Consumption of ultra-processed foods and mental health of pregnant women from the South of Brazil

Fernanda Oliveira Meller[1], Caroline dos Santos Costa[2], Micaela Rabelo Quadra[3], Vanessa Iribarrem Avena Miranda[1], Fernanda Daminelli Eugênio[4], Tamara Justin da Silva[1], Maria Vitória Rodrigues Teixeira[4], Antônio Augusto Schäfer[1]

[1]Public Health Graduate Program University of the Extreme South of Santa Catarina Criciúma, Santa Catarina, Brazil.
[2]Epidemiology Graduate Program. Federal University of Pelotas. Pelotas, Rio Grande do Sul, Brazil.
[3]Health Sciences Graduate Program. University of the Extreme South of Santa Catarina. Criciúma, Santa Catarina, Brazil.
[4]Medical School. University of the Extreme South of Santa Catarina. Criciúma, Santa Catarina, Brazil.

Corresponding author: Fernanda Oliveira Meller, Public Health Graduate Program University of the Extreme South of Santa Catarina., Address: Avenida Universitária, 1105, CEP 88806-000, Criciúma, Santa Catarina, Brasil., Telephone: +55 (48) 3431.2609, E-mail: fernandameller@unesc.net

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Abstract

The objective of this study is to evaluate the association between the consumption of ultra-processed foods (UPF) and the mental health of pregnant women from the South of Brazil. This is a cross-sectional study carried out in Criciúma, Brazil, through face-to-face interviews, from April to December 2022. Pregnant women aged 18 or older who underwent prenatal care in the 48 Basic Health Units of the municipality and who were in their third trimester of pregnancy were included. High consumption of UPF was considered as 6 or more items or subgroups of UPF consumed on the day before the interview, using the Nova-UPF screener. The mental health variables were depressive symptoms, stress, sadness, and anxiety. Crude and adjusted analyses were conducted using the Fisher's exact test and the Poisson regression with robust variance. In total, 428 pregnant women were studied; most of them were aged between 20 and 25 years and were white. Pregnant women who presented high consumption of UPF were 1.42-fold (95%CI 1.06;1.92) more likely to experience anxiety and presented a prevalence 56% (95%CI 1.18;2.07) higher of stress when compared to those who did not present high consumption of UPF. The prevalence of depressive symptoms and feelings of sadness was 1.31-fold (95%CI 1.08;1.60) and 3.41-fold (95%CI 1.77;6.58) higher among those with high consumption of UPF, respectively. The results suggest that diet quality is associated with the mental health of pregnant women. Promoting joint actions focused on food and nutritional education for pregnant women, as well as mental health, is necessary.

Keywords: pregnant women, ultra-processed foods, mental health, food consumption.

Introduction

The gestational period is characterized by several changes in biological, social, and psychological domains, and it requires the assistance of women's families and health services[1,2]. Studies suggest that the gestational period is an influential moment in mental health[1,3,4]. Insecurity, fear, and sleep alterations are examples of situations that occur during the gestational period and highlight feelings of anxiety and depression[5].

Gestation and postpartum periods are critical for implementing health promotion and preventive interventions, as they may lead to the emergence or aggravation of mental health situations[1,2]. Untreated mental health conditions may cause difficulties in following medical guidance, a decrease in medical visits, and a higher risk of problems with gestation and the baby, as well as irregular life habits[1].

Dietary choices may be influenced by the pregnant emotional state. Situations linked to negative emotions may stimulate a preference for more palatable foods, which are rich in sugars and fats, to provide comfort to an organism with high cortisol[6]. Pregnant women's adequate food consumption is a key factor for promoting mother/child health and preventing negative postpartum outcomes[7]. An unhealthy diet during the gestational period may influence placental development, which may impact fetal development and growth, as well as increase the risk of gestational diabetes mellitus, hypertensive syndromes, nutritional deficiencies, and excessive weight gain. This may favor the emergence of chronic non-communicable diseases for mother and child[8].

