Minimally processed versus processed and ultra-processed food in individuals at cardiometabolic risk

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Abstract

Purpose – The purpose of this paper is to evaluate the association between food consumption classified by the degree of processing and cardiometabolic risk factors in a population at risk of cardiovascular disease.

Design/methodology/approach – A cross-sectional study conducted with 325 adults and elderlies who present a cardiovascular risk factor. The food consumption was evaluated by a 24 h dietary recall, and it was classified according to the NOVA classification.

Findings – Individuals who presented a higher consumption of processed and ultra-processed food had a higher prevalence of abdominal obesity, waist/hip ratio (PR = 1.005; p-value = 0.049), waist circumference (PR = 1.003; p-value = 0.02) and high total cholesterol (PR = 1.008; p-value = 0.047), while ultra-processed had a higher prevalence of excess weight (PR = 1.004; p-value = 0.04), and abdominal obesity, waist/hip ratio (PR = 1.005; p-value = 0.04), waist circumference (PR = 1.004; p-value = 0.004) and waist/height ratio (PR = 1.003; p-value = 0.03).

Practical implications – An association was found between the degree of food processing and cardiometabolic risk factors, even in a population that already has a risk factor for cardiovascular disease, reinforcing the importance of personalized nutrition orientation that considers the profile of the target population as well as types of meals.

Originality/value – Food processing in itself can influence cardiometabolic risk and, as far as is known, no study has evaluated food processing in individuals who already have some type of cardiovascular risk. Also, consumption was assessed by the degree of processing between meals.

Keywords Women, Young, Marital status, Cardiovascular disease, Food processing, NOVA classification

Paper type Research paper

Introduction

Cardiovascular diseases (CVD) are the leading cause of death, accounting for 17.9 million deaths worldwide as of 2016 (WHO, 2018a). In relation to Brazil, the total prevalence of CVD in 2017 was 13,702,303; when it was compared to 2010, there was a 4.2% reduction in the prevalence of CVD (6,290 versus 6,025 per 100 thousand inhabitants, respectively) (Oliveira *et al.*, 2020). Even though, CVD is the main cause of death from noncommunicable diseases (NCDs), corresponding to 369.6 thousand (28% of all global deaths) (WHO, 2018a), and hospitalization cost related to CVD is the most expensive (IBGE, 2014). This scenario is associated with the increasing prevalence of cardiometabolic risk factors, such as hypertension, dyslipidemia, insulin resistance (IR), diabetes mellitus (DM) and excess body weight among individuals in Brazil (IBGE, 2014) and worldwide (WHO, 2018b), due to inadequate dietary intake and sedentary lifestyle (González *et al.*, 2017; Yu *et al.*, 2018).

In this context, the frequency of cardiometabolic risk factors has grown concomitantly with the household availability of processed and ultra-processed foods (UPF) and consequent

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consumption of the same, mainly due to their practicality and low cost (Monteiro *et al.*, 2018), which can be observed since the sale of UPF increased 43.7% in the world and 50% in Latin America between 2000 and 2013 (PAHO, 2015). Furthermore, the caloric contribution of unprocessed or minimally processed foods to dietary intake continues to decrease (Monteiro *et al.*, 2018). Similarly, in Brazil, the consumption of processed and UPF increased between 2002 and 2003 (8.3% for processed and 12.6% for UPF), 2008 and 2009 (9.4% for processed and 16% for UPF) and 2017 and 2018 (9.8% for processed and 18.4% for UPF), whereas the consumption of unprocessed or minimally processed foods decreased simultaneously (IBGE, 2020).

Recent meta-analyses have shown that consumption of UPF was associated with cardiometabolic risk factors such as excess body weight, low high-density lipoprotein (HDL)-cholesterol levels and metabolic syndrome, in addition to positive associations with risk of all-cause mortality, increased risk of CVD and cerebrovascular disease (Askari *et al.*, 2020; Pagliai *et al.*, 2021). Moreover, a first Randomized Controlled Trial study was carried out to assess consumption of ultra-processed and unprocessed foods in weight-stable adults, and they found that the group that received an ultra-processed diet had weight gain, while the group that received unprocessed diet reduced the weight (Hall *et al.*, 2019).

According to the NOVA classification, the foods are grouped by the nature, extend and purposes of the industrial processes they undergo. This classification only takes into account the industrial processing of foods. Food processing is the modification of natural and whole foods by physical, chemical or thermal processes (Monteiro *et al.*, 2016). Processed foods contain added salt, sugar, oil or other processed culinary ingredients added to unprocessed or minimally processed foods; most processed foods have two or three ingredients and the main purpose is to increase the durability of unprocessed or minimally processed foods, or to modify or enhance their sensory qualities (Gibney, 2018; Hendriksen *et al.*, 2015; Monteiro *et al.*, 2016), while UPF contain substances extracted from foods (e.g. rich in oils, fats, sugar, starch and proteins), or derived from food constituents (e.g. fats hydrogenated and modified starch), or synthesized in laboratories from food substrates or other organic sources (e.g. flavor enhancers, dyes and various food additives used to make the product hyper-palatable). Ingredients found in this group include substances not commonly used in culinary preparations. It is important to state that UPF contain none or very little whole foods in their composition and are added of ingredients that are exclusive to the industrial use. Thus, UPF are energetically dense and highly palatable, providing higher glycemic response and less satiety, in addition to being cheaper (Latasa *et al.*, 2018; Monteiro *et al.*, 2010, 2012, 2016; Moubarac *et al.*, 2013). Instead, unprocessed or minimally processed foods are rich in fiber, micronutrients, polyunsaturated fats, phytochemicals, have a low glycemic response and because of those characteristics provide more satiety than UPF (Fardet, 2016). Unprocessed (or natural) foods are edible parts of plants (seeds, fruits, leaves, stems and roots) or of animals (muscle, offal, eggs and milk), and also fungi, algae and water, after separation from nature. While minimally processed foods are natural foods altered by processes such as removal of inedible or unwanted parts, drying, crushing, grinding, fractioning, filtering, roasting, boiling, pasteurization, refrigeration, freezing, placing in containers, vacuum packaging or non-alcoholic fermentation. None of these processes adds substances such as salt, sugar, oils or fats to the original food (Monteiro *et al.*, 2016).

Due to the described characteristics of UPF and the fact that processed foods are not only added with sugar, oil, salt or other ingredients, but they also have other factors introduced during food processing that can be important for the development of outcomes, this needs to be taken into account. Studies have shown that processed meat or processed fish other than meat or fish, it is more harmful to health (Kouvari *et al.*, 2016; Larsson and

Orsini, 2014; Tørris *et al.*, 2017). A meta-analysis found an inverse association between whole grain intake and outcomes of several major chronic diseases, