REVISTA DE NUTRIÇÃO
Brazilian Journal of Nutrition

ORIGINAL

Collective Health

Editors
Carla Cristina Enes,
Eliane Fialho de Oliveira.

Support
Fundação de Amparo à Pesquisa de Minas Gerais (FAPEMIG) (CDS-APQ-00571/13, CDS-APQ-02407/16, CDS - APQ-00424-17). *Coordenação de Aperfeiçoamento de Pessoal de Nível Superior* (Capes) (Finance Code 001).

Conflict of interest
The authors declare that there are no conflicts of interest.

Received
June 22, 2022

Final version
November 8, 2023

Approved
February 1, 2024

Food consumption according to the degree of industrial food processing in Brazilian graduates (CUME Project): A hierarchical analysis of associated factors

Consumo alimentar segundo o grau de processamento industrial dos alimentos em brasileiros graduados (Projeto CUME): uma análise hierarquizada dos fatores associados

Michelle Andrade Moreira[1], Ana Paula Boroni Moreira[2], Helen Hermana Miranda Hermsdorff[3], Adriano Marçal Pimenta[4], Josefina Bressan[3], Ana Paula Carlos Cândido[2]

[1] Universidade Federal de Juiz de Fora, Faculdade de Medicina, Programa de Pós-Graduação em Saúde Coletiva. Juiz de Fora, MG, Brasil.

[2] Universidade Federal de Juiz de Fora, Instituto de Ciências Biológicas, Departamento de Nutrição. Juiz de Fora, MG, Brasil. Correspondence to: APC CÂNDIDO. E-mail: <anapaula.candido@ufjf.edu.br>.

[3] Universidade Federal de Viçosa, Departamento de Nutrição e Saúde, Programa de Pós-Graduação em Ciência da Nutrição. Viçosa, MG, Brasil.

[4] Universidade Federal do Paraná, Departamento de Enfermagem. Programa de Pós-Graduação em Enfermagem. Curitiba, PR, Brasil.

Article based on the master's dissertation of MA MOREIRA, entitled "*Consumo alimentar e fatores associados na Coorte de Universidades Mineiras - projeto CUME: uma abordagem das recomendações do Guia Alimentar para a População Brasileira*. Universidade Federal de Juiz de Fora; 2021.

How to cite this article: Moreira MA, Moreira APB, Hermsdorff HHM, Pimenta AM, Bressan J, Cândido APC. Food consumption according to the degree of industrial food processing in Brazilian graduates (CUME Project): A hierarchical analysis of associated factors. Rev Nutr. 2024;37:e220148. https://doi.org/10.1590/1678-9865202437e220148

ABSTRACT

Objective

Evaluate the food consumption of the participants of the Cohort of Universities of Minas Gerais, according to the degree of processing, and its relationship with socioeconomic, behavioral, and individual factors.

Methods

A total of 4,124 individuals from the baseline of the Cohort of Universities of Minas Gerais (2016 and 2018) participated in this study. Food consumption was self-reported by completing an online Food Frequency Questionnaire. The foods were divided into 3 groups: Group 1, in natura, minimally processed foods, culinary ingredients and culinary preparations; Group 2, processed foods; Group 3, ultra-processed foods. A hierarchical multiple linear regression model was used to verify the associated factors.

Results
Regarding the factors associated with food consumption, it is noteworthy that Group 1 was positively associated with the practice of physical activity, female gender, age, "non-white" skin color, and the presence of diabetes *Mellitus*; and negatively with "not married/without stable union" marital status, alcohol abuse, tobacco use, obesity, and depression. Considering Group 2, it was positively associated with alcohol abuse, tobacco use, and age; and negatively with physical activity, female gender, and "non-white" skin color. As for Group 3 it was positively associated with a marital status of "not married/without stable union", obesity, and depression; and negatively with physical activity, age, "non-white" skin color, and presence of diabetes *Mellitus*.

Conclusion
The factors that are in at least one of the final hierarchical linear regression models stand out: marital status, physical activity, alcohol abuse, tobacco use, sex, age, skin color, obesity, diabetes mellitus, and depression.

Keywords: Eating. Nutrition policy. Regression analysis. Social determinants of health.

RESUMO

Objetivo
Avaliar o consumo alimentar dos participantes da Coorte de Universidades Mineiras, de acordo com grau de processamento, e sua relação, com fatores socioeconômicos, comportamentais e individuais.

Método
Participaram desse estudo 4.124 indivíduos da linha de base da Coorte de Universidades Mineiras (2016 e 2018). O consumo alimentar foi autorrelatado por um questionário online de frequência de consumo alimentar. Os alimentos foram divididos em: Grupo 1: alimentos in natura, minimamente processados, ingredientes culinários e preparações culinárias; Grupo 2: alimentos processados; e Grupo 3: alimentos ultraprocessados. Foi utilizado modelo de regressão linear múltipla hierarquizada para verificar os fatores associados.

Resultados
O Grupo 1 se associou positivamente à prática de atividade física, sexo feminino, idade, cor da pele "não branca" e presença de diabetes Mellitus; e negativamente ao estado civil "não casado/sem união estável", consumo abusivo de álcool, uso do tabaco, obesidade e depressão. O Grupo 2 se associou positivamente ao consumo abusivo de álcool, uso do tabaco e idade; e negativamente à prática de atividade física, sexo feminino e cor da pele "não branca". O Grupo 3 se associou positivamente ao estado civil "não casado/sem união estável", obesidade e depressão; e negativamente à prática de atividade física, idade, cor da pele "não branca" e presença de diabetes Mellitus.

Conclusão
Destacam-se os fatores que estão em pelo menos um dos modelos de regressão linear hierarquizada final: estado civil, atividade física, consumo abusivo de álcool, uso do tabaco, sexo, idade, cor da pele, obesidade, diabetes mellitus e depressão.

Palavras-chave: *Ingestão de alimentos. Política nutricional. Análise de regressão. Determinantes sociais da saúde.*

INTRODUCTION

Chronic Non-Communicable Diseases (NCD), responsible for 71% of deaths worldwide, have modifiable risk factors such as physical inactivity, smoking, unhealthy diet, alcohol abuse, in addition to socioeconomic factors [1]. In Brazil, in order to fight NCD, the goal is to change the diet of individuals, aiming at a healthy diet [2].