A study with pregnant women in Alagoas, Brazil, showed that ultra-processed foods (UPF)—products formulated from mostly industrial ingredients that undergo several processing steps in the food industry until they are considered ready for consumption, such as sugary drinks, ice cream, chocolate, cookies, snacks, pre-ready and instant foods[9]—corresponded to 22.2% of their daily energy intake, with reduced ingestion of proteins, fibers, magnesium, iron, potassium, zinc, selenium, folate, and vitamins D and E. This affected the nutritional quality of their diet[10].

Dietary patterns during the gestational period must prioritize the consumption of a great variety of minimally processed *in natura* foods such as fruits, vegetables, lean meat, and whole grains because of their gestational physiological demands. The consumption of UPF must be restricted to preserve the mother's and neonate's health[11,12]. For this reason, the food consumption of pregnant women, especially regarding UPF, and its relationship with mental health must be investigated to subsidize actions to promote quality of life for mothers

and infants. Thus, this study aimed to assess the association of UPF consumption with the mental health of pregnant women in Southern Brazil.

Methodology

Study design and sampling

This cross-sectional study is part of a larger study named "Mental health and living conditions of pregnant women serviced at Primary Health Care". This investigation was carried out in the city of Criciúma between April and December 2022. Criciúma is located in the southernmost part of Santa Catarina state, Brazil. It has 217,965 inhabitants, a Human Development Index (HDI) of 0.788, and a populational density of about 815.87 inhabitants per km^{2}[13].

This study targeted pregnant women aged 18 years and above who had their prenatal consultation at any of the 48 Basic Health Care Units in the city and were in their third gestational trimester. Pregnant women who had different nationality, which might affect Portuguese language comprehension, had an abortion, or were at a high-risk pregnancy, were excluded from this study.

Identification of women who were in their third trimester of pregnancy was carried out via the health system used in the city called "CELK Saúde." This system enabled the generation of monthly reports with a likely delivery date for every pregnant woman in the next three months, thus corresponding to the third trimester of their pregnancies. When the monthly reports were made, "new" pregnant women were found; they had not yet been identified in previous searches due to a delay in entering data in the CELK system, in discovering their pregnancy, and/or in searching for prenatal service. After that, a selection filter was used in the Excel software to identify pregnant women aged 18 years or over.

To calculate the sample size, the annual average of pregnant women who received service at the Primary Health Care of Criciúma (n=1,517) was considered, as well as the following parameters: a 95%-confidence level, an 80%-statistical power, and a 50%-unknown outcome prevalence. After adding a 10% margin for losses and refusals, and 15% for confounding factors, 384 pregnant women should be studied. All eligible pregnant women were invited to participate in the study.

Data collection

Interviews were conducted in person, at a reserved place, during prenatal consultations, or at the participant's homes by previously trained interviewers. Tablets were used for data collection, and the mean interview time was 30 minutes. The questionnaire included sociodemographic, behavioral, health, and gestation and prenatal-related information. The data were stored in the RedCap® software.

Investigated variables

Food consumption

The variable of interest was the high consumption of UPF. Information to assess UPF consumption was collected at the time of recruitment via the Nova-UPF screener, as proposed by Costa et al.[14]. This tool includes the UPF items or subgroups with the higher participation in the diet, as estimated by the national food consumption survey carried out in the 2008–2009 Household Budget Survey (in Portuguese, Pesquisa de Orçamentos Familiares – POF) by Brazilian Institute of Geography and Statistics (in Portugues, Instituto Brasileiro de Geografia e Estatística – IBGE)[15]. The Nova-UPF screener presents a list of 23 UPF items or subgroups and evaluates their consumption on the day before the interview. It is divided into three parts: ultra-processed beverages (six subgroups); products that replace or are meal side dishes (ten subgroups); and snack-type products (seven subgroups).

