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ARTIGO ORIGINAL

Ultra-processed food consumption and its association with nutritional, functional, and health characteristics in Brazilian elders

Consumo de alimentos ultraprocessados e sua associação com características nutricionais, funcionais e de saúde em idosos brasileiros

Consumo de alimentos ultraprocesados y su asociación con características nutricionales, funcionales y de salud en ancianos brasileños

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Abstract

Aims: to estimate the dietary energy contribution of ultra-processed foods and the association on nutritional dietary profile, nutritional status, chronic disease, and functional capacity of Brazilian elders.
Methods: we performed an epidemiology cross-sectional study conducted with 332 participants (≥60 years old). Food consumption was measured by three 24-h food recall. Foods were classified according to NOVA classification as in natura/minimally processed foods, processed culinary ingredients, processed foods, and ultra-processed foods. Anthropometric variables were used to assess nutritional status, and scales of activities of daily living to assess functional capacity. Chronic diseases were self-reported.
Results: the average daily consumption of energy was 2433,96 kcal, being 10.44% from ultra-processed foods. Elders with higher ultra-processed foods intake showed higher consumption of energy, added sugar, total and saturated fat, and fewer consumption of proteins, fibres, potassium, magnesium, iron, zinc, copper, selenium, B6 vitamin e folate. Most participants were independent for functional capacity, overweight, and very high risk for cardiovascular disease, but no statistical significance was observed. No association was found between ultra-processed foods and nutritional dietary profile, nutritional status, chronic disease, and functional capacity.
Conclusions: elders who had the highest ultra-processed foods consumption had lower diet quality, although no influences on nutritional status and health variables assessed were observed in this sample.
Keywords: aged, frail elderly, nutritional status, chronic disease, eating, industrialized foods.

Resumo

Objetivo: estimar a contribuição energética de alimentos ultraprocessados e a sua associação com o perfil nutricional da dieta, estado nutricional, doenças crônicas e capacidade funcional de idosos brasileiros.
Métodos: foi realizado um estudo epidemiológico transversal com 332 participantes (≥60 anos). O consumo alimentar foi medido pela aplicação de três recordatórios alimentares de 24 horas. Os alimentos foram classificados de acordo com a classificação NOVA em alimentos *in natura*/minimamente processados, ingredientes culinários processados, alimentos processados e alimentos ultra-processados. Variáveis antropométricas foram utilizadas para avaliar o estado nutricional e escalas de atividades de vida diária para avaliar a capacidade funcional. As doenças crônicas foram autorreferidas.

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Resultados: o consumo médio diário de energia foi de 2433,96 kcal, sendo 10,44% provenientes de alimentos ultraprocessados. Idosos com maior consumo de alimentos ultraprocessados apresentaram maior ingestão energética, de açúcar de adição, gordura total e saturada, e menor consumo de proteínas, fibras, potássio, magnésio, ferro, zinco, cobre, selênio, vitamina B6 e folato. A maioria dos participantes era independente para capacidade funcional, apresentavam excesso de peso e risco muito elevado para doenças cardiovasculares, mas não foi observada significância estatística. Não foi encontrada associação entre o consuumo de alimentos ultraprocessados e perfil nutricional da dieta, estado nutricional, doença crônica e capacidade funcional.
Conclusões: idosos que possuíam maior consumo de alimentos ultraprocessados apresentaram menor qualidade da dieta, embora não tenham sido observadas influências sobre o estado nutricional e a saúde nesta amostra.
Palavras-chave: idoso, idoso fragilizado, estado nutricional, doença crônica, ingestão de alimentos, alimentos industrializados.

Resumen

Objetivo: Estimar el aporte energético de los alimentos ultraprocesados y su asociación con el perfil nutricional de la dieta, estado nutricional, enfermedades crónicas y capacidad funcional de ancianos brasileños.
Métodos: Se realizó un estudio epidemiológico transversal con 332 participantes (≥60 años). El consumo de alimentos se promedió aplicando tres registros de alimentos de 24 horas. Alimentos clasificados según la clasificación NOVA, en alimentos naturales/miniprocesados, ingredientes culinarios procesados, alimentos procesados y alimentos ultraprocesados. Se utilizaron variables antropométricas para evaluar el estado nutricional y escalas de actividad vital para evaluar funcionalmente. Las enfermedades crónicas fueron auto reportadas.
Resultados: El consumo diario de energía fue de 2433.96 kcal, 10.44% proveniente de alimentos ultraprocesados. Ancianos con mayor consumo de alimentos ultraprocesados tenía un mayor consumo de energía, azúcar añadida, ingesta total de grasas y menor consumo de proteínas, fibras alimenticias, potasio, magnesio, hierro, zinc, cobre, selenio, vitamina B6 y folatos. La mayoría de los participantes eran independientes para la capacidad funcional, tenían sobrepeso y un riesgo muy alto de enfermedad cardiovascular, pero no se observó significación estadística. No se encontró asociación entre el consumo de alimentos ultraprocesados y el perfil nutricional de la dieta, el estado nutricional, las enfermedades crónicas y la capacidad funcional.
Conclusiones: Los ancianos que tenían un mayor consumo de alimentos ultraprocesados tenían una dieta de menor calidad, aunque en esta muestra no se observaron influencias sobre el estado nutricional y las variables de salud evaluadas.
Palabras clave: anciano, anciano frágil, estado nutricional, enfermedad crónica, ingestión de alimentos, alimentos industrializados.

Introduction

The population's lifestyle has been changing throughout decades mainly after globalization. These changes have affected nutritional status and food choices, particularly by replacing fresh foods to processed and ultra-processed foods (UPFs).[1] Overall, the consumption of UPFs has increased significantly exceeding up to 50% of the energy intake daily in developed countries.[2] In Brazil, around 20.0% of the total energy intake comes from UPFs,[3] and it is expected to rise over the years for age groups.[4] In this sense, the aging curves have also changed, being elderly people with a higher expectancy of life.[5] Therefore, for better healthy life expectancy, the need of knowing the elders' nutritional dietary profile and nutritional status becomes essential in a health scenario.