In this perspective, the Dietary Guidelines for the Brazilian Population (DGBP) were developed, which at the forefront of food and nutritional recommendations, adopted the degree of processing as a criterion for choosing foods, holding as a golden rule: "Always prefer fresh foods or minimally processed foods and culinary preparations over ultra-processed foods (UPF)" [3]. The NOVA food

classification was recognized as important in scientific research and its investigation was encouraged in food consumption assessments [4]. As a result, the number of studies that assess food consumption according to degree of processing has increased, especially focused on associations between UPF consumption and health outcomes [5-7]. Some others include the assessment of food consumption also for other levels of processing [8-10].

In addition, it is known that just as there is an interaction between health and society, in which factors in different layers have an influence on the health of the individual [11,12], so too food consumption is influenced by different determinants, such as clinical, psychological, social, economic, demographic, cultural, and contextual factors [13,14].

In this context, knowing the food consumption of a population and its associated factors provides a means to apply effective interventions, contributing to reducing modifiable risk factors to improve the health of individuals and reduce subsequent expenses with NCD.

Therefore, the objective of this study was to evaluate the food consumption of Brazilian graduates, participants of the Cohort of Universities of Minas Gerais (CUME Project), according to the degree of processing, and its association with socioeconomic, behavioral, and individual factors.

METHODS

CUME Project and study sample

This is a cross-sectional study with baseline data from the Cohort of Universities of Minas Gerais (CUME Project), from online questionnaires applied in 2016 and 2018. The CUME Project aims to assess the impact of the Brazilian dietary pattern on the development of non-communicable diseases and conditions in individuals graduated from Universities in the State of Minas Gerais, Brazil. Information about the CUME Project methodology can be found in a previously published article [15].

The project was guided by Resolution nº 466/12 of the National Health Council, under the opinion number of the Ethics Committee in Research of the institutions involved 596.741-0/2013 (Federal University of Viçosa), 2.491.386 (Federal University of Minas Gerais), 2.615.738 (Federal University of Juiz de Fora), and 2.565.240 (Federal University of Ouro Preto). All participants read and agreed to the online free and informed consent form.

The Q_0 was divided into two steps. The first stage included sociodemographic, anthropometric and lifestyle characteristics, and issues related to the individual's health. The second stage included a quantitative Food Frequency Questionnaire.

The initial sample of CUME Project (2016 and 2018) was 4,626 individuals who answered the complete Q_0 and were 20 years of age or older. For this study, the exclusion criteria were: non-Brazilian nationality, individuals who did not reside in Brazil, pregnant women and women who had a child in the year prior, and daily energy intake with inconsistent values [16]. Therefore, the final sample analyzed had 4,124 participants.

Food consumption and degree of industrial food processing

Food consumption was assessed using an online Food Frequency Questionnaire of 144 food items, validated for the population of our cohort [17]. Participants selected the foods consumed in the year prior to completing the Q_0, indicating the number, size of portions, and frequency of

consumption. This information was transformed into quantities (g or mL) of foods consumed per day. To quantify nutrients and energy (kcal), the Brazilian Food Composition Table [18] and the US Department of Agriculture Table [19] were used.

The foods were divided according to their degree of processing into 3 groups: Group 1, in natura, minimally processed foods, culinary ingredients and culinary preparations; Group 2, processed foods; Group 3, Ultra-Processed Foods (UPF), according to the NOVA food classification [3,20]. It was decided to divide the foods into three groups, instead of four according to the NOVA food classification of the DGBP, due to the group of culinary ingredients being used to create the culinary preparations, which are mentioned in the golden rule of the DGBP as a priority of choice with the in natura and minimally processed foods [3].

Furthermore, the foods were grouped in a similar way to other studies, in order to describe in more detail which foods were considered in each of the 3 groups and what the mean percentagem energy contribution of each of them was and their respective 95% confidence intervals (95% CI) [8,20].

The study outcome variables are continuous, obtained from the relative consumption of foods from Groups 1, 2 and 3.

Factors associated with food consumption

Exposure variables were divided into three blocks: Block 1, socioeconomic factors; Block 2, behavioral factors; and Block 3, individual factors.

Considering the variables in Block 1, marital status was divided into "married legally or in a stable union" and "not married legally and without a stable union" (this includes single, divorced, widowed, others). The education level of the study participants is high, as all of them have at least a degree, which is divided into "Undergraduate" and "Graduate" (this includes specialization, master's, doctoral, and post-doctoral degrees). The professional status was divided into "Works" (has formal full-time or part-time work or informal work) and "Does not work" (student, unemployed, retired, and housewife). Individual and Family Income were obtained by continuous numerical values in the questionnaire, later divided into multiples of minimum wage (MW) in force in the year the questionnaire was answered (R$ 880,00, in 2016; R$ 954,00, in 2018). In addition, they were classified into incomes of up to 5 x MW and incomes equal to or greater than 5 x MW.

Regarding the variables of Block 2, the practice of physical activity was divided into Active and Inactive/Insufficiently active. Active individuals were those who practiced leisure-time physical activity at least 150 minutes/week of moderate-intensity activity or at least 75 minutes/week of vigorous-intensity activity. Physical activity for less time, intensity, and frequency were considered insufficiently active or inactive [21]. Abusive alcohol consumption was classified as 4 doses or more for females and 5 doses or more for males (binge drinking) [22]. Tobacco use was divided into yes or no, according to self-report of whether the individual currently "smokes", even if occasionally, classified as "yes" or "no".

Considering the Block 3 variables, gender was answered as female or male. Age was answered as a natural number, and was evaluated as a continuous variable. Skin color was classified as "white" and "non-white" (black, brown, yellow, or indigenous). Self-reported Health Status was classified as "Very Good/Good" and "Fair/Poor/Very Bad". The presence of obesity was classified as Body Mass Index (BMI) greater than 30 kg/m2, both for adults and for the elderly [23,24]. The presence of Systemic Arterial Hypertension (SAH) was considered present if the participant met any of the

following criteria: systolic arterial pressure greater than or equal to 140 mmHg and/or diastolic arterial pressure greater than or equal to 90 mmHg [25]; use of antihypertensive medication; positive report of medical diagnosis of hypertension (high blood pressure). Diabetes *Mellitus* (DM) was considered if: fasting serum glucose greater than or equal to 126 mg/dL [26]; or use of antidiabetic medication and/or insulin; or positive report of medical diagnosis of diabetes. Depression was considered present only by the positive report of a medical diagnosis of depression. It is important to emphasize that the data on weight, height, systolic blood pressure, diastolic blood pressure, and fasting serum glucose, self-reported by the participants, were validated [27].

The database was created using Stata software, version 13.0 and exported to IBM®SPSS® software, version 21.0 for statistical analyses. For the descriptive analysis, absolute and relative frequencies were used for the categorical variables, and measures of central tendency and dispersion for the quantitative variables. The normality of quantitative variables was verified using the Kolmogorov-Smirnov test.

