress, anxiety, and depression [58]. Stress management strategies during the COVID-19 pandemic period can be positive in also perceiving habits and better food choices.

Higher consumption of carbohydrates is associated with greater chances of depressed individuals [59], as refined carbohydrates consumption may contribute to depression [60]. This fact could be noticed in this study, in which the more depressed participants were associated with an increase consumption of carbohydrate as sugar added in beverages. On the other hand, consuming less carbohydrates contributes to better sleep, lower levels of stress, and anxiety [61], as observed in Table 4. Vegetable consumption is inversely associated with symptoms of stress, anxiety, and depression (Table 4). As it is important for better mood, depression [62,63] and stress lower symptoms [64], contributing for global human health [65], the same association is observed with a lower consumption of fruits and depressive symptoms [63].

Our study found out that alcohol consumption is associated with stress symptoms. During the pandemic, an increase in alcohol consumption was observed [51] and associated with a reduction in physical activity [35], stress, anxiety and depression [66], as observed in Fig. 3. About the changes, consumption of sugar sweetened beverages is associated with stress, anxiety and depression symptoms in this study, while adding sugar to beverages is associated with depression [67,68] and so is the general addition of sugar to food [69]. Therefore, avoiding excessive sugar consumption is vital for the individual's health and mood. The cycle

Table 4
Linear regression analysis to predict stress, anxiety and depression symptoms through modification in food consumption reported.

Consumption changes	Stress	Anxiety	Depression
	β coefficient (95%IC)	β coefficient (95%IC)	β coefficient (95%IC)
Bread, pasta, potatoes, cassava			
Unchanged	reference	reference	reference
Decreased	**1.75 (0.09–3.41)***	**1.70 (0.24–3.17)***	1.18 (−0.39–2.76)
Increased	**4.66 (3.15–6.17)***	**3.32 (1.99–4.66)***	3.35 (1.92–4.79)
Red meat, fish, and chicken			
Unchanged	reference	reference	reference
Decreased	**3.53 (2.00–5.06)***	**3.46 (2.12–4.81)***	**3.31 (1.87–4.76)***
Increased	3.49 (1.42–5.55)	1.39 (−0.43–3.20)	1.76 (−0.19–3.71)
Eggs			
Unchanged	reference	reference	reference
Decreased	**2.97 (1.09–4.85)***	**3.57 (1.92–5.21)***	**2.74 (0.96–4.51)***
Increased	**1.58 (0.09–3.07)***	1.12 (−0.19–2.43)	**1.73 (0.32–3.13)***
Dairy			
Unchanged	reference	reference	reference
Decreased	**2.09 (0.42–3.76)***	**2.42 (0.95–3.89)***	**1.59 (0.01–3.17)***
Increased	**3.55 (1.90–5.21)***	**2.25 (0.79–3.71)***	**2.30 (0.74–3.87)***
Vegetables			
Unchanged	reference	reference	reference
Decreased	**2.44 (0.71–4.16)***	**2.36 (0.84–3.87)***	**2.53 (0.90–4.15)***
Increased	0.42 (−1.11–1.95)	0.20 (−1.14–1.54)	−0.04 (−1.48–1.40)
Legumes (soy, peas, chickpeas or lentils)			
Unchanged	reference	reference	reference
Decreased	**2.65 (0.91–4.39)***	**2.11 (0.58–3.64)***	**2.19 (0.55–3.83)***
Increased	**1.66 (0.04–3.28)***	0.91 (−0,52–2,34)	0.55 (−0.98–2.08)
Rice and beans			
Unchanged	reference	reference	reference
Decreased	0.69 (−0.81–2.18)	0.55 (−0.77–1.87)	0.19 (−1.23–1.61)
Increased	**3.52 (1.38–5.65)***	1.15 (−0.73–3.04)	1.30 (−0.72–3.32)
Fats			
Unchanged	reference	reference	reference
Decreased	0.56 (-095–2.07)	**1.65 (0.32–2.99)***	0.98 (−0.45–2.40)
Increased	**5.53 (3.62–7.44)***	**3.99 (2.30–5.67)***	**4.61 (2.81–6.42)***
Fruits			
Unchanged	reference	reference	reference
Decreased	**3.68 (2.02–5.34)***	**2.94 (1.48–4.41)***	**2.12 (0.54–3.70)***
Increased	**2.13 (0.60–3.66)***	1.16 (−0.18–2.51)	0.67 (−0.78–2.12)
Chestnuts/oilseeds			
Unchanged	reference	reference	reference
Decreased	1.01 (−0.51–2.53)	1.17 (−0.16–2.51)	0.24 (−1.19–1.68)
Increased	0.65 (−1.23–2.54)	0.69 (−0.97–2.34)	0.25 (−1.52–2.03)
Alcoholic beverages			
Unchanged	reference	reference	reference
Decreased	**1.58 (0.06–3.10)***	0.84 (−0.51–2.18)	1.41 (−0.03–2.85)
Increased	**3.07 (1.40–4.74)***	1.22 (−0.26–2.70)	1.50 (−0.08–3.08)
Sugar sweetened beverages			
Unchanged	reference	reference	reference
Decreased	**1.65 (0.21–3.09)***	**2.20 (0.93–3.47)***	**1.38 (0.01–2.74)***
Increased	**7.24 (5.24–9.24)***	**5.67 (3.91–7.44)***	**5.57 (3.67–7.47)***
Fast Foods			
Unchanged	reference	reference	reference
Decreased	0.11 (−1.36–1.59)	0.53 (−0.77–1.83)	−0.21 (−1.60–1.19)
Increased	**4.34 (2.49–6.18)***	**3.24 (1.61–4.87)***	**2.85 (1.10–4.60)***