UPFs are defined as industrially manufactured foods, ready-to-eat formulations made mostly from little or no food. The most ingredients included are sugars, fats, salt, and a large number of additives.[6] Sugary drinks, packaged snacks, breakfast cereals, processed meats, and frozen ready-to-eat meals can be cited as examples of UPFs.[1] This food category is part of NOVA system, based on the degree of processing, which classifies foods and food products into four clearly distinct groups according to the extent and purpose of their industrial processing: in natura/minimally processed foods; processed culinary ingredients; processed foods; and UPFs.[1,2]

Considering that UPFs are unhealthy foods due to poorer nutritional quality,[6-8] it relates to non-communicable diseases (NCDs) such as cancer, type 2 diabetes, and cardiovascular diseases (CVD) along with frailty syndrome in elders.[9-11] Given that elders can be affected by NCDs, and frailty syndrome, losing the autonomy of performing activities of daily life,[2,12–14] the inadequate food consumption associated with a sedentary lifestyle impacts on quality of life and it might raise the morbi-mortality and decrease the healthy life expectancy[12] in this age group.

Although the elders' pattern of food consumption has been previously described in the literature,[15–19] there is a lack of information about elders´ food consumption according to the degree of food processing and its possible effect

on health. Addressing this gap, the present study aims to estimate the dietary energy contribution of ultra-processed food and the association on nutritional dietary profile, nutritional status, chronic disease, and functional capacity.

Methods

Study design

This is an epidemiologic cross-sectional study with a representative sample of elderly residents in Botucatu, Brazil. This study integrates a large cohort study: "Quality of life associated with nutritional aspects in old age". Ethical approval was obtained from Ethical Committee of University of the State of São Paulo (protocol nº 3.111/2009) and it was consistent with the Declaration of Helsinki. All participants provided written informed consent.

Study participants and recruitment

Eligible participants were dwelling elders, 60 years old or above, both sexes, who fully complied the study protocol. Elders unable to walk, with mental disabilities or cognitive mental health, and/or hearing difficulty to answer the questionnaires and those with the impossibility of measuring the variables of interest to the study, were excluded.

Data collection

The data were collected from January 2010 to August 2011 through home visits. Interviews were done using a standardised questionnaire ("Quality of Life, Health and Nutrition Questionnaire) by researchers previously trained. Variable investigates were socioeconomic (sex, age, marital status, income, schooling), occupation (if he/her works or retired), self-reported chronic disease, functional capacity (activities of daily life), and food consumption. The dataset was built in double-entry on Excel to reduce possible typing errors.

Dietary assessment

Food consumption was assessed by three 24-hour food recalls (R24h) of non-consecutive days. All R24h were collected through in-person interviews using the Multiple Pass Method (MPM)[20]. To obtain greater accuracy of the food portions consumed, photo album[21] were used. Food portion sizes were quantified using household measures (e.g., glasses, spoons), standard food portions (e.g., apples, packages), and household measurement books.[22] All questionnaires were reviewed and agreed upon by nutritionists/dietitians.

The nutritional components were identified using the Nutrition Data System for Research (NDS-R) software (Nutrition Coordination Centre, 2010, University of Minnesota, USA). The NDS-R provides most food items systematically disaggregated into their individual components. When homemade and artisanal food recipes were not available on NDS-R®, they were identified using standardised recipes,[22] and the classification was applied to their ingredients. After registry, the calories per day were obtained and data consistency analyses were performed by checking the R24h with less than 800 kcal and greater than 3500 kcal.[15]

Classification of food according to the degree and purpose of processing

All food items were classified into NOVA system.[1] Group one (unprocessed/minimally processed foods) included fresh fruits, leaves, roots, grains, flours, and pasta; pasteurised or powder milk, plain yogurt, meat, eggs; group two (processed culinary ingredients) included table sugar, oils, butter, salt; group three (processed foods) included canned/bottled whole vegetables preserved in brine, simple bread, whole fruits preserved in syrup, some types of processed meat and cheese; and group four (UPFs) included sugary drinks, breakfast cereals, packaged snacks, instant noodles, confectionery; packaged bread reconstituted meat products and pre-prepared frozen or shelf-stable dishes.

After identification of NOVA groups, calories from each food group were calculated as follows: Energy contribution of the food group assessed = Energy from the assessed group x100/ total energy intake. The use of the percentage of caloric

contribution minimises the differences in the total energy intake and makes it possible to assess the exchange of homemade preparations for UPFs.[6]

Anthropometric data

Body weight (kg) and height (m) were measured by trained fieldworkers. Body Mass Index (BMI) was calculated, and its classification was performed according to Pan-American Health Organization[23] criteria.

Midarm circumference (MAC, cm), waist circumference (WC, cm), arm muscle area (AMA, cm), corrected arm muscle area (CAMA, cm^2) and triceps skinfold thickness (TSF, mm), were evaluated. All measurements followed the techniques recommended by Lohman et al. (1988).[24]

Functional capacity

To assess the functional capacity, Katz Index of Independence in Activities of Daily Living (BADLs)[25] and the Lawton Instrumental Activities of Daily Living (IADL)[26] were used. The BADLs are skills required to manage one's basic physical needs, including personal hygiene, dressing, toileting, transferring/ambulating, and eating. The IADLs include more complex activities related to the ability to live independently in the community like managing finances, medications, food preparation, housekeeping, and laundry.[26]

Both scales (BADLs/IADL) were validated for the Brazilian population[27,28]. The summary score of BADLs ranges from 0 (low function, dependent) to 6 (high function, independent). The summary score of IADLs ranges from 7 (low function, dependent) to 21 (high function, independent). The elderly with <17 points were considered dependent.