To verify the factors associated with food consumption, we started with univariate linear regression analysis and the variables that presented statistical significance in the univariate analysis of less than 20% ($p<0.20$) were selected to be inserted into the multivariate model [11,28]. This, hierarchical input was adopted, as previously described, in the following order: Block 1; Block 2; Block 3.

For interpretation of the results, an association with $p<0.05$ was considered statistically significant, and variables with $p<0.2$ remained in the final models in order to obtain better adjustments. Explanatory power analysis was evaluated using R Square Change; the significance of the model was evaluated using the ANOVA statistic; residuals were also evaluated; the Durbin-Watson test was used to detect independence in the residuals of the regression analysis, with values between 1.5–2.5 being considered as independent; and the normality and homoscedasticity graphs were analyzed.

RESULTS

Considering food consumption, total energy (non-parametric variable) is best described by the median, which presented a value of 2,224 kcal and an Interquartile Range (IQ) of 1,108 kcal.

In a percentage of 100% of the total energy contribution of the 3 groups, each had the following contribution: Group 1, 65.5% (95% CI: 65.2-65.9%); Group 2, 10.0% (95% CI: 9.8-10.2%); Group 3, 24.5% (95% CI: 24.1-24.8%). In order to describe the food consumption of the sample in more detail, the energy contribution was grouped into subgroups (Table 1).

The population of the present study had a minimum age (non-parametric variable) of 20 years and a maximum of 86 years, with a median of 34 years and an IQ of 12 years. Most were female (68.1%), not legally married or without a stable union (51.9%), and white skin color (65.1%). The minimum education level was undergraduate, which is characteristic of this population, and 72.5% of the individuals had graduate-level degrees. Regarding income, 52.4% of the participants had an individual income equal to or greater than 5 x MW, and 78.6% had a family income equal to or greater than 5 x MW. Considering their behavioral characteristics, 55.8% of the individuals were active, 41.6% presented alcohol abuse, and 8.6% reported currently smoking. Regarding self-perception of health, most of the sample (88.5%) self-reported their health status as very good or good. Regarding the presence of NCD, 11.7% were obese, 12.1% had SAH, 3.1% had DM, and 12.4% reported a medical diagnosis of depression (Table 2).

Table 1 – Food consumption, according to the degree of processing, of participants in the baseline of the Cohort of Universities of Minas Gerais – CUME Project, 2016/2018.

Food groups and consumables	Energy contribution (% DEI)	
	Mean	95% CI
Group 1: In natura food [§]	65.5	(65.2-65.9)
Rice	4.5	(4.4-4.6)
Noodles	0.9	(0.9-1.0)
Legumes	3.9	(3.8-4.0)
Roots and Tubers	1.7	(1.6-1.7)
Vegetables	2.1	(2.0-2.1)
Fruits	12.8	(12.5-13.1)
Natural fruit juice	2.3	(2.3-2.4)
Coffee, teas, and *chimarrão*	0.7	(0.7-0.8)
Milk	3.3	(3.2-3.4)
Beef and pork	9.3	(9.1-9.6)
Chicken meats	4.2	(4.1-4.3)
Fish meats	1.7	(1.6-1.8)
Eggs	1.4	(1.4-1.5)
Culinary preparations [a]	2.0	(1.9-2.1)
Fried preparations [b]	1.8	(1.7-1.9)
Added sugar	1.7	(1.6-1.8)
Oils and fats [c]	4.6	(4.5-4.7)
Other in natura foods [†] [d]	6.3	(6.1-6.5)
Group 2: Processed foods	10.0	(9.8-10.2)
French bread	3.3	(3.2-3.4)
Cheeses	3.4	(3.3-3.5)
Processes meats [e]	0.7	(0.7-0.8)
Fruit jams and jellies	0.5	(0.5-0.6)
Processed alcoholic beverages [f]	2.0	(1.9-2.1)
Group 3: Ultra-processed foods	24.5	(24.1-24.8)
White bread	1.1	(1.1-1.2)
Others types of bread [g]	5.7	(5.6-5.9)
Margarine, mayonnaise, and cream cheese	2.3	(2.2-2.4)
Sausages [h]	2.2	(2.1-2.3)
Fast foods [i]	2.3	(2.2-2.4)
Ready or semi-ready dishes [j]	1.9	(1.9-2.0)
Sweetened dairy drinks	1.2	(1.2-1.3)
Soft drinks and industrialized juices	1.5	(1.5-1.6)
Ultra-processed alcoholic beverages [k]	0.3	(0.3-0.4)
Sweets [l]	3.4	(3.3-3.5)
Other ultra-processed foods [m]	2.3	(2.2-2.4)

Note: [§] In natura, minimally processed foods, culinary preparations and culinary ingredients; [†] Other in natura, minimally processed foods and culinary ingredients; [a] Meatballs, hominy, gnocchi, polenta/cornmeal, noodle or rice soups; [b] Polenta, cassava, and French fries; [c] Olive oil, canola, soybean, sunflower, and corn oils, butter, pork fat; [d] Cassava flour, corn flour, acai pulp, raisins, peanuts, nuts, chestnuts, shrimp, offal, textured soy protein, sushi, oats, granola, peppers, and honey; [e] Smoked meats, dried meat, sardines and canned tuna, cod; [f] Beers and wines; [g] Toast, whole grain bread, light bread, sweet bread, cheese bread; [h] Mortadella, turkey breast, sausage links, sausage, bacon; [i] Hot dogs, hamburgers, fried and baked snacks; [j] Lasagna, pizza; [k] Cachaça, distilled beverages; [l] Chocolates, bonbons, candies, ice creams, puddings, dulce de leche, rice pudding, other non-fruit sweets; [m] Breakfast cereals, cereal bars, chocolate milk, mustard, soluble soy extract, popcorn, snacks, and chips. CI: Confidence Interval; DEI: Daily Energy Intake.

Table 3 presents the final hierarchical model, with the consumption outcome for Group 1. In Block 1, marital status was the only socioeconomic factor that remained in the final model, in which the association was negative in relation to individuals who were unmarried or without a stable union (B:-0.76; p=0.049). From Block 2, the physical activity variable (B:2.56; p<0.001) was positively associated, while alcohol abuse (B:-2.50; p<0.001) and tobacco use (smoker) (B:-1.64; p=0,014) were negatively associated. Regarding Block 3, female gender (B:1.51; p=0.001), "non-white" skin color (B:1.71; p<0.001), and age (B:0.19; p<0.001) were positively associated. Regarding the presence of NCD, a positive association was observed with DM (B:2.12; p=0.049) and a negative one with obesity (B:-2.65; p<0.001) and depression (B:-1.91; p=0.001).