Model was adjusted by sex, age, education and sleep hours. 95%CI = 95% confidence interval. *statistically significant difference (p-value<0.05).

good mood with good food choices and bad mood with bad food choices is frequently observed. Both positive and negative moods can lead to increased food consumption [70]. As well as different food, choices can also alter the mood.

The positive aspect of this study is the generation of preliminary data regarding associations and predictions between mood states (anxiety, depression and stress) and food group intake, during social isolation in a pandemic period, which can work as a basis and lead to the elaboration of larger and more robust future studies. As to its limitations, we highlight the impossibility of verifying the effect between the variables. Moreover, as it was an online study, it did not allow the participation of individuals without internet access, generally low-income people who might have been more affected. Questions about COVID-19 diagnosis and physical activity score would also be relevant.

5. Conclusions

Most participants reported not having perceived changes in eating habits, but on the other hand, a remarkable increase in added sugar in general was observed. Fast foods and alcoholic beverages, increased levels of stress, anxiety and depression and low physical activity levels were reported. The consumption of carbohydrate-rich foods was associated with stress and anxiety symptoms. The increase of caloric foods such as fats, sugar sweetened beverages and fast foods were associated to stress, anxiety and depression symptoms. Moreover, the decrease in proteins, vitamins and fibers sources foods as red meat, fish, chicken, eggs, dairy, vegetables, and fruits had a strong association with stress, anxiety, and depression symptoms. Therefore, future studies that assess mental health and nutrition are important to measure the impact during the COVID-19 pandemic.

Funding statement

This research did not receive any grant from funding agencies in the public or private sectors.

Conflict of interests

The authors declare not having any known competing financial interests or personal relationships that could have influenced the work reported in this paper.

Author contributions

Conceptualization and methodology: L.D. Negrão, L.C. Natacci, E.A.F.S. Torres; Data collection: LD. Negrão, L.C. Natacci, M.C.Z. Alfino; Data analysis: L.D. Negrão, A.A.F. Carioca; Preparation of original draft: L.D. Negrão, L.C. Natacci, V.F. Marchiori; Writing review and editing: L.D. Negrão, L.C. Natacci, M.C.Z. Alfino, V.F. Marchiori, D.H. Oliveti, E.A.F.S. Torres. Project administration: E.A.F.S. Torres. All authors reviewed the article.