Statistical analyses

The sample size was calculated assuming an unknown prevalence of people having a good quality of life (50%), an error margin of 5%, and a confidence interval of 95%, totalling a minimum of 365 older people, who were randomly drawn from the population. In case of refusal to participate or death, a new participant was placed.

The variables' normality was assessed by the Shapiro-Wilk test. The median and mean were used as a measure of central tendency, and the interquartile range and standard deviation as a dispersion measure for continuous variables. The variables of food consumption (NOVA) were investigated in categorised in quartiles of energy.

For categorical variables, data are presented in absolute (n) and relative (%) values. Fisher´s Exact Test was used to compare proportions between groups of categorical variables. To analyse the association between a quantitative and a qualitative variable, due to the abnormality of the variables, the Mann-Whitney U test was used. Crude and adjusted logistic regression analyses were performed with an estimate of Prevalence Ratio (PR) and its respective confidence interval (95%CI), using anthropometric measures, functional capacity, and self-reported disease as outcomes. Three adjustment models were used: Model 1- Adjusted for gender; Model 2- Adjusted for age; Model 3- Adjusted for gender and age.

The multiple models were selected by the automated backward method, including all variables with $p<0.20$. For all analyses, the level of significance adopted was $\alpha<5\%$ and were performed using the statistical software STATA, version 14.0.

Results

From 384 elders approached, 332 met the inclusion criteria. Were excluded participants who the interviewers were unable to contact after three attempts on different days (n=9), had died (n=7), or did not participate in all stages of data collection (n=36).

The sample characteristics are presented in **Table 1**. The most prevalent self-reported comorbidity was systemic arterial hypertension (44.68%), followed by type 2 diabetes mellitus (28.81%), hypercholesterolemia (15.51%), osteoporosis (8.59%), and heart disease (7.76%). Regarding functional capacity, elders classified as completely independent through BADL and IADL scales presented a proportion of 89.90% and 67.60%, respectively on those scales.

Table 1 – Sociodemographic characteristics of elderly. Botucatu, Brazil. 2011 (n=332)

Variables	Female (n=206)		Male (n=126)		p-value
Age (years)	72.16±7.11		70.86±7.37		0.0978
	n	%	n	%	
Marital status					
Married/living with a partner	91	44.17	101	80.16	<0.0001
Divorced	10	4.85	5	3.97	
Single	22	10.68	7	5.55	
Widower	83	40.29	13	10.32	
Schooling					
Illiterate	40	19.42	10	7.94	0.0004
Elementary school	131	63.59	75	59.52	
High school	17	8.25	18	14.29	
University	18	8.74	23	18.25	
Labor status					
Working	15	7.28	20	15.87	0.0077
Not working	191	92.72	106	84.13	
Retired					
Yes	173	83.98	116	92.06	<0.0001
No	33	16.02	10	7.94	

p-value: Fisher's exact test with 5% significance level

In natura/minimally processed foods were the most consumed group. Results from NOVA food intake are shown in **Table 2**. Considering the nutritional status by BMI, around 50% (n=168) were overweight (**Table 3**).

The highest quartile (Q4) of energy from UPFs presented the highest total energy consumption (p<0.001) compared to the lowest quartiles (Q1-Q3). A greater amount of added sugar (p<0.001), total fat (p=0.004), saturated fat (p<0.001), and fewer calories from protein sources (p=0.021) were described in Q4. In addition, fibre intake (p=0.003) and some vitamins and minerals intake were lower in the Q4 group (**Table 4**). No association was observed between anthropometric variables, functional capacity, and self-reported chronic diseases with Q4, in the crude and adjusted models (**Table 5**).

Discussion

The consumption of UPFs was not associated to nutritional status, chronic disease, and functional capacity in our sample. However, an effect of its consumption on the nutritional dietary profile was observed. Higher consumption of UPFs was associated to higher consumption of energy, added sugar, total and saturated fats, and lower consumption of dietary fibre, protein sources, vitamins, and minerals.

In our study, UPFs presented 10.44% of energy intake. Compared to other countries, we had found the lowest rate of UPFs consumption among elders, rating from different countries, i.e. Spain (17%),[2] Chile (17.4%),[29] Canada (47.6%)[8] and the UK (51.8%),[30] except for French elders (9.45%).[31] The consumption of UPFs in Brazil is fluctuating over the last two decades. In 2002-2003, the proportion of UPFs was 20.8% of energy intake,[4] in 2008-2009, 25.4%[4] and, in 2017-2018, 19.7%.[3]

Table 2 – Absolute and relative food consumption, according to the NOVA classification of the elderly. Botucatu, Brazil. 2011 (n=332)

NOVA food groups	Kcal/day	% of total energy intake mean
In natura **and minimally processed foods**	**1513.69**	**62.20**
Vegetables	411.74	16.62
Milk and natural yogurt	317.27	13.04
Rice	219.69	9.03
Red meat	210.80	8.67
Potatoes, roots and tubers	123.09	5.06
Fruit[a]	56.82	2.33
Tea and coffee	54.71	2.25
Other cereal, seeds and nuts[b]	32.92	1.35
Poultry meat and fish	31.03	1.27
Beans	29.10	1.20
Eggs	15.73	0.65
Other *in natura* or minimally processed foods	10.79	0.44
Processed culinary ingredients	**415.70**	**17.07**
Vegetable fat[c]	202.4	8.31
Sugars	192.55	7.91
Animal fat[d]	7.09	0.29
Other processed culinary ingredients	13.66	0.56
Processed foods	**250.45**	**10.29**
French bread and French bread toast	104.61	4.30
Canned vegetables[e]	80.52	3.31
Cheese	58.96	2.42
Processed meats[f]	6.36	0.26
Ultra-processed foods	**254.12**	**10.44**
Sugary drinks[g]	87.03	3.58
Candies[h]	8.83	0.36
Packaged salty snacks and cookies	7.11	0.29
Sausage and other reconstituted meat products (ham, bacon)	7.07	0.29
Industrialized breads[i]	3.69	0.15
Packaged pre-prepared meals and fast food[j]	1.86	0.08
Other ultra-processed foods	138.53	5.69
TOTAL	**2.433.96**	**100**