Participants indicated all items they consumed the previous day. The information obtained from the Nova-UPF screener enabled the calculation of the Nova-UPF score by the simple sum of the positive answers to the items or subgroups. The Nova-UPF score was previously tested against the dietary share of UPF, obtained from 24-hour recalls, and the authors found a substantial agreement between the two measures[14]. For this study, the score was first categorized into quintiles. Then, women were considered as having a high UPF consumption when they presented scores in the fifth quintile of the distribution.

Mental health

The presence of depressive symptoms was assessed using the Patient Health Questionnaire (PHQ-9), previously validated for the Brazilian population[16]. This instrument is composed of nine questions, considering a two-week recall period. The frequency of each symptom is assessed on a Likert scale of 0 to 3, corresponding to the following answers: "not at all", "several days", "more than half the days", and "nearly every day", respectively (Supplementary Material 1). All women who scored 9 or above were considered to be experiencing depressive symptoms.

Stress was assessed through the Perceived Stress Scale (PSS-14), also validated for the Brazilian population[17]. This scale comprises 14 items that assess the perception of stressful experiences in the previous month (Supplementary Material 2). The total score is the sum of points ranging from 0 to 56, which was later categorized into quintiles. Pregnant women in the highest quintile were classified as having the highest level of perceived stress.

Feelings of sadness were measured by the Faces Scale[18]. This scale features 7 faces (1 corresponds to "very happy", and 7 corresponds to "very sad"), representing how the individual felt most of the time over the last year (Supplementary Material 3). Those who selected the last three faces (5, 6, and 7) were classified as experiencing feelings of sadness.

Anxiety was assessed by the question: "Has any doctor or psychologist ever told you that you have anxiety?" The answer options were "yes" and "no".

Potential confounding factors

The variables considered as potential confounders were: age (collected in complete years and categorized as 18-19, 20-25, 26-30, 31-35, >35), skin color (collected as white, black, mixed-race, yellow, indigenous), lives with a partner (no, yes), educational level (collected in complete years and categorized as ≤8, 9-11, ≥12), monthly income (<500.00; 500.00-1,000.00; 1,001.00-2,000.00 > 2,000.00 Brazilian Reais) quality of sleep (very good, good, regular, bad, very bad), and sufficient physical activity (no, yes). Physical activity was assessed by the long version of the International Physical Activity Questionnaire (IPAQ), considering leisure and movement activities[19]. Physical activity was considered sufficient when a pregnant woman exercised for at least 150 minutes a week[20].

Data analysis

Absolute (n) and relative (%) frequencies were calculated via descriptive analyses of the investigated variables and their respective 95%-confidence intervals (CI95%). The prevalence for the consumption of each item or UPF subgroup on the day before the interview was also presented (n, %). By utilizing the Fisher's exact test at a 5%-significance level, crude analyses were conducted to examine the association between UPF consumption and the mental health-related variables.

The adjusted analyses were carried out to verify whether the link between consumption of UPF and the mental health variables was independent of potential confounding factors. Poisson regression with robust variance was used for this purpose, adjusting for covariates across hierarchical deterministic levels. The demographic variables (age and skin color) were classified as level 1 (distal); the socioeconomic variables (lives with a partner, educational level, and monthly income), as level 2 (intermediate); and the behavioral variables (quality of sleep and sufficient physical activity), as level 3 (proximal). The backward model was utilized to select the variables in the adjusted model. Variables with a 20%-significance level (p-value <0.20) were maintained in the final model as potential confounding factors. The prevalence ratio (PR) was presented as the effect measure, with a 95%-confidence interval (CI95%).

All analyses were conducted on Stata software, version 17.0.

Ethical Considerations

This study adhered to the guidelines laid down in the Declaration of Helsinki, and the Ethics Committee of the University of the Extreme South of Santa Catarina approved all procedures involving human subjects in October 2021, under opinion no. 5.053.755. Verbal informed consent was obtained from all subjects, witnessed and formally recorded.

Results

In total, 428 pregnant women were investigated (85.6%-response rate). Most of them were aged between 20 and 30 years (58.1%), were white (68.1%), and lived with a partner (85.7%). One-third of them had completed up to 8 years of education (29.0%), and nearly half had a monthly income between R$ 1,001.00 and R$ 2,000.00 (45.0%). Regarding mental health, nearly one-third presented anxiety (34.4%) and stress (36.4%), and more than half reported depressive symptoms (50.9%) (Table 1).