Acknowledgments

Leonardo Dias Negrão (L.D.N.) is grateful to the Coordination Office for Academic Staff Improvement (CAPES) for granting him a scholarship at doctorate degree modality. Lara Cristine Natacci (L.C.N.) is grateful for the post-doctoral degree and Maria Carolina Zsigovics Alfino (M.C.Z.A.) for granting her a scholarship at undergraduate nutrition degree.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.clnesp.2022.06.017.

References

[1] Ahn DG, Shin HJ, Kim MH, Lee S, Kim HS, Myoung J, et al. Current status of epidemiology, diagnosis, therapeutics, and vaccines for novel coronavirus disease 2019 (COVID-19). J Microbiol Biotechnol 2020;30:313–24. https://doi.org/10.4014/jmb.2003.03011.

[2] Lu R, Zhao X, Li J, Niu P, Yang B, Wu H, et al. Genomic characterisation and epidemiology of 2019 novel coronavirus: implications for virus origins and receptor binding. Lancet 2020;395:565–74. https://doi.org/10.1016/S0140-6736(20)30251-8.

[3] Chen N, Zhou M, Dong X, Qu J, Gong F, Han Y, et al. Epidemiological and clinical characteristics of 99 cases of 2019 novel coronavirus pneumonia in Wuhan, China: a descriptive study. Lancet 2020;395:507–13. https://doi.org/10.1016/S0140-6736(20)30211-7.

[4] Huang C, Wang Y, Li X, Ren L, Zhao J, Hu Y, et al. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. Lancet 2020;395:497–506. https://doi.org/10.1016/S0140-6736(20)30183-5.

[5] Yuefei J, Haiyan Y, Wangquan J, Weidong W, Shuaiyin C, Weiguo Z, et al. Virology, epidemiology, pathogenesis, and control of COVID-19. Viruses 2020;12:1–17.

[6] Ge H, Wang X, Yuan X, Xiao G, Wang C, Deng T, et al. The epidemiology and clinical information about COVID-19. Eur J Clin Microbiol Infect Dis 2020;39:1011–9. https://doi.org/10.1007/s10096-020-03874-z.

[7] Pires RRC. Os efeitos sobre grupos sociais e territórios vulnerabilizados das medidas de enfrentamento à crise sanitária da covid-19: propostas para o aperfeiçoamento da ação pública. Ipea 2020:1–18.

[8] Bezerra ACV, da Silva CEM, Soares FRG, da Silva JAM. Factors associated with people's behavior in social isolation during the covid-19 pandemic. Ciência Saúde Coletiva 2020;25:2411–21. https://doi.org/10.1590/1413-81232020256.1.10792020.

[9] Altena E, Baglioni C, Espie CA, Ellis J, Gavriloff D, Holzinger B, et al. Dealing with sleep problems during home confinement due to the COVID-19 outbreak: practical recommendations from a task force of the European CBT-I Academy. J Sleep Res 2020:1–7. https://doi.org/10.1111/jsr.13052.

[10] Torales J, O'Higgins M, Castaldelli-Maia JM, Ventriglio A. The outbreak of COVID-19 coronavirus and its impact on global mental health. Int J Soc Psychiatr 2020;66:317–20. https://doi.org/10.1177/0020764020915212.

[11] Maia BR, Dias PC. Anxiety, depression and stress in university students: the impact of COVID-19. Estud Psicol 2020;37:1–8. https://doi.org/10.1590/1982-0275202037e200067.

[12] Luo M, Guo L, Yu M, Jiang W, Wang H. The psychological and mental impact of coronavirus disease 2019 (COVID-19) on medical staff and general public – a systematic review and meta-analysis. Psychiatr Res 2020;291:113190. https://doi.org/10.1016/j.psychres.2020.113190.

[13] Li W, Yang Y, Liu ZH, Zhao YJ, Zhang Q, Zhang L, et al. Progression of mental health services during the COVID-19 outbreak in China. Int J Biol Sci 2020;16:1732–8. https://doi.org/10.7150/ijbs.45120.