Table 2 – Profile of baseline participants of the Cohort of Universities of Minas Gerais - CUME Project, 2016/2018.

Variable	n	%
Block 1 - Socioeconomic Factors		
Marital Status		
Married legally or in a stable union	1,982	48.1
Not Married/No Stable Union	2,142	51.9
Education		
Graduate	1,136	27.5
Graduate degrees	2,988	72.5
Professional situation		
Works	3,127	75.8
Does not work	997	24.2
Individual Income		
<5 x MW	1,965	47.6
≥5 x MW	2,159	52.4
Family Income		
<5 x MW	884	21.4
≥5 x MW	3,240	78.6
Block 2 - Behavioral Factors		
Physical Activity		
Inactive or Insufficiently	1,823	44.2
Active	2,301	55.8
Binge Drinking		
No	2,409	58.4
Yes	1,715	41.6
Tobacco use		
No	3,769	91.4
Yes	355	8.6
Block 3 – Individual Factors		
Sex		
Male	1,316	31.9
Female	2,808	68.1
Skin Color		
White	2,683	65.1
Non- White	1,441	34.9
Self-reported Health Status		
Very Good/Good	3,645	88.5
Fair/Poor/Very Bad	473	11.5
Presence of Obesity		
No	3,640	88.3
Yes	482	11.7
Presence of Systemic Arterial Hypertension		
No	3,626	87.9
Yes	498	12.1
Presence of diabetes *Mellitus*		
No	3,996	96.9
Yes	128	3.1
Presence of Depression		
No	3,611	87.6
Yes	513	12.4

Note: MW: Minimum Wage R$ 880,00 in 2016; R$ 954,00 in 2018. IQ: Interquartile Range.

Table 4 presents the final hierarchical model, with the outcome of food consumption for Group 2. In Block 1, no variable remained in the final model. In Block 2, the physical activity variable (B:-0.56; p=0.002) was negatively associated with the consumption of food in Group 2, while alcohol abuse (B:2.41; p<0.001) and tobacco use (smoker) (B:1.39; p<0.001) were positively associated. In relation to Block 3, female gender (B:-1.18; p<0.001), "non-white" skin color (B:-0,53; p=0.004) and age (B:0.06; p<0.001) were associated with the increase in energy from the consumption of food in Group 2.

Table 3 – Hierarchical model of factors associated with food consumption, according to the percentage of energy consumption of in natura, minimally processed foods, culinary preparations and culinary ingredients, of baseline participants of the Cohort of Universities of Minas Gerais - CUME Project, 2016/2018.

Variable	Group 1 – In natura foods §		
	B	(CI 95%)	*p*-value
Block 1 - Socioeconomic Factors			
Marital Status			
(Reference category: Married Legally or in a Stable Union)			
Not Married/No Stable Union	-0.76	(-1.52; -0.03)	0.049*
Block 2 - Behavioral Factors			
Physical Activity			
(Reference category: Inactive or Insufficiently active)			
Active	2.56	(1.82; 3.30)	<0.001*
Binge Drinking			
(Reference category: No)			
Yes	-2.50	(-3.27; -1.75)	<0.001*
Tobacco use			
(Reference category: No)			
Yes	-1.64	(-2.95; -0.33)	0.014*
Block 3 – Individual Factors			
Sex			
(Reference category: male)			
Female	1.51	(0.72; 2.31)	0.001*
Age			
(Continuous variable)	0.19	(0.14; 0.23)	<0.001*
Skin Color			
(Reference category: white)			
Non-White	1.71	(0.96; 2.46)	<0.001*
Self-reported Health Status			
(Reference category: Very Good/Good)			
Fair/Poor/Very Bad	-1.003	(-2.19; -0.18)	0.097
Presence of Obesity			
(Reference category: No)			
Yes	-2.65	(-3.82; -1.47)	<0.001*
Presence of diabetes *Mellitus*			
(Reference category: No)			
Yes	2.12	(0.01; 4.23)	0.049*
Presence of Depression			
(Reference category: No)			
Yes	-1.91	(-3.02; -0.80)	0.001*

Note: *Variables with $p<0.05$. § In natura, minimally processed foods, culinary preparations and culinary ingredients. Multiple Hierarchical Linear Regression. ANOVA ($p<0.001$) / R Square Change= 0.061/ Durbin-Watson=1.97. All graphs were adequate for normality and homoscedasticity. CI: Confidence Interval.

Table 5 presents the final hierarchical model, with the consumption outcome for Group 3. In Block 1, marital status was the only socioeconomic factor that remained in the final model, in which the association was positive for individuals who were unmarried or without a stable union (B:1.004; $p=0.003$). In Block 2, being active (a) was negatively associated (B:-1.98; $p<0.001$). In Block 3, "non-white" skin color (B:-1.20; $p=0.001$) and age (B:-0.24; $p<0.001$) were negatively associated with the increase in energy from the consumption of food in Group 3. Regarding the presence of NCD, there was a positive association with obesity (B:2.58; $p<0.001$) and depression (B:1.88; $p<0.001$) and a negative association with DM (B:-2.03; $p=0.035$).

Table 4 – Hierarchical model of factors associated with food consumption, according to the percentage of energy consumed from processed foods, of participants from the baseline of the Cohort of Universities of Minas Gerais - CUME Project, 2016/2018.

Variable	Group 2 - Processed foods		
	B	(CI 95%)	*p*-value
Block 1 - Socioeconomic Factors			
No variables from this block remained in the final model	–	–	–
Block 2 - Behavioral Factors			
Physical Activity			
(Reference category: Inactive or Insufficiently active)			
Active	-0.56	(-0.92; -0.21)	0.002*
Binge Drinking			
(Reference category: No)			
Yes	2.41	(2.04; 2.78)	<0.001*
Tobacco use			
(Reference category: No)			
Yes	1.39	(0.75; 2.02)	<0.001*
Block 3 – Individual Factors			
Sex			
(Reference category: male)			
Female	-1.18	(-1.56; -0.81)	<0.001*
Age			
(Continuous variable)	0.06	(0.04; 0.08)	<0.001*
Skin Color			
(Reference category: white)			
Non-White	-0.53	(-0.89; -0.16)	0.004*

Note: *Variables with $p<0.05$. Multiple Hierarchical Linear Regression. ANOVA ($p<0.001$) / R Square Change= 0.074/ Durbin-Watson=2.01. All graphs were adequate for normality and homoscedasticity. CI: Confidence Interval.