Table 2 presents UPF consumed on the day before the interview. It was found that the most consumed foods were sandwich bread, hot dog bread, or hamburger bread (53.3%), margarine (33.2%), sweet cookies with or without filling (26.2%), and regular or diet soda (25.5%). Conversely, the least consumed foods were frozen lasagna or another ready-made dish bought frozen (1.4%) and ready-made salad dressing (1.4%). The score distribution in the sample, presented in Figure 1, shows that women in the fifth quintile of scores distribution consumed 6 or more UPF items or subgroups the previous day. The prevalence of high consumption of UPF corresponded to 13.8%.

Figure 2 illustrates both the crude and adjusted associations between the high consumption of UPF and the mental health variables. It was found that all mental health outcomes remained associated with high consumption of UPF after an adjustment for potential confounding factors. The pregnant women who presented high consumption of UPF had a 1.42-fold higher prevalence of anxiety (95%CI 1.06; 1.92) and a 1.56-fold higher prevalence of stress (95%CI 1.18; 2.07) when compared to those who did not present high consumption. The prevalence of depressive symptoms was 1.31-fold higher among those who presented high consumption of UPF (95%CI 1.08; 1.60) than their peers. Besides, the prevalence of feelings of sadness was 3.41-fold higher among those with high consumption of UPF (95%CI 1.77; 6.58).

Discussion

This study aimed to assess the relationship between the consumption of UPF and the mental health of pregnant women. It found that all examined mental health conditions, including anxiety, stress, depressive symptoms, and feelings of sadness, were associated with high UPF consumption.

In recent years, because of the processes of globalization and an industrial, social, and economic transition, an intense shift in dietary patterns has been seen worldwide[21,22]. Consuming homemade meals cooked with *in natura* or minimally processed products has been replaced by the consumption of UPF, which are rich in fats, sugars, sodium, and food additives[23]. These foods are not only promoted with aggressive marketing campaigns, but they are also hyperpalatable, and potentially addictive. As a result, they have become a primary source of energy and nutrients for many populations, influencing diets across various life stages[21,23].

In Latin America, the food and nutritional transition situation is relatively recent. This region shares many common factors with other areas. Factors such as economy, urbanization, and convenience contributed to this scenario. It is known that social, economic, and political history aspects significantly contribute to determining UPF consumption[24]. Specifically in Brazil, UPF consumption has been increasing in all social strata[25].

Gestation is a period when women are more vulnerable, which might worsen their nutrition quality. A study by Gomes et al.[26] showed that 25%, on average, of the energy consumption of pregnant women in a São Paulo municipality originated from ultra-processed foods. In the United States, the mean UPF energy contribution reached 52.6% during pregnancy[27]. Another study in Alagoas, Brazil, showed that women in the highest (fifth) quintile of UPF consumption presented a dietary share of 40.1% from UPF, almost 10-fold higher compared to the lowest (first) quintile (4.9%)[26]. In our study, 14% of the pregnant women were in the fifth quintile of the distribution, consuming 6 or more UPF items or subgroups on the day before the interview. A previous study demonstrated that the Nova-UPF score, derived from the tool applied in this study, accurately represented the dietary share of UPF, evaluated through 24-hour recalls. The authors found a substantial agreement in ranking individuals into the quintiles of consumption, comparing the Nova-UPF score and the dietary share of UPF. Simultaneously, other studies with adults found the cutoff values for the highest quintile to be 4 or more[28] and 5 or more[14,29,30], which are lower than what we discovered. Therefore, our sample may exhibit both a high consumption of UPF items and a high dietary share of UPF, compared to other adult samples.