[14] Rajkumar RP. COVID-19 and mental health: a review of the existing literature. Asian J Psychiatr 2020;52:102066. https://doi.org/10.1016/j.ajp.2020.102066.

[15] Huang Y, Zhao N. Generalized anxiety disorder, depressive symptoms and sleep quality during COVID-19 outbreak in China: a web-based cross-sectional survey. Psychiatr Res 2020;288:112954. https://doi.org/10.1016/j.psychres.2020.112954.

[16] Bo H-X, Li W, Yang Y, Wang Y, Zhang Q, Cheung T, et al. Posttraumatic stress symptoms and attitude toward crisis mental health services among clinically stable patients with COVID-19 in China. Psychol Med 2020;103:1–2. https://doi.org/10.1017/S0033291720000999.

[17] Coping with stress: coronavirus dis 2019. 2020. https://www.cdc.gov/coronavirus/2019-ncov/daily-life-coping/managing-stress-anxiety.html. [Accessed 9 July 2020]. accessed.

[18] Herle M, Smith AD, Bu F, Steptoe A, Fancourt D. Trajectories of eating behavior during COVID-19 lockdown: longitudinal analyses of 22,374 adults. Clin Nutr ESPEN 2021;42:158–65. https://doi.org/10.1016/j.clnesp.2021.01.046.

[19] Muscogiuri G, Barrea L, Savastano S, Colao A. Nutritional recommendations for CoVID-19 quarantine. Eur J Clin Nutr 2020;74:850–1. https://doi.org/10.1038/s41430-020-0635-2.

[20] Ruiz-Roso MB, de Carvalho Padilha P, Mantilla-Escalante DC, Ulloa N, Brun P, Acevedo-Correa D, et al. Covid-19 confinement and changes of adolescent's dietary trends in Italy, Spain, Chile, Colombia and Brazil. Nutrients 2020;12:1807. https://doi.org/10.3390/nu12061807.

[21] Fotuhi M, Mian A, Meysami S, Raji CA. Neurobiology of COVID-19. J Alzheim Dis 2020:1–17. https://doi.org/10.3233/jad-200581.

[22] Shader RI. COVID-19 and depression. Clin Therapeut 2020;42:962–3. https://doi.org/10.1016/j.clinthera.2020.04.010.

[23] Loades ME, Chatburn E, Higson-Sweeney N, Reynolds S, Shafran R, Brigden A, et al. Rapid systematic review: the impact of social isolation and loneliness on the mental health of children and adolescents in the context of COVID-19. J Am Acad Child Adolesc Psychiatry 2020;59(11):1218–39. https://doi.org/10.1016/j.jaac.2020.05.009.

[24] Haraj NE, El Aziz S, Chadli A, Dafir A, Mjabber A, Aissaoui O, et al. Nutritional status assessment in patients with Covid-19 after discharge from the intensive care unit. Clin Nutr ESPEN 2021;41:423–8. https://doi.org/10.1016/j.clnesp.2020.09.214.

[25] da Saúde Ministério. Guia alimentar para a população brasileira. 2006.

[26] Lovibond PF, Lovibond SH. The structure of negative emotional states: comparison of the depression anxiety stress scales (DASS) with the Beck depression and anxiety inventories. Behav Res Ther 1995;33:335–43. https://doi.org/10.1016/0005-7967(94)00075-U.

[27] Osman A, Wong JL, Bagge CL, Freedenthal S, Gutierrez PM, Lozano G. The Depression Anxiety Stress Scales-21 (DASS-21): further examination of