DISCUSSION

The assessment of food consumption in this study was not limited to factors associated with UPF consumption, but also included the analysis of factors associated with the consumption of processed foods and in natura, minimally processed foods, culinary ingredients and culinary preparations, based on the DGBP [3]. It also considered that this consumption has interaction with different factors, thus applying the hierarchical analysis of associated, socioeconomic, behavioral, and individual factors, and found important associations as shown in the results.

Food consumption, divided into degrees of food processing, presented frequencies similar to other studies with the Brazilian population [8,29,30]. UPF consumption receives attention, as it is directly associated with the presence of NCD [5,6,31] and its consumption is growing at a fast pace globally, especially in high-income countries, where these foods are the main source of daily energy [32]. In the US, the average daily energy contribution found was more than half (58.5%) from UPF [33]. In samples from Canada [34] and the United Kingdom [35], the average daily UPF consumption found was 46.8% and 53%, respectively.

Soft drinks and industrialized juices appear as a marker of an unhealthy diet and may be associated with greater abdominal adiposity and obesogenic eating behaviors [36,37]. The 1.5% daily energy frequency of these drinks in the present study is similar to other Brazilian populations [8,30], and different from the percentage of 4.6% found in a US study [33]. Fast foods also constitute the UPF group and appear in the present study with a mean daily energy contribution of 2.3%. Such foods are frequent in food eaten away from home and may be related to obesity [38]. In a study in Latin America, only Argentina and Venezuela (due to financial crisis) did not observe an increase in the consumption of beverages and UPF sold in retail fast food [39].

Table 5 – Hierarchical model of factors associated with food consumption, according to the percentage of energy consumption of ultra-processed foods, of baseline participants of the Cohort of Universities of Minas Gerais - CUME Project, 2016/2018.

Variable	Group 3 - Ultra-processed foods		
	B	(CI 95%)	*p*-value
Block 1 - Socioeconomic Factors			
Marital Status			
(Reference category: Married Legally or in a Stable Union)			
Not Married/No Stable Union	1.004	(0.33; 1.68)	0.003*
Block 2 - Behavioral Factors			
Physical Activity			
(Reference category: Inactive or Insufficiently active)			
Active	-1.98	(-2.63; -1.33)	<0.001*
Block 3 – Individual Factors			
Age			
(Continuous variable)	-0.24	(-0.27; -0.21)	<0.001*
Skin Color			
(Reference category: white)			
Non-White	-1.20	(-1.87; -0.53)	0.001*
Self-reported Health Status			
(Reference category: Very Good/Good)			
Fair/Poor/Very Bad	1.002	(-0.54; 2.06)	0.063
Presence of Obesity			
(Reference category: No)			
Yes	2.58	(1.54; 3.63)	<0.001*
Presence of diabetes *Mellitus*			
(Reference category: No)			
Yes	-2.03	(-3.92; -0.15)	0.035*
Presence of Depression			
(Reference category: No)			
Yes	1.88	(0.89; 2.86)	<0.001*

Note: *Variables with $p<0.05$. Multiple Hierarchical Linear Regression. ANOVA ($p<0.001$) / R Square Change= 0.069/ Durbin-Watson=1.96. All graphs were adequate for normality and homoscedasticity. CI: Confidence Interval.

Starting with the distal block of socioeconomic factors, both the relative percentage of energy from foods in Group 1 and foods in Group 3 were associated with marital status, while Group 2 was not associated with any factor in this block. This study showed that those married or in a stable relationship tended to consume more foods from Group 1, and less UPF. Canuto et al. [40] reviewed Brazilian surveys, in which only one article found an association with marital status, finding greater consumption of fruits and vegetables, which are in the group of in natura foods. In the USA, a study showed a significant association between UPF consumption and marital status, in which in the last quintile, the total for unmarried individuals tended toward higher UPF consumption [41]. Suggesting that married individuals tend to have a healthier diet than those without a spouse [40].

Considering behavioral factors, physical activity was directly associated with higher food consumption in Group 1, inversely with Group 2, and inversely with Group 3, similar to a study with Brazilians that showed that better food consumption was associated with leisure-time physical activity [42]. Alcohol abuse and tobacco use were associated only with Groups 1 and 2, being inversely with Group 1 food consumption and directly with Group 2, similar to a study conducted with young adults, in which the diet quality index was worse for those who smoked at least once a week, and who were in the habit of consuming alcoholic beverages [43]. In this case it is important to emphasize that 2% of the daily energy intake of Group 2 foods comes from processed alcoholic beverages, which would obviously have a direct association between Group 2 foods and higher alcohol consumption. Another relationship that can be suggested is that tobacco use is associated with alcohol abuse. Such results

may be linked to risk behaviors, among which are the alcohol abuse, cigarette use, low consumption of fruits and vegetables, physical inactivity, and non-use of sunscreen, in which individuals present an average of three health risk behaviors, and these behaviors are interrelated [44].

Regarding individual characteristics, women tended to have a higher percentage of energy from foods in Group 1, and a lower percentage of energy from foods in Group 2, confirming what a review of Brazilian studies shows, that gender is a determinant of food consumption, demonstrating different intake of food groups and micronutrients between men and women [40]. Further demonstrating that the women in the present study have a protective diet, since UPF consumption is associated with excess weight and abdominal obesity, more pronounced in women [41].

The present study found that individuals with "non-white" skin color tended to have better food choices, being directly associated with the consumption of foods from Group 1 and inversely with the consumption of Groups 2 and 3, contrasting with another review, which showed white individuals showing greater consumption of fruits and vegetables [40]. Skin color tends to be associated with the presence of moderate to severe food insecurity [45], which in this study could be related to higher UPF consumption, however other characteristics, such as low education and more precarious socioeconomic conditions are not present to the population of the CUME project. Another important association was age, which was directly associated with the consumption of foods in Groups 1 and 2, and inversely with the consumption of UPF, corroborating other studies [8,46]. Such results may be related mainly to the emergence of UPF, which appear as substitutes for foods from the in natura food group, in 1987-8 [20], the period in which the older individuals in the present study probably already had their eating habits established [8].

Considering NCD, this study did not find a significant association between hypertension and food consumption in the three groups, although in a longitudinal analysis of the CUME Project, the association between UPF consumption and SAH can be observed [47].