This is a particularly concerning scenario because while an increase in the consumption of these products has been observed, there has also been a steady increase in the prevalence of negative mental health outcomes and their consequences in the world population[31]. A significant portion of this issue may be attributed to family relationships, social support, economic factors, environmental influences, and gender roles[32]. During pregnancy, mental health may be strongly influenced by hormonal alterations and concerns and doubts about the future of the mother and child, as well as a lack of social support[33].

The consequences of the consumption of ultra-processed foods for the population's general mental health have been extensively studied[34]. However, studies exploring the relationship between consumption of these products and mental health among pregnant women are still scarce. This study found that women with high UPF consumption showed a higher prevalence of anxiety, stress, depressive symptoms, and feelings of sadness. Other studies corroborate these findings. Similarly, a study from Ribeirão Preto, Brazil, revealed that being

in the 2nd or 3rd tercile for energy consumption from ultra-processed foods was associated with a higher risk of reporting feelings of depression or sadness during pregnancy[35]. In the United States, a pro-inflammatory diet was linked to depressive symptoms among pregnant women facing economic hardships[36]. In Australia, non-standard eating patterns in pregnant women, characterized by consuming candies, fast food, red meat, and soft drinks, were associated with a higher frequency of depressive symptoms[37]. Moreover, in Taiwan, an increased consumption of sugary drinks was linked to rising depressive symptoms throughout pregnancy[38].

Given that pregnant women are particularly vulnerable to the effects of UPF consumption during pregnancy, and considering the rising trend in these foods' consumption, their mental health will likely be severely affected. This turns the association between UPF consumption and mental health into a public health issue, especially considering that a nutritionally balanced diet is crucial for optimal fetal development and growth[8]. This highlights its significance not only for pregnant women's mental health but also for the overall health of their children.

The relationship between ultra-processed food consumption and mental health is complex. A multi-country study showed that high consumption of these foods detrimentally affected the nutritional quality of diets[39]. This diet profile has been associated with mental health outcomes through various mechanisms, such as inflammation, oxidative stress, and intestinal microbiota imbalance[40]. Additionally, the consumption of nutrients like proteins, food fibers, vitamins D, E, the B complex, zinc, and magnesium, as well as omega-3 polyunsaturated fatty acids, is linked to mothers' better humor and well-being, reducing the risk of negative psychological conditions such as perceived stress, anxiety, and depression, during both prenatal and postnatal periods[41,42].

On the other hand, the literature suggests that prenatal psychological stress is associated with less healthy eating behaviors, such as "emotional eating" driven by consuming highly palatable foods[41]. Palatability is a determining factor in food choice. Highly palatable, ultra-processed foods promote non-homeostatic eating—food consumption without a metabolic need[23,43–45]. Besides, UPF deliver calories more quickly because of their easy digestion and altered bioavailability, encouraging overconsumption[46]. Ultra-processed food consumption also affects the reward system, which is composed of oral and post-oral signals and is highly activated by ingredients like sugar and fat. Although the reward system may not exhibit immediate food preferences following initial consumption, especially with sugary foods, a

preference for these foods[45–47] often develops due to the sense of well-being they provoke[44,45].

This cycle of food consumption, reward, and well-being encourages ongoing UPF consumption and especially overconsumption. It also undermines efforts to avoid such consumption, as it triggers undesirable sensations in individuals and diminishes their ability to control their eating habits[47]. The inability to control food intake frequently leads to negative feelings, such as guilt and shame[48]. These feelings may contribute to adverse mental health outcomes, which can be particularly intense in pregnant women. Therefore, there might be a bidirectional relationship between UPF consumption and negative mental health outcomes.