a: Whole fruits, natural juice, and coconut water; b: Corn, flour (wheat, corn, cassava), pasta dish; c: Sunflower oil, corn oil, soy oil, and olive oil; d: Butter, cream, heavy cream, and lard; e: Green corn, palm hearts, and olives; f: Dried meat and canned tuna or sardines; g: Soft drinks, fruit drinks, milk-based drinks; h: Cakes, bonbon, chocolate, deserts, ice cream, whipped cream, caramels, milkshake, and jelly. i: packaged bread, hot dog bread, hamburger bread, packaged toast; j: Frozen and shelf-stable dishes, industrial pizza.

Table 3 – Consumption of ultra-processed foods (quartile of energy) and its relationship with socio-economic and nutritional variables and functional capacity of elderly. Botucatu, Brazil. 2011 (n=332)

Variables	Tota sample (n=332)	Q1-Q3 (n=249)	Q4 (n=83)	p-value
Income (R$)	1581.82±2076.59	1612.09±227.29	1488.86±1533.46	0.508
Age group				
60-69 years	138(41.57)	102(40.96)	36(43.37)	0.751
70-79 years	141(42.47)	105(42.17)	36(43.37)	
≥ 80 years	53(15.96)	42(16.87)	11(13.25)	
Body weight (Kg)	70.94±14.77	71.47±15.17	69.33±13.48	0.234
BMI (Kg/m²)	27.87±5.21	28.02±5.33	27.43±4.83	0.311
Underweight	39(11.75)	32(12.85)	7(8.43)	0.111
Adequate weight	125(37.65)	86(34.54)	39(46.99)	
Overweight	168(50.60)	131(52.80)	39(44.58)	
WC (cm)	98.65±12.85	99.20±13.07	97.01±1210	0.138
Adequate	47(19.92)	33(18.75)	14(23.33)	0.728
High risk for CV disease	93(39.41)	71(40.34)	22(36.67)	
Very high risk for CV disease	96(40.68)	72(40.91)	24(40.00)	
AMA (cm)	24.30±3.58	24.27±3.57	24.40±3.63	0.842
MAC (cm)	29.96±4.47	29.90±4.49	30.17±4.42	0.757
TSF (mm)	18.00±7.99	17.88±7.90	18.35±8.30	0.574
CAMA (cm²)	47.79±13.72	47.64±13.66	48.23±14.00	0.771
IADL	22.71±8.18	23.06±7.82	21.69±9.16	0.261
ADL	5.70±1.99	5.75±1.87	5.57±2.33	0.876

Values presented as mean ± standard deviation of the mean. p-value obtained by Fisher's exact test or *U of Mann-Whitney, both with 5% significance level. BMI= Body Mass Index; WC= waist circumference; CV= cardiovascular; AMA= arm muscle area; MAC= midarm circumference; TSF= triceps skinfold thickness; CAMA= corrected arm muscle area; IADL= Instrumental Activities of Daily Living; ADL= Activities of Daily Living. Q1-Q3= First, second and third quartile of energy from ultra-processed foods; Q4= Fourth quartile of energy from ultra-processed foods.

Regarding to the quality of diet and UPFs, our results were similar to what was previously described by studies across different countries and age groups.[29,32,33] Data from NHANES (National Health and Nutrition Examination Survey), have described a consumption of 56.1% of energy intake from UPFs.[32] Participants in the highest quintile of energy (≥74.2%) had higher energy intake, energy from sugar, and a lower intake of protein and fibre. Chilean population consumed 28.6% of energy from UPFs, presenting a direct linear association between the share of UPFs and the content of added sugar (coefficient for linear term=0.22; 95%CI 0.08, 0.34).[30] French adults[33] (NutriNet-Santé cohort) consumed 35.9% of energy in UFPs and the highest quartile of consumption (>23%) had a higher intake of energy, added sugar, and low intakes of fruits, vegetables, fibre, β-carotene, and calcio (all p<0,0001). A negative impact of UPFs on diet (51.2% of energy intake) was described among young Brazilian adults.[34]

Table 4 – Diet's nutritional profile according to the caloric contribution of the consumption of ultra-processed foods by Brazilian elderly. Botucatu, Brazil. 2011 (n=332)