However, there was an inverse association of obesity and depression with the consumption of foods in Group 1 and a direct association with the consumption of foods in Group 3. Similar results were found in relation to the higher consumption of UPF linked to higher BMI values and the presence of obesity [48,49]. A study in the USA found that higher UPF consumption was associated with higher BMI [41]. In Australia, research has suggested that UPF negatively impact the intake of all nutrients related to NCD, especially in relation to excess free sugars, total, saturated, and trans fats, and fiber deficiency in these foods [50]. Longitudinal studies in Europe showed an association between UPF consumption and risk for overweight, obesity, and arterial hypertension [51,52].

Regarding depression, the findings were similar in France and Spain, in which the higher consumption of UPF was associated with the presence of depression, suggesting that more studies investigate this association, along with other factors related to diet and mental illness [53,54]. Unhealthy lifestyle habits can be related to both the presence of depression and poor diet quality.

The presence of diabetes in this population was directly associated with the increase in the percentage of energy from Group 1 and inversely with that from Group 3. This finding may be related to the impact of diabetes on the individual's health and the fear of developing comorbidities, causing people with diabetes to choose more appropriate and healthier options [55].

This study presented important results that corroborate the current literature, and some positive points should be noted: 1) the assessment of food consumption was not limited to factors associated with UPF consumption 2) the use of hierarchical analysis made it possible to contemplate the exposure factors at different levels 3) and although the data was collected using a virtual environment, the self-reported data was validated.

However, it should be noted that our study was limited to the baseline of the Cohort of Minas Gerais Universities (CUME Project), presenting a cross-sectional design, which does not allow establishing a causal relationship between exposure and outcome.

CONCLUSION

Energy contribution of Groups 1, 2, and 3 was found to be 65.5%, 10.0%, and 24.5%, respectively. Regarding the factors associated with food consumption, it is noteworthy that Group 1 was positively associated with the practice of physical activity, female gender, age, "non-white" skin color, and the presence of DM; and negatively with unmarried/non-stable marital status, alcohol abuse, tobacco use, presence of obesity, and presence of depression. Considering Group 2, it was positively associated with alcohol abuse, tobacco use, and age; and negatively with physical activity, female gender, and "non-white" skin color. As for Group 3, it was positively associated with a marital status of not married/without a stable union, presence of obesity, and presence of depression; and negatively with physical activity, age, "non-white" skin color, and presence of DM.

REFERENCES

1. World Health Organization. Assessing national capacity for the prevention and control of noncommunicable diseases: Report of the 2019 global survey [Internet]. Geneva: Organization; 2020 [cited 2021 Oct 10]. Available from: https://www.who.int/publications/i/item/9789240002319
2. Malta DC, Silva Jr JB. Brazilian Strategic Action Plan to Combat Chronic Non-communicable Diseases and the global targets set to confront these diseases by 2025: A review. Epidemiol Serv Saude. 2013;22(1):151-64. https://doi.org/10.5123/S1679-49742013000100016
3. Ministério da Saúde (Brasil). Guia alimentar para a população brasileira [Internet]. 2nd ed. Brasília: Ministério; 2014 [cited 2021 Oct 10]. Available from: https://bvsms.saude.gov.br/bvs/publicacoes/guia_alimentar_populacao_brasileira_2ed.pdf
4. Food and Agriculture Organization. Guidelines on the collection of information on food processing through food consumption surveys [Internet]. Rome: Organization; 2015 [cited 2021 Oct 10]. Available from: https://www.fao.org/documents/card/fr/c/a7e19774-1170-4891-b4ae-b7477514ab4e/
5. Elizabeth L, Machado P, Zinöcker M, Baker P, Lawrence M. Ultra-processed foods and health outcomes: A narrative review. Nutrients. 2020;12(7):1955. https://doi.org/10.3390/nu12071955
6. Pagliai G, Dinu M, Madarena MP, Bonaccio M, Iacoviello L, Sofi F. Consumption of ultra-processed foods and health status: A systematic review and meta-analysis. Br J Nutr. 2021;125(3):308-18. https://doi.org/10.1017/S0007114520002688
7. Santos FS, Dias MS, Mintem GC, Oliveira IO, Gigante DP. Food processing and cardiometabolic risk factors: A systematic review. Rev Saude Publica. 2020;54:70. https://doi.org/10.11606/s1518-8787.2020054001704
8. Berti TL, Rocha TFD, Curioni CC, Verly Junior E, Bezerra FF, Canella DS, et al. Food consumption according to degree of processing and sociodemographic characteristics: Estudo Pró-Saúde, Brazil. Rev Bras Epidemiol. 2019;26(22):e190046. https://doi.org/10.1590/1980-549720190046
9. Oliveira RR, Peter NB, Muniz LC. Consumo alimentar segundo grau de processamento entre adolescentes da zona rural de um município do sul do Brasil. Cien Saude Colet. 2021;26(3):1105-14. https://doi.org/10.1590/1413-81232021263.06502019
10. Naspolini NF, Machado PP, Fróes-Asmus CIR, Câmara VM, Moreira JC, Meyer A. Food consumption according to the degree of processing, dietary diversity and socio-demographic factors among pregnant women in Rio de Janeiro, Brazil: The Rio Birth Cohort Study of Environmental Exposure and Childhood Development (PIPA project). Nutr Health. 2021;27(1):79-88. https://doi.org/10.1177/0260106020960881
11. Dahlgren G, Whitehead M. Policies and Strategies to promote social equity in health Stockholm [Internet]. Bryghuspladsen: Institute for Future Studies; 1991 [cited 2021 Oct 10]. Available from: https://core.ac.uk/download/pdf/6472456.pdf

12. Souza DO, Silva SEV, Silva NO. Determinantes Sociais da Saúde: reflexões a partir das raízes da "questão social". Saude Soc. 2013;22(1):44-56. https://doi.org/10.1590/S0104-12902013000100006

13. Silva I, Pais-Ribeiro JL, Cardoso H. Por que comemos o que comemos? Determinantes psicossociais da seleção alimentar. Psic Saude & Doenças. 2008 [cited 2021 Oct 10];9(2):189-208. Available from: https://www.redalyc.org/pdf/362/36219057002.pdf

14. Alexandre VP, Peixoto MRG, Schmitz BAS, Moura EC. Factors associated with the feeding practices of the adult population of Goiânia, Goiás, Brazil. Rev Bras Epidemiol. 2014;17(1):267-80. https://doi.org/10.1590/1415-790X201400010021ENG

15. Gomes Domingos AL, Miranda AEDS, Pimenta AM, Hermsdorff HHM, Oliveira FLP, Dos Santos LC, et al. Cohort Profile: The Cohort of Universities of Minas Gerais (CUME). Int J Epidemiol. 2018;47(6):1743-54. https://doi.org/10.1093/ije/dyy152