dimensions, scale reliability, and correlates. J Clin Psychol 2012;68:1322–38. https://doi.org/10.1002/jclp.21908.
[28] Pais-Ribeiro JL, Honrado A, Isabel L. Contribuição para o Estudo da Adaptação Portuguesa das Escalas de Ansiedade, Depressão e Stress (EADS) de 21 itens de Lovibond e Lovibond. Psicol Saúde Doenças 2004;5:229–39. https://doi.org/10.1016/j.ajp.2020.102014.
[29] Diet nutrition and the prevention of chronic diseases. Geneva: WHO; 2003. http://www.who.int/elena/titles/fruit_vegetables_ncds/en/.
[30] HealthyAtHome: dieta saudável. 2020. https://www.who.int/campaigns/connecting-the-world-to-combat-coronavirus/healthyathome/healthyathome–healthy-diet. [Accessed 17 December 2021]. accessed.
[31] Giorgi G, Lecca LI, Alessio F, Finstad GL, Bondanini G, Lulli LG, et al. COVID-19-related mental health effects in the workplace: a narrative review. Int J Environ Res Publ Health 2020;17:7857. https://doi.org/10.3390/ijerph17217857.
[32] Kovaleva M, Spangler S, Clevenger C, Hepburn K. Chronic stress, social isolation, and perceived loneliness in dementia caregivers. J Psychosoc Nurs Ment Health Serv 2018;56:36–43. https://doi.org/10.3928/02793695-20180329-04.
[33] Jacques A, Chaaya N, Beecher K, Ali SA, Belmer A, Bartlett S. The impact of sugar consumption on stress driven, emotional and addictive behaviors. Neurosci Biobehav Rev 2019;103:178–99. https://doi.org/10.1016/j.neubiorev.2019.05.021.
[34] Mohseni H, Amini S, Abiri B, Kalantar M, Kaydani M, Barati B, et al. Are history of dietary intake and food habits of patients with clinical symptoms of COVID 19 different from healthy controls? A case–control study. Clin Nutr ESPEN 2021;42:280–5. https://doi.org/10.1016/j.clnesp.2021.01.021.
[35] Reyes-Olavarría D, Latorre-Román PÁ, Guzmán-Guzmán IP, Jerez-Mayorga D, Caamaño-Navarrete F, Delgado-Floody P. Positive and negative changes in food habits, physical activity patterns, and weight status during COVID-19 confinement: associated factors in the Chilean population. Int J Environ Res Publ Health 2020;17:5431. https://doi.org/10.3390/ijerph17155431.
[36] Rodríguez-Pérez C, Molina-Montes E, Verardo V, Artacho R, García-Villanova B, Guerra-Hernández EJ, et al. Changes in dietary behaviours during the COVID-19 outbreak confinement in the Spanish COVIDiet study. Nutrients 2020;12:1730. https://doi.org/10.3390/nu12061730.
[37] Kriaucioniene V, Bagdonaviciene L, Rodríguez-Pérez C, Petkeviciene J. Associations between changes in health behaviours and body weight during the COVID-19 quarantine in Lithuania: the Lithuanian COVIDiet study. Nutrients 2020;12:3119. https://doi.org/10.3390/nu12103119.
[38] Chew HSJ, Lopez V. Global impact of COVID-19 on weight and weight-related behaviors in the adult population: a scoping review. Int J Environ Res Publ Health 2021;18:1876. https://doi.org/10.3390/ijerph18041876.
[39] Tehrani S, Khabiri N, Moradi H, Mosavat MS, Khabiri SS. Evaluation of vitamin D levels in COVID-19 patients referred to Labafinejad hospital in Tehran and its relationship with disease severity and mortality. Clin Nutr ESPEN 2021;42:313–7. https://doi.org/10.1016/j.clnesp.2021.01.014.
[40] Dutheil S, Ota KT, Wohleb ES, Rasmussen K, Duman RS. High-fat diet induced anxiety and anhedonia: impact on brain homeostasis and inflammation. Neuropsychopharmacology 2016;41:1874–87. https://doi.org/10.1038/npp.2015.357.