Variables	Total sample (n=332)	Q1-Q3 (n=249)	Q4 (n=83)	p-value
Total energy intake (Kcal/day)	2337.02±1180.91	2202.43±1175.18	2740.79±1110.12	<0.001
Protein (%)	17.81±4.38	18.07±4.05	17.01±5.18	0.021
Carbohydrate (%)	49.85±9.71	50.43±9.64	48.11±9.76	0.117
Added sugar (%)	7±6.14	6.05±5.17	9.85±7.75	<0.001
Total fat (%)	32.69±7.99	32.01±7.85	34.74±8.11	0.004
Satured fat (%)	10.31±3.34	9.97±3.35	11.31±3.14	<0.001
Dietary fibre (g/1000Kcal)	15.87±18.19	17.11±19.58	12.15±12.56	0.003
Sodium (g/1000 Kcal)	3245.58±10960.08	3545.15±12428.52	2346.88±4077.46	0.057
Potassium (mg/1000 Kcal)	1461.33±525.03	1515.74±506.67	1298.13±548.07	<0.001
Calcium (mg/1000 Kcal)	358.52±177.42	353.58±165.99	373.36±208.41	0.566
Magnesium (mg/1000 Kcal)	142.4±47.08	145.73±42.16	132.41±58.62	0.001
Iron (mg/1000 Kcal)	7.98±3.68	8.12±2.67	7.56±5.73	<0.001
Zinc (mg/1000 Kcal)	5.87±1.66	5.97±1.51	5.58±2.04	0.008
Cupper (mg/1000 Kcal)	0.68±0.49	0.71±0.54	0.58±0.25	0.001
Selenium (mcg/1000 Kcal)	69.58±52.79	71.88±59.97	62.68±17.45	0.009
Vitamin A (IU/1000 Kcal)	5622.39±9298.22	5900.55±9556.5	4787.89±8476.07	0.433
Vitamin D (mcg/1000 Kcal)	2.19±1.74	2.22±1.68	2.13±1.94	0.537
Vitamin K (mcg/1000 Kcal)	112.83±692.23	76.77±64.96	220.99±1380.48	0.546
Vitamin C (mg/1000 Kcal)	69.62±138.59	67.11±131.01	77.16±159.85	0.275
Vitamin B1 (mg/1000 Kcal)	0.85±0.19	0.86±0.18	0.81±0.23	0.005
Vitamin B2 (mg/1000 Kcal)	0.84±0.27	0.85±0.27	0.83±0.25	0.766
Vitamin B3 (mg/1000 Kcal)	11.09±3.98	11.16±3.65	10.87±4.85	0.059
Vitamin B5 (mg/1000 Kcal)	2.67±0.81	2.71±0.71	2.54±1.07	0.005
Vitamin B6 (mg/1000 Kcal)	0.97±0.34	0.99±0.33	0.90±0.35	0.020
Folate (mcg/1000 Kcal)	214.66±83.41	220.46±57.33	197.24±133.18	<0.001
Vitamin B12 (mcg/1000 Kcal)	3.88±5.84	4.22±6.45	2.84±3.26	0.416

Values presented as mean ± standard deviation of the mean. p-value obtained by Fisher's exact test or *U of Mann-Whitney, both with 5% significance level. Q1-Q3= First, second and third quartile of energy from ultra-processed foods; Q4= Fourth quartile of energy from ultra-processed foods.

Table 5 – Crude and adjusted analyses of association between the dietary contribution of ultra-processed food (Q4) and nutritional variables, functional capacity and self-reported chronic disease of the elderly. Botucatu. Brazil. 2011

Variables	Crude PR (IC95%)	p-value	Model 1	p-value	Model 2	p-value	Model 3	p-value
Body weight (kg)	1.00 (0.98-1.01)	0.322	0.99 (0.97-1.01)	0.238	0.99 (0.97-1.00)	0.232	0.99 (0.97-1.00)	0.173
BMI (kg/m^2)	0.99 (0.94-1.03)	0.435	0.98 (0.94-1.03)	0.444	0.98 (0.94-1.02)	0.387	0.98 (0.94-1.02)	0.394
WC (classification)	0.99 (0.97-1.01)	0.244	0.99 (0.97-1.01)	0.212	0.99 (0.97-1.00	0.225	0.99 (0.97-1.00)	0.199
AMA (cm)	1.00 (0.95-1.07)	0.801	1.00 (0.94-1.07)	0.880	1.00 (0.94-1.07)	0.919	1.00 (0.94-1.07)	0.983
MAC (cm)	1.01 (0.96-1.06)	0.676	1.01 (0.96-1.06)	0.675	1.01 (0.96-1.06)	0.785	1.01 (0.96-1.06)	0.782
TSF (mm)	1.00 (0.97-1.03)	0.979	1.01 (0.98-1.04)	0.533	1.00 (0.98-1.03)	0.729	1.01 (0.98-1.04)	0.595
CAMA (cm^2)	1.00 (0.99-1.02)	0.766	1.00 (0.98-1.01)	0.841	1.00 (0.98-1.02)	0.886	1.00 (0.98-1.02)	0.947
IADL	0.98 (0.96-1.00)	0.254	0.98 (0.96-1.01)	0.243	0.98 (0.96-1.06)	0.157	0.98 (0.96-1.01)	0.152
ADL	0.97 (0.87-1.07)	0.526	0.97 (0.87-1.07)	0.530	0.97 (0.87-1.07)	0.521	0.97 (0.87-1.07)	0.522
Hypertension	1.09 (0.76-1.56)	0.633	1.09 (0.75-1.57)	0.642	1.11 (0.77-1.61)	0.571	1.11 (0.77-1.60)	0.580
Diabetes	0.96 (0.71-1.30)	0.790	0.96 (0.71-1.30)	0.801	0.96 (0.71-1.30)	0.806	0.96 (0.71-1.30)	0.814
Coronary disease	0.99 (0.76-1.28)	0.947	0.99 (0.76-1.28)	0.948	0.99 (0.76-1.28)	0.925	0.99 (0.76-1.28)	0.926
Thyroid dysfunction	1.02 (0.79-1.32)	0.844	1.02 (0.79-1.32)	0.853	1.02 (0.79-1.33)	0.836	1.03 (0.79-1.32)	0.843
Dyslipidemia	1.01 (0.78-1.32)	0.919	1.01 (0.78-1.32)	0.924	1.01 (0.78-1.32)	0.916	1.01 (0.96-1.06)	0.920
Osteoporosis	1.03 (0.79-1.33)	0.842	1.03 (0.79-1.33)	0.859	1.03 (0.79-1.32)	0.872	1.02 (0.79-1.32)	0.884

Logistic regression with estimation of the Prevalence Ratio (PR) and its respective confidence interval (95%CI). using as outcomes anthropometric measures, functional capacity, and self-reported chronic diseases. Model 1- Adjusted for sex; Model 2- Adjusted for age; Model 3 – Adjusted for sex and age. BMI= Body Mass Index; WC= waist circumference; CV= cardiovascular; AMA= arm muscle area; MAC= midarm circumference; TSF= triceps skinfold thickness; CAMA= corrected arm muscle area; IADL= Instrumental Activities of Daily Living; ADL= Activities of Daily Living.