16. Schmidt MI, Duncan BB, Mill JG, Lotufo PA, Chor D, Barreto SM, et al. Cohort Profile: Longitudinal Study of Adult Health (ELSA-Brasil). Int J Epidemiol. 2015;44(1):68-75. https://doi.org/10.1093/ije/dyu027

17. Azarias H, Marques-Rocha JL, Miranda A, Santos LC, Gomes-Domingos AL, Hermsdorff HHM, et al. Online food frequency questionnaire from Cohort of Universities of Minas Gerais (CUME project, Brazil): Construction, validity and reproducibility. Front Nutr. 2021;8:709915. https://doi.org/10.3389/fnut.2021.709915

18. Universidade Estadual de Campinas. Tabela Brasileira de Composição de Alimentos (TACO). [Internet]. 4th ed. Campinas: NEPA/UNICAMP; 2011 [cited 2021 Oct 10]. Available from: https://www.nepa.unicamp.br/taco/tabela.php?ativo=tabela

19. United States Department of Agriculture. Composition of Foods Raw, Processed, Prepared USDA National Nutrient Database for Standard Reference, Release 25 [Internet]. Maryland: Department of Agriculture; 2012 [cited 2021 Oct 10]. Available from: https://www.ars.usda.gov/ARSUserFiles/80400525/Data/SR25/sr25_doc.pdf

20. Martins APB, Levy RB, Claro RM, Moubarac JC, Monteiro CA. Increased contribution of ultra-processed food products in the Brazilian diet (1987-2009). Rev Saude Publica. 2013;47(4):656-65. https://doi.org/10.1590/S0034-8910.2013047004968

21. World Health Organization. Who guidelines on physical activity and sedentary behaviour [Internet]. Geneva: Organization; 2020 [cited 2021 Oct 10]. Available from: https://www.who.int/publications/i/item/9789240015128

22. National Institute on Alcohol Abuse and Alcoholism. Drinking Levels Defined [Internet]. Bethesda: Institute; 2015 [cited 2021 Oct 10]. Available from: https://www.niaaa.nih.gov/alcohol-health/overview-alcohol-consumption/moderate-binge-drinking

23. World Health Organization. Obesity: Preventing and managing the global epidemic [Internet]. Geneva: Report of a WHO Consultation on Obesity; 1998. (WHO technical report series; nº 894) [cited 2021 Oct 10]. Available from: https://apps.who.int/iris/handle/10665/42330

24. Organización Panamericana de la Salud. XXXVI Reunióndel Comitê Asesor de Ivestigaciones en Salud – Encuestra Multicêntrica – Salud Beinestar y Envejecimeiento (SABE) en América Latina e el Caribe [Internet]. México: Organización; 2002 [cited 2021 oct 10] Available from: https://iris.paho.org/handle/10665.2/38968

25. Barroso WKS, Rodrigues CIS, Bortolotto LA, Mota-Gomes MA, Brandão AA, Feitosa ADM, et al. Diretrizes Brasileiras de Hipertensão Arterial – 2020. Arq Bras Cardiol. 2021;116(3):516-658. https://doi.org/10.36660/abc.20201238

26. Sociedade Brasileira de Diabetes. Diretrizes Sociedade Brasileira de Diabetes 2019-2020 [Internet]. Clanad: São Paulo; 2019 [cited 2021 Oct 10]. Available from: http://www.saude.ba.gov.br/wp-content/uploads/2020/02/Diretrizes-Sociedade-Brasileira-de-Diabetes-2019-2020.pdf

27. Miranda AES, Ferreira AVM, Oliveira FLP, Hermsdorff HHM, Bressan J, Pimenta AM. Validation of metabolic syndrome and its self reported components in the CUME Study**.** REME. 2017;21:e-10691. https://www.doi.org/10.5935/1415-2762.20170079

28. Victora CG, Huttly SR, Fuchs SC, Olinto MT. The role of conceptual frameworks in epidemiological analysis: A hierarchical approach. Int J Epidemiol. 1997;26(1):224-7. https://doi.org/10.1093/ije/26.1.224

29. Louzada ML, Baraldi LG, Steele EM, Martins AP, Canella DS, Moubarac JC, et al. Consumption of ultra-processed foods and obesity in Brazilian adolescents and adults. Prev Med. 2015;81:9-15. https://doi.org/10.1016/j.ypmed.2015.07.018

30. Instituto Brasileiro de Geografia e Estatística. Pesquisa de Orçamentos Familiares – POF: 2017-2018: Avaliação Nutricional da Disponibilidade Domiciliar de Alimentos no Brasil [Internet]. Rio de Janeiro: Instituto; 2020 [cited 2021 Oct 10]. Available from: https://biblioteca.ibge.gov.br/visualizacao/livros/liv101704.pdf

31. Chen X, Zhang Z, Yang H, Qiu P, Wang H, Wang F, et al. Consumption of ultra-processed foods and health outcomes: A systematic review of epidemiological studies. Nutr J. 2020;19(1):86. https://doi.org/10.1186/s12937-020-00604-1

32. Baker P, Machado P, Santos T, Sievert K, Backholer K, Hadjikakou M, et al. Ultra-processed foods and the nutrition transition: Global, regional and national trends, food systems transformations and political economy drivers. Obes Rev. 2020;21(12):1-22. https://doi.org/10.1111/obr.13126

33. Baraldi LG, Martinez Steele E, Canella DS, Monteiro CA. Consumption of ultra-processed foods and associated sociodemographic factors in the USA between 2007 and 2012: Evidence from a nationally representative cross-sectional study. BMJ Open. 2018;8(3):1-9. https://doi.org/10.1136/bmjopen-2017-020574

34. Nardocci M, Polsky JY, Moubarac JC. Consumption of ultra-processed foods is associated with obesity, diabetes and hypertension in Canadian adults. Can J Public Health. 2021;112(3):421-9. https://doi.org/10.17269/s41997-020-00429-9

35. Adams J, White M. Characterisation of UK diets according to degree of food processing and associations with socio-demographics and obesity: Cross-sectional analysis of UK National Diet and Nutrition Survey (2008–12). Int J Behav Nutr Phys Act. 2015;12:160. https://doi.org/10.1186/s12966-015-0317-y

36. Damiani TF, Pereira LP, Ferreira MG. Consumo de frutas, legumes e verduras na Região Centro-Oeste do Brasil: prevalência e fatores associados. Cien Saude Colet. 2017;22(2):369-82. https://doi.org/10.1590/1413-81232017222.12202015