[41] Hassan AM, Mancano G, Kashofer K, Fröhlich EE, Matak A, Mayerhofer R, et al. High-fat diet induces depression-like behaviour in mice associated with changes in microbiome, neuropeptide Y, and brain metabolome. Nutr Neurosci 2019;22:877–93. https://doi.org/10.1080/1028415X.2018.1465713.
[42] Zemdegs J, Quesseveur G, Jarriault D, Pénicaud L, Fioramonti X, Guiard BP. High-fat diet-induced metabolic disorders impairs 5-HT function and anxiety-like behavior in mice. Br J Pharmacol 2016;173:2095–110. https://doi.org/10.1111/bph.13343.
[43] Wong SK, Chin K-Y, Ima-Nirwana S. Vitamin D and depression: the evidence from an indirect clue to treatment strategy. Curr Drug Targets 2018;19:888–97. https://doi.org/10.2174/1389450118666170913161030.
[44] Zachary Z, Brianna F, Brianna L, Garrett P, Jade W, Alyssa D, et al. Self--quarantine and weight gain related risk factors during the COVID-19 pandemic. Obes Res Clin Pract 2020;14:210–6. https://doi.org/10.1016/j.orcp.2020.05.004.
[45] Di Renzo L, Gualtieri P, Pivari F, Soldati L, Attinà A, Cinelli G, et al. Eating habits and lifestyle changes during COVID-19 lockdown: an Italian survey. J Transl Med 2020;18:229. https://doi.org/10.1186/s12967-020-02399-5.
[46] Laguna L, Fiszman S, Puerta P, Chaya C, Tárrega A. The impact of COVID-19 lockdown on food priorities. Results from a preliminary study using social media and an online survey with Spanish consumers. Food Qual Prefer 2020;86:104028. https://doi.org/10.1016/j.foodqual.2020.104028.
[47] Ngwa W, Kumar R, Thompson D, Lyerly W, Moore R, Reid T-E, et al. Potential of flavonoid-inspired phytomedicines against COVID-19. Molecules 2020;25:2707. https://doi.org/10.3390/molecules25112707.
[48] Fraga CG, Croft KD, Kennedy DO, Tomás-Barberán FA. The effects of polyphenols and other bioactives on human health. Food Funct 2019;10:514–28. https://doi.org/10.1039/c8fo01997e.
[49] Rasouli H, Farzaei MH, Khodarahmi R. Polyphenols and their benefits: a review. Int J Food Prop 2017;20:1700–41. https://doi.org/10.1080/10942912.2017.1354017.
[50] Matsuo LH, Tureck C, Lima de LP, Hinnig PF, Trindade Ebs de M, Vasconcelos FAG. Impact of social isolation by Coronavirus disease 2019 in food: a narrative review. Rev Nutr 2021;34. https://doi.org/10.1590/1678-9865202134e200211.
[51] Sidor A, Rzymski P. Dietary choices and habits during COVID-19 lockdown: experience from Poland. Nutrients 2020;12:1657. https://doi.org/10.3390/nu12061657.
[52] Hossain MM, Sultana A, Purohit N. Mental health outcomes of quarantine and isolation for infection prevention: a systematic umbrella review of the global evidence. Epidemiol Health 2020;42:e2020038. https://doi.org/10.4178/epih.e2020038.
[53] Scarmozzino F, Visioli F. Covid-19 and the subsequent lockdown modified dietary habits of almost half the population in an Italian sample. Foods 2020;9:675. https://doi.org/10.3390/foods9050675.
[54] Xia N, Li H. Loneliness, social isolation, and cardiovascular health. Antioxidants Redox Signal 2018;28:837–51. https://doi.org/10.1089/ars.2017.7312.
[55] Liu CH, Zhang E, Wong GTF, Hyun S, Hahm HC. Factors associated with depression, anxiety, and PTSD symptomatology during the COVID-19 pandemic: clinical implications for U.S. young adult mental health. Psychiatr Res 2020;290:113172. https://doi.org/10.1016/j.psychres.2020.113172.
[56] Campagne DM. Stress and perceived social isolation (loneliness). Arch Gerontol Geriatr 2019;82:192–9. https://doi.org/10.1016/j.archger.2019.02.007.