This study has some limitations that must be mentioned. High consumption of ultra-processed foods was defined from a sample distribution (the highest quintile), according to the previous study methodology[14,49], but not at a specific cutoff point. Although there is no specific definition for it in the literature, our use of the highest quintile for categorization aligns with recent meta-analyses. These analyses investigate UPF consumption's impact on non-communicable diseases and mortality, with many studies employing population distribution as a key parameter[34,39]. Consumption data on the day before the interview does not reflect the usual consumption. However, several studies from the above-mentioned meta-analyses[34,39] evaluate UPF consumption through 24-hour recalls applied in a single occasion. The cross-sectional design does not allow to establish a causal relationship between the observed associations. Moreover, the relationship between UPF consumption and mental health variables may be bidirectional. The findings concerning UPF consumption and mental health issues during pregnancy must be interpreted with caution, as they suggest a worst-case scenario for mother/child health, which requires actions focused on minimizing both problems. Depressive symptoms, perceived stress, and feelings of sadness were assessed using screening questionnaires rather than diagnostic ones. Nevertheless, these questionnaires are widely used in population studies for their practicality in data collection[17,50,51]. Additionally, anxiety assessment was based on participants' recollection of a professional diagnosis, without screening or diagnostic questionnaires, which means its prevalence could be overestimated or underestimated. Finally, it is important to highlight that the Nova-UPF screener was initially validated in a sample where the majority (four-fifths) of the participants had completed at least secondary education. In our sample, almost 30% of respondents had less than 8 years of education. However, a second study evaluating the tool in a broader sample also found a good performance among participants with less than 12 years of education[52].

One strength of this study is its assessment of the association between consumption of UPF and the mental health among pregnant women—a target audience/topic that is still not extensively studied. The findings presented here are of utmost importance to build scientific evidence on this subject.

Based on these study findings, it can be suggested that diet quality is associated with the mental health of pregnant women. High consumption of UPF was linked to all mental health outcomes, showing an increased prevalence of anxiety, stress, depressive symptoms, and feelings of sadness. Thus, the high consumption of UPF during the nutritional transition, coupled with the current state of the population's mental health, has raised concerns within health sectors. Intersectoral and interdisciplinary efforts are crucial to promote initiatives focused on food and nutrition education for pregnant women and the wider population, as well as mental health care, especially aftermath of the COVID-19 pandemic.

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Abbreviations

95%CI	95%-confidence interval
FAPESC	Santa Catarina Research and Innovation Foundation
HDI	Human Development Index

IBGE	Instituto Brasileiro de Geografia e Estatística
IPAQ	International Physical Activity Questionnaire
UPF	Ultra-processed foods
PHQ-9	Patient Health Questionnaire
PSS-14	Perceived Stress Scale
POF	Pesquisa de Orçamentos Familiares

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Table 1. Characteristics of the pregnant women. Criciúma, Brazil, 2022. (n=428)

	n	%
Age		
18-19	42	9.8
20-25	147	34.4
26-30	102	23.7
31-35	88	20.6
>35	49	11.5
Skin color*		
White	284	68.1
Black	48	11.5
Mixed-race	85	20.4
Lives with a partner		
No	61	14.3
Yes	367	85.7
Educational level (complete years)		
≤8	124	29.0
9-11	216	50.5
≥12	88	20.6
Monthly income (in reais)		
<500.00	86	20.8
500,00-1000,00	70	17.0
1001,00-2000,00	186	45.0
>2000.00	71	17.2
Sleep quality		
Very good/good	172	40.2
Regular	157	36.7
Bad/very bad	99	23.1
Sufficient physical activity		
No	386	90.6
Yes	40	9.4
Anxiety		
No	281	65.7
Yes	147	34.4
Stress		
No	272	63.6
Yes	156	36.4
Depressive symptoms		
No	210	49.1
Yes	218	50.9
Feelings of sadness		
No	397	92.8
Yes	31	7.2

CI: confidence interval. *Yellow and indigenous were excluded (n=5; 1.2%).

Table 2. Prevalence of ultra-processed food consumption on the day before the interview. Criciúma, Brazil, 2022. (n=428).