Louzada et al. (2015)[6] assessed diet among Brazilians aged 10 years or more and found that UPFs intake had 2.5 times more energy/g, 1.5 times more total and sutured fat, 8.0 times more trans-fat, and 2.0 times more sugar than the fraction of the diet concerning natural/minimally processed food. In addition, UPFs group had 3.0 times less fibre, 2.0 times less protein, and 2.5 less potassium.[35]

The poor diet characteristics of UPFs contribute to the development of overweight and NCDs.[2,11,35]

Possibly, it occurs because of UPFs components contribute negatively to the body's energy balance regulation,[36] due to excessive consumption of added sugar and fats leading to more energy storaged.[37] However, we did not observe it in our sample and a possible explanation for it can be due to the small amount of energy consumed from UPFs when compared to other studies.[2,8,29,33] Evidence described a dose-response relationship between UPFs and health outcomes.[35] An increase of 10% in the consumption of UPFs was associated with an increase of 17% and 18% in obesity prevalence among women and men, respectively. Louzada et al (2015)[7] showed that, among Brazilian elders, the risk of becoming obese starts to be significant when energy from UPFs is above 10% (OR=1.65; 95%CI=1.14,2.38; P<0.001), presenting a higher risk when this contribution rises to 37% (OR=2.62; 95%CI=1.22,5.64; P<0,001). These results may indicate that our sample is on the limit of having nutritional status affected and it can suggest that health professionals can work on this age population for avoiding further negative outcomes across aging.

In natura/minimally processed foods represented more than half of the energy consumed by the elders studied. Pereira et al (2020)[18] in a population-based study, using microdata from National Health Policy 2013, described a healthy dietary pattern among Brazilian elders, characterised by higher consumption of vegetables, fruits, milk, and chicken. This fact could be attributed to the presence of traditional food culture among Brazilian elders, based on this source of food and homemade products.[18,24,33] Thus, it is noted that the consumption of fruits and vegetables increases with the advancing of age, while the consumption of soft drinks and UPFs decreases. In addition, the food guide for the Brazilian Population, based on regional and cultural characteristics, promotes healthy practices of a diet based on in natura/minimally processed food in all age groups.[1]

Besides the eating habits, low income can also contribute to this food choice. From 1995 to 2017, the price of UPF (R$ 6.92/kg) was higher than unprocessed or minimally processed foods (R$ 4.28/kg), aspect that could facilitate the consumption of this food group[38]. However, the price of unprocessed or minimally processed foods increased continuously during this period (1995-2017) and, after the COVID-19 pandemic, with high world inflation that affects food, prices tend to get even higher. It is expected that, in 2030, UPF (R$ 6.62/kg in 2017 to R$ 4.34/kg in 2030) become cheaper than healthy foods (R$ 4.69/kg in 2017 to R$ 5.24/kg in 2030)[38].

It is important to point out the protein intake. The higher proportion of UPFs is associated to lower consumption of protein, especially for elderly people.[7] and it was observed in our data, however, it was not observed association between the consumption of UPFs and functionality. An inadequate protein intake among elders can increase the risk of compromising the muscle mass level.[39] It can decrease functionality and increases the risk of falls, fractures, hospitalization, death, and is more likely to be accentuated in the aging process.[39]

Our study showed several strengths. First, the use of NOVA food classification system has been recognised to be a valid tool for nutrition and public health research and policy.[40] Second, studying the association between NOVA items and elders' nutrition and functional capacity has not been well described in the literature. Third, we used three 24-hour food records. This method is recommended to be used in large epidemiological studies and enables us to have a more reliable estimation of a usual diet. Finally, the use of NDS-R® to analyse nutrition data is another high-quality aspect, as it shows the disaggregation of dishes into underlying ingredients and provides an estimative of UPFs' dietary contributions.

Limitations of the study include potential biased sources. The elderly's memory is needed and, to reduce this possible sort of bias, photo albums were used. Additionally, recipes for preparations not included on the NDS-R® were added (i.e., traditional Brazilian cuisine) which has the odds of not representing the same food intake. Lastly,

because of the study design, causality was not possible to be investigated.

Conclusions

In this sample of Brazilian elders, the consumption of UPF was below the national average and also below the values described for elderly people in other countries, however, the elders placed in the highest quartile of consumption of UPFs had lower quality of diet, considering the reduced intake of protein, fibre, minerals, and vitamins, and higher energy intake, added sugar, total and saturated fat. Despite the lower quality of diet, the consumption of UPF was not associated to the nutritional status, chronic disease, and functional capacity of Brazilian elders.

Authorship

The concept of the study was formulated by LBS and RAB. The methodology design was done by LBS with the assistance and guidance of LVG, RAB, and RMS. The data collection was done by LBS, and RAB. RMS conducted the data analysis, and the interpretation of the results was discussed in consultation with all authors. The author team was responsible for writing, reviewing, and approving the final version of this manuscript.

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Conflicts of interest

The authors declare no conflict of interest.

References

1. Brasil. Guia Alimentar para a População Brasileira [Internet]. 2. ed. Brasília: Ministério da Saúde; 2014 [cited 2020, Mar 18]. Disponível em: www.saude.gov.br/bvs.

2. Sandoval-Insausti H, Jiménez-Onsurbe M, Donat-Vargas C, Rey-García J, Banegas JR, Rodríguez-Artalejo F et al. Ultra-Processed Food Consumption Is Associated with Abdominal Obesity: A Prospective Cohort Study in Older Adults. Nutrients [Internet]. 2020 Aug 7 [cited 2021 Oct 5];12(8):2368-78. Available from:http://doi.10.3390/nu12082368.