37. Silva DCGD, Segheto W, Amaral FCDS, Reis NA, Veloso GSS, Pessoa MC, et al. Consumo de bebidas açucaradas e fatores associados em adultos. Cien Saude Colet. 2019;24(3):899-906. https://doi.org/10.1590/1413-81232018243.05432017

38. Bezerra IN, Moreira TM, Cavalcante JB, Souza AM, Sichieri R. Food consumed outside the home in Brazil according to places of purchase. Rev Saude Publica. 2017;51(0):15. https://doi.org/10.1590/S1518-8787.2017051006750

39. Matos RA, Adams M, Sabaté J. Review: The Consumption of Ultra-Processed Foods and Non-communicable Diseases in Latin America. Front Nutr. 2021;8:622714. https://doi.org/10.3389/fnut.2021.622714

40. Canuto R, Fanton M, Lira PIC. Iniquidades sociais no consumo alimentar no Brasil: uma revisão crítica dos inquéritos nacionais. Cien Saude Colet. 2019;24(9):3193-212. https://doi.org/10.1590/1413-81232018249.26202017

41. Juul F, Martinez-Steele E, Parekh N, Monteiro CA, Chang VW. Ultra-processed food consumption and excess weight among US adults. Br J Nutr. 2018;120(1):90-100. https://doi.org/10.1017/S0007114518001046

42. Silva JA, Silva KS, Matias TS, Leal DB, Oliveira ESA, Nahas MV. Food consumption and its association with leisure-time physical activity and active commuting in Brazilian workers. Eur J Clin Nutr. 2020;74(2):314-21. https://doi.org/10.1038/s41430-019-0454-5

43. Castilhos CB, Schneider BC, Muniz LC, Assunção MC. Qualidade da dieta de jovens aos 18 anos de idade, pertencentes à coorte de nascimentos de 1993 da cidade de Pelotas (RS), Brasil. Cien Saude Colet. 2015;20(11):3309-18. https://doi.org/10.1590/1413-812320152011.17822014

44. French S, Rosenberg M, Knuiman M. The clustering of health risk behaviours in a Western Australian adult population. Health Promot J Austr. 2008;19(3):203-9. https://doi.org/10.1071/he08203

45. Marin-Leon L, Francisco PM, Segall-Corrêa AM, Panigassi G. Household appliances and food insecurity: gender, referred skin color and socioeconomic differences. Rev Bras Epidemiol. 2011;14(3):398-410. https://doi.org/10.1590/S1415-790X2011000300005

46. Simões BDS, Barreto SM, Molina MDCB, Luft VC, Duncan BB, Schmidt MI, et al. Consumption of ultra-processed foods and socioeconomic position: A cross-sectional analysis of the Brazilian Longitudinal Study of Adult Health (ELSA-Brasil). Cad Saude Publica. 2018;34(3):e00019717. https://doi.org/10.1590/0102-311X00019717

47. Rezende-Alves K, Hermsdorff HHM, Miranda AES, Lopes ACS, Bressan J, Pimenta AM. Food processing and risk of hypertension: Cohort of Universities of Minas Gerais, Brazil (CUME Project). Public Health Nutr. 2020;6:1-9. https://doi.org/10.1017/S1368980020002074

48. Silva FM, Giatti L, Figueiredo RC, Molina MDCB, Oliveira Cardoso L, Duncan BB, et al. Consumption of ultra-processed food and obesity: Cross sectional results from the Brazilian Longitudinal Study of Adult Health (ELSA-Brasil) cohort (2008-2010). Public Health Nutr. 2018;21(12):2271-79. https://doi.org/10.1017/S1368980018000861

49. Canhada SL, Luft VC, Giatti L, Duncan BB, Chor D, Fonseca MJMD, et al. Ultra-processed foods, incident overweight and obesity, and longitudinal changes in weight and waist circumference: The Brazilian Longitudinal Study of Adult Health (ELSA-Brasil). Public Health Nutr. 2020;23(6):1076-86. https://doi.org/10.1017/S1368980019002854

50. Machado PP, Steele EM, Levy RB, Sui Z, Rangan A, Woods J, et al. Ultra-processed foods and recommended intake levels of nutrients linked to non-communicable diseases in Australia: Evidence from a nationally representative cross-sectional study. BMJ Open. 2019;9(8):e029544. https://doi.org/10.1136/bmjopen-2019-029544

51. Mendonça RD, Lopes AC, Pimenta AM, Gea A, Martinez-Gonzalez MA, Bes-Rastrollo M. Ultra-processed food consumption and the incidence of hypertension in a mediterranean cohort: The seguimiento universidad de Navarra project. Am J Hypertens. 2017;30(4):358-66. https://doi.org/10.1093/ajh/hpw137

52. Mendonça RD, Pimenta AM, Gea A, de la Fuente-Arrillaga C, Martinez-Gonzalez MA, Lopes AC, et al. Ultraprocessed food consumption and risk of overweight and obesity: The University of Navarra Follow-Up (SUN) cohort study. Am J Clin Nutr. 2016;104(5):1433-40. https://doi.org/10.3945/ajcn.116.135004

53. Adjibade M, Julia C, Allès B, Touvier M, Lemogne C, Srour B, et al. Prospective association between ultra-processed food consumption and incident depressive symptoms in the French NutriNet-Santé cohort. BMC Medicine. 2019;17:78. https://doi.org/10.1186/s12916-019-1312-y

54. Gómez-Donoso C, Sánchez-Villegas A, Martínez-González MA, Gea A, Mendonça RD, Lahortiga-Ramos F, et al. Ultra-processed food consumption and the incidence of depression in a Mediterranean cohort: The SUN Project. Eur J Nutr. 2020;59(3):1093-1103. https://doi.org/10.1007/s00394-019-01970-1

55. Zanchim MC, Kirsten VR, Marchi ACB. Consumption of dietary intake markers by patients with diabetes assessed using a mobile application. Cien Saude Colet. 2018;23(12):4199-208. https://doi.org/10.1590/1413-812320182312.01412017

ACKNOWLEDGEMENTS

Thanks to the participants and researchers of the University Cohort of Minas Gerais, Brazil (CUME Project). The complete list of researchers and institutions participating in CUME can be found at <www.projetocume.com.br>.

CONTRIBUTORS

MA MOREIRA and APC CÂNDIDO was responsible for the conception and design, analysis and interpretation. APBM MOREIRA, HHM HERMSDORFF, J BRESSAN and AM PIMENTA was responsible for the analysis and interpretation. All authors approved the final version of the article.