Ultra-processed foods	**n**	**%**
Sandwich bread, hot dog bread, hamburger bread	228	53.3
Margarine	142	33.2
Sweet cookies, with or without filling	112	26.2
Regular or diet soda	109	25.5
Chocolate in bar or candy form	99	23.1
Ham, salami, or mortadella	94	22.0
Tang-like powdered juice	89	20.8
Packaged snack, matchstick potato, or salted cookie	63	14.7
Yogurt with a fruit or chocolate flavor	60	14.0
Mayonnaise, ketchup, or mustard	60	14.0
Del Valle-like carton or canned juice	57	13.3
Sausage, hamburger, or nuggets	55	12.9
Miojo-like instant noodles or packaged soup	52	12.2
Nescau-like chocolate beverage	47	11.0
Popsicle or brand ice cream	38	8.9
Frozen French fries or from chains like McDonald's fries	34	7.9
Frozen pizza or from chains like Pizza Hut or Domino's	15	3.5
Packaged cake	15	3.5
Cereal bar	14	3.3
Ice Tea-like tea-based beverage	8	1.9
Corn Flakes-like morning cereal	8	1.9
Ready-made salad dressing	6	1.4
Frozen lasagna or another ready-made dish that was bought frozen	6	1.4

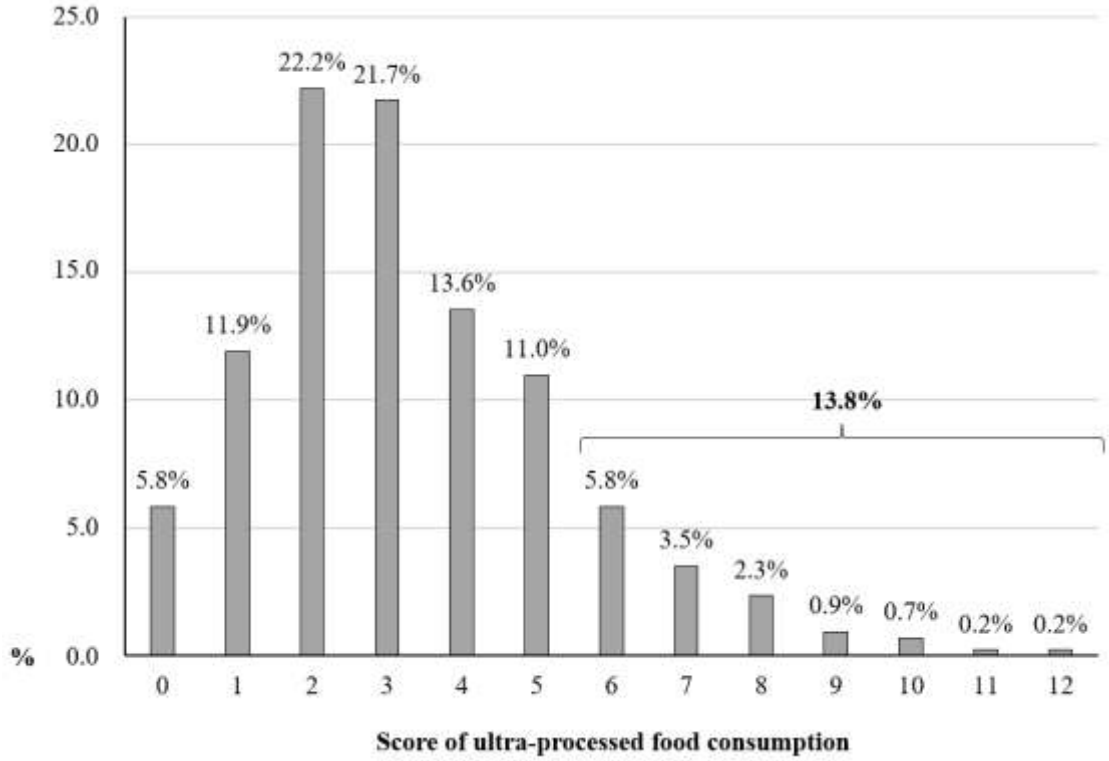

Figure 1. Distribution of the score of ultra-processed foods in the sample. Criciúma, SC, 2022. (n=428)