3. Instituto Brasileiro de Geografia e Estatística (IBGE). Pesquisa de Orçamentos Familiares 2017-2018 : análise do consumo alimentar pessoal no Brasil [Internet]; 2020 [cited 2020 Dec 10]. Available from: https://biblioteca.ibge.gov.br/visualizacao/livros/liv101742.pdf.

4. 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.

5. Instituto Brasileiro de Geografia e Estatística (IBGE). Projeção da população [Internet].2021 [cited 2021 Oct 6]. Available from: https://www.ibge.gov.br/apps/populacao/projecao/index.html.

6. Louzada MLC, Martins APB, Canella DS, Baraldi LG, Levy RB, Claro RM et al. Ultra-processed foods and the nutritional dietary profile in Brazil. Rev Saude Publica [Internet]. 2015 [cited 2021, Mar 18];49:38-48. Available from: http://doi.10.1590/S0034-8910.2015049006132

7. Louzada MLC, Baraldi LG, Steele EM, Martins AP, Canella DS, Moubarac JC, Levy RB, Cannon G, Afshin A, Imamura F, Mozaffarian D, Monteiro CA. Consumption of ultra-processed foods and obesity in Brazilian adolescents and adults. Prev Med. [Internet]. 2015 [cited 2020, Oct 20];81:9-15. Available from: http://doi.10.1016/j.ypmed.2015.07.018.

8. Moubarac JC, Martins AP, Claro RM, Levy RB, Cannon G, Monteiro CA. Consumption of ultra-processed foods and likely impact on human health. Evidence from Canada. Public Health Nutr. [Internet]. 2013 [cited 2020, Oct 21];16(12):2240-8. Available from: http://doi.10.1017/S1368980012005009.

9. Lawrence MA, Baker PI. Ultra-processed food and adverse health outcomes. BMJ [Internet]. 2019 [cited 2021, Mar 18];365:2289. Available from: http://doi.10.1136/bmj.l2289.

10. Meneguelli TS, Hinkelmann JV, Hermsdorff HHM, Zulet MÁ, Martínez JA, Bressan J. Food consumption by degree of processing and cardiometabolic risk: a systematic review. Int J Food Sci Nutr. [Internet]. 2020 [cited 2021, Mar 21];71:678-92. Available from: http://doi.10.1080/09637486.2020.1725961.

11. Chen X, Zhang Z, Yang H, Peishan Q, Haizhou W, Fan W et al. Consumption of ultra-processed foods and health outcomes: A systematic review of epidemiological studies. Nutr J. [Internet]. 2020 [cited 2021, Nov 03];19:86-96. Available from: https://doi.org/10.1186/s12937-020-00604-1.

12. Dalla Lana L, Herberto Schneider R. The frailty syndrome in elderly: a narrative review. Rev Bras Geriatr Gerontol. [Internet]. 2014 [cited 2021, Mar 21];17(3):673-80. Available from: http://doi.10.1590/1809-9823.2014.12162.

13. Veras R. Envelhecimento populacional contemporâneo: Demandas, desafios e inovações. Rev Saude Publica [Internet]. 2009 [cited 2021, Mar 18];43(3): 548-54. Available from: https://doi.org/10.1590/S0034-89102009005000025.

14. World Health Organization (WHO). Noncommunicable diseases prematurely take 16 million lives annually, WHO urges more action. Genebra: WHO; 2015.

15. Assumpção D, Domene SMA, Fisberg R, Barros MBA. Qualidade da dieta e fatores associados entre idosos:estudo de base populacional em Campinas, São Paulo, Brasil. Cad Saúde Pública [Internet]. 2014 [cited 2020, Nov 03];30:1680-1694. Available from: http://dx.doi.org/10.1590/0102-311X00009113.

16. Silveira EA, Martins BB, de Abreu LRS, Cardoso CKS. Baixo consumo de frutas, verduras e legumes: Fatores associados em idosos em capital no Centro-Oeste do Brasil. Cienc Saude Colet. [Internet] 2015 [cited 2020, Nov 03];20:3689-3699. Available from: https://doi.org/10.1590/1413-812320152012.07352015.

17. Gomes AP, Soares ALG, Gonçalves H. Baixa qualidade da dieta de idosos: estudo de base populacional no sul do Brasil. Cien Saude Colet. [Internet]. 2016 [cited 2020, Nov 03];21(11):3417-28. Available from: https://doi.org/10.1590/1413-812320152111.17502015.

18. Pereira IFS, Vale D, Bezerra M, Lima KC, Roncalli AG, Lyra CO. Padrões alimentares de idosos no Brasil: Pesquisa Nacional de Saúde, 2013. Cien Saúde Colet. [Internet]. 2020 [cited 2020, Nov 04];25(3):1091-102. Available from: https://dx.doi.org/10.1590/1413-81232020253.01202018.

19. Brasil. Ministério da Saúde. Secretaria de Vigilância em Saúde. VIGITEL 2019: Vigilância de Fatores de Risco e Proteção para Doenças Crônicas por Inquérito Telefônico [Internet]. 2020 [cited 2020, December 10]. Available from: http://bvsms.saude.gov.br/bvs/publicacoes/vigitel_brasil_2019_vigilancia_fatores_risco.pdf.

20. Moshfegh AJ, Rhodes DG, Baer DJ, Murayi T, Clemens JC, Rumpler WV et al. The US Department of Agriculture Automated Multiple-Pass Method reduces bias in the collection of energy intakes. Am J Clin Nutr. [Internet] 2008 Aug [cited 2020, March 18];88(2):324-32. Available from: http://doi.10.1093/ajcn/88.2.324.