[57] Mattos dos Santos R. Isolation, social stress, low socioeconomic status and its relationship to immune response in Covid-19 pandemic context. Brain, Behav Immun - Heal 2020;7:100103. https://doi.org/10.1016/j.bbih.2020.100103.
[58] Corrêa CA, Verlengia R, Ribeiro AGSV, Crisp AH. Níveis de estresse, ansiedade, depressão e fatores associados durante a pandemia de COVID-19 em praticantes de Yoga. Rev Bras Atividade Física Saúde 2020;25:1–7. https://doi.org/10.12820/rbafs.25e0118.
[59] Gopinath B, Flood VM, Burlutksy G, Louie JCY, Mitchell P. Association between carbohydrate nutrition and prevalence of depressive symptoms in older adults. Br J Nutr 2016;116:2109–14. https://doi.org/10.1017/S0007114516004311.
[60] Gangwisch JE, Hale L, Garcia L, Malaspina D, Opler MG, Payne ME, et al. High glycemic index diet as a risk factor for depression: analyses from the women's health initiative. Am J Clin Nutr 2015;102:454–63. https://doi.org/10.3945/ajcn.114.103846.
[61] Daneshzad E, Keshavarz SA, Qorbani M, Larijani B, Azadbakht L. Association between a low-carbohydrate diet and sleep status, depression, anxiety, and stress score. J Sci Food Agric 2020;100:2946–52. https://doi.org/10.1002/jsfa.10322.
[62] Cheng HY, Shi YX, Yu FN, Zhao HZ, Zhang JH, Song M. Association between vegetables and fruits consumption and depressive symptoms in a middle-aged Chinese population: an observational study. Medicine 2019;98:1–5. https://doi.org/10.1097/MD.0000000000015374.
[63] Grases G, Colom MA, Sanchis P, Grases F. Possible relation between consumption of different food groups and depression. BMC Psychol 2019;7:1–6. https://doi.org/10.1186/s40359-019-0292-1.
[64] Shin Y, Kim Y. Association between psychosocial stress and cardiovascular disease in relation to low consumption of fruit and vegetables in middle-aged men. Nutrients 2019;11:1915. https://doi.org/10.3390/nu11081915.
[65] Angelino D, Godos J, Ghelfi F, Tieri M, Titta L, Lafranconi A, et al. Fruit and vegetable consumption and health outcomes: an umbrella review of observational studies. Int J Food Sci Nutr 2019;70:652–67. https://doi.org/10.1080/09637486.2019.1571021.
[66] Stanton R, To QG, Khalesi S, Williams SL, Alley SJ, Thwaite TL, et al. Depression, anxiety and stress during COVID-19: associations with changes in physical activity, sleep, tobacco and alcohol use in Australian adults. Int J Environ Res Publ Health 2020;17:1–13. https://doi.org/10.3390/ijerph17114065.
[67] Ángeles Pérez-Ara M, Gili M, Visser M, Penninx BWJH, Brouwer IA, Watkins E, et al. Associations of non-alcoholic beverages with major depressive disorder history and depressive symptoms clusters in a sample of overweight adults. Nutrients 2020;12:1–15. https://doi.org/10.3390/nu12103202.
[68] Reis DJ, Ilardi SS, Namekata MS, Wing EK, Fowler CH. The depressogenic potential of added dietary sugars. Med Hypotheses 2020;134:109421. https://doi.org/10.1016/j.mehy.2019.109421.
[69] Sanchez-Villegas A, Zazpe I, Santiago S, Perez-Cornago A, Martinez-Gonzalez MA, Lahortiga-Ramos F. Added sugars and sugar-sweetened beverage consumption, dietary carbohydrate index and depression risk in the Seguimiento Universidad de Navarra (SUN) Project. Br J Nutr 2018;119:211–21. https://doi.org/10.1017/S0007114517003361.
[70] Evers C, Dingemans A, Junghans AF, Boevé A. Feeling bad or feeling good, does emotion affect your consumption of food? A meta-analysis of the experimental evidence. Neurosci Biobehav Rev 2018;92:195–208. https://doi.org/10.1016/j.neubiorev.2018.05.028.