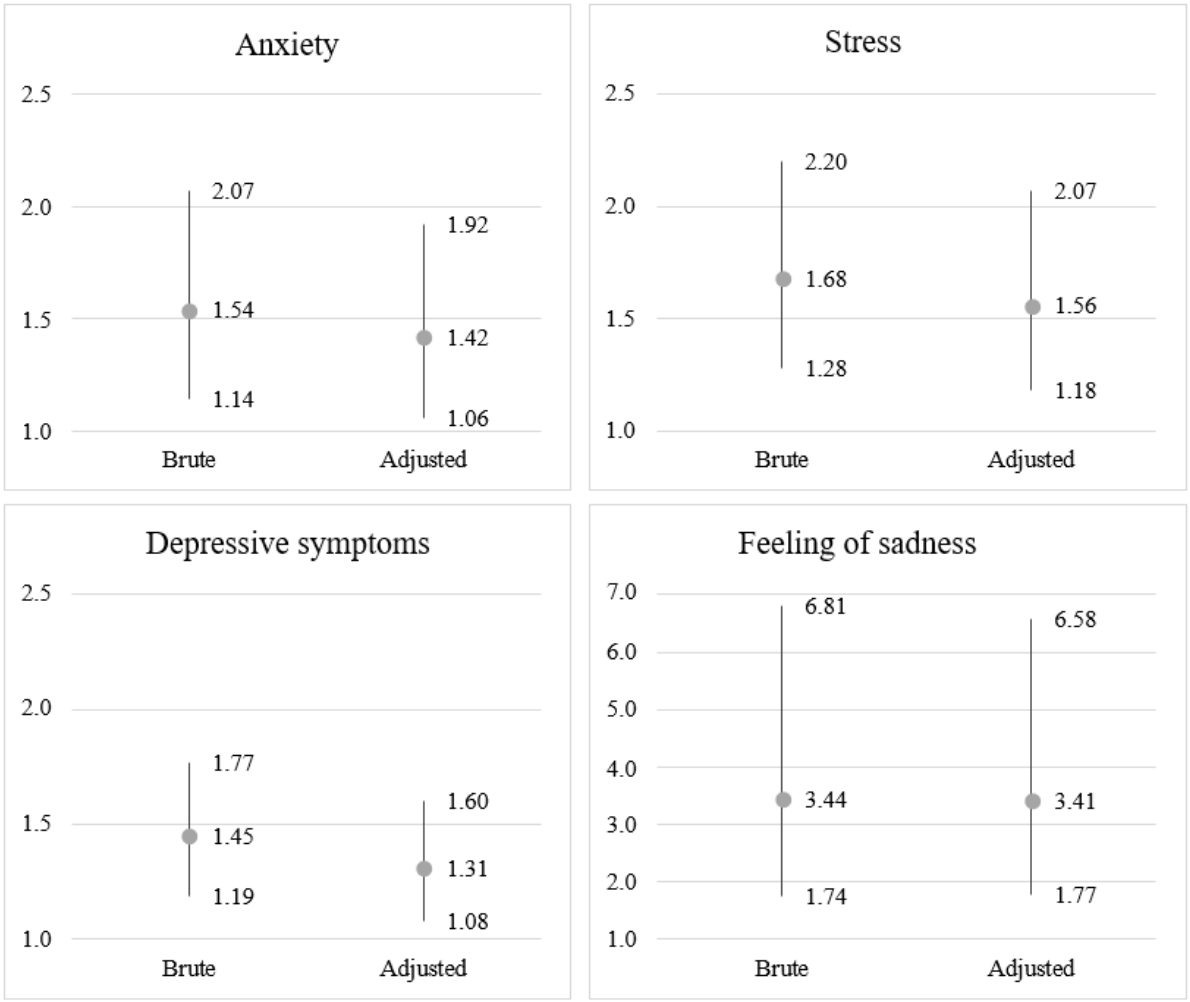

Figure 2. Crude and adjusted* prevalence ratios of the association between high consumption of ultra-processed foods (6 or more items) and mental health variables. Criciúma, SC, 2022. (n=428)

*Analysis adjusted for age, skin color, lives with a partner, educational level, monthly income, quality of sleep, and physical activity.