21. Lopes R, Botelho R. Álbum fotográfico de porções alimentares. 1. ed. São Paulo, Brasil: Editora Metha; 2013.

22. Pinheiro ABV, Lacerda EMA, Benzecty EH, et al. Tabela para Avaliação de Consumo Alimentar em Medidas Caseiras. 5. ed. Rio de Janeiro, Brasil: Editora Atheneu; 2008.

23. Pan-American Health Organisation (PAHO). Encuesta Multicéntrica salud bienestar y envejecimiento (SABE) en América Latina y el Caribe: Informe Preliminar. Washington D.C: OPAS; 2002.

24. Lohman TG, Roche AF, Martorell R. Anthropometric standardization reference manual. Champaign, IL: Human Kinetics Books; 1988.

25. Katz S, Ford AB, Moskowitz RW, Jackson BA, Jaffe MW. Studies of Illness in the Aged. JAMA [Internet]. 1963 [cited 2021, Mar 03];185:914-29. Available from: http://doi.10.1001/jama.1963.03060120024016.

26. Lawton MP, Brody EM. Assessment of Older People: Self-Maintaining and Instrumental Activities of Daily Living. Gerontologist [Internet] 1969 [cited 2021, Mar 03];9:179-186. Available from: https://doi.org/10.1093/geront/9.3_Part_1.179

27. Lino VTS, Pereira SRM, Camacho LAB, Ribeiro Filho ST, Buksman S. Cross-cultural adaptation of the Independence in Activities of Daily Living Index (Katz Index). Cad Saude Publica [Internet]. 2008 [cited 2021, Mar 03];24(1):103-12. Available from: https://dx.doi.org/10.1590/S0102-311X2008000100010.

28. Santos RL, Virtuoso Júnior JS. Confiabilidade da versão brasileira da escala de atividades instrumentais da vida diária. RBPS. 2008;21(4):290-6.

29. Cediel G, Reyes M, Louzada MLC, Steele EM, Monteiro CA, Corvalán C et al. Ultra-processed foods and added sugars in the Chilean diet (2010). Public Health Nutr. [Internet]. 2018 [cited 2020, Nov 03];21(1):125-33. Available from: http://doi.10.1017/S1368980017001161.

30. Rauber F, Steele EM, Louzada MLDC, Millett C, Monteiro CA, Levy RB. Ultra-processed food consumption and indicators of obesity in the United Kingdom population (2008-2016). PLoS One. [Internet]. 2020 May [cited 2021, Mar 04];15(5):e0232676. Available from: http://doi.10.1371/journal.pone.0232676.

31. Fardet A, Méjean C, Labouré H, Andreeva VA, Feron G. The degree of processing of foods which are most widely consumed by the French elderly population is associated with satiety and glycemic potentials and nutrient profiles. Food Funct [Internet]. 2017 [cited 2021, Mar 04];8:651-8. Available from: http://doi.10.1039/c6fo01495j.

32. Juul F, Martinez-Steele E, Parekh N, Monteiro CA, Chang VW. Ultra-processed food consumption and excess weight among US adults. Br J Nutr. [Internet] 2018 [cited 2021, Mar 03];120(1):90-100. Available from: http://doi.10.1017/S0007114518001046.

33. Julia C, Martinez L, Allès B, Touvier M, Hercberg S, Méjean C et al. Contribution of ultra-processed foods in the diet of adults from the French NutriNet-Santé study. Public Health Nutr. [Internet]. 2018 [cited on 2021, Mar. 04];21(1):27-37. Available from: http://doi.10.1017/S1368980017001367.

34. Bielemann RM, Motta JV, Minten GC, Horta BL, Gigante DP. Consumption of ultra-processed foods and their impact on the diet of young adults. Rev Saude Publica [Internet]. 2015 May [cited 2021, Mar 02];49:28-38. Available from: http://doi:10.1590/s0034-8910.2015049005572.

35. Louzada MLDC, Ricardo CZ, Steele EM, Levy RB, Cannon G, Monteiro CA. The share of ultra-processed foods determines the overall nutritional quality of diets in Brazil. Public Health Nutr. [Internet]. 2018 [cited 2021, Mar 04];21(1):94-102. Available from: http://doi.10.1017/S1368980017001434.

36. Vernarelli JA, Mitchell DC, Rolls BJ, Hartman TJ. Dietary energy density and obesity: how consumption patterns differ by body weight status. Eur J Nutr. [Internet] 2018 [cited 2021, Mar 02];57: 351-61.Available from: http://doi.10.1007/s00394-016-1324-8.

37. González-Muniesa P, Mártinez-González MA, Hu F, Després, JP, Matsuzawa Y, Loos RJF et al. Obesity. Nat Rev Dis Primers. [Internet]. 2017 [cited on 2021, Mar 04];3:17034-52. Available from: https://doi.org/10.1038/nrdp.2017.34.

38. Maia E, Dos Passos C, Levy R, Martins APB, Mais L, Claro R. What to expect from the price of healthy and unhealthy foods over time? The case from Brazil. Public Health Nutrition [Internet]. 2020 [cited 2022, May 26];23(4),579-88. Available from: http://doi.org/10.1017/S1368980019003586.

39. Cruz-Jentoft AJ, Bahat G, Bauer J, Boirie Y, Bruyère O, Cederholm T et al. Sarcopenia: revised European consensus on definition and diagnosis. Age Ageing [Internet]. 2019 [cited 2022, Jan 17];48:16-31. Available from: http://doi.10.1093/ageing/afy169.

40. Pan-American Health Organization (PAHO). Ultra-processed food and drink products in Latin America: Sales, sources, nutrient profiles, and policy implications. [Internet]. Washington, D.C.: PAHO; 2019. Available from: https://iris.paho.org/handle/10665.2/51094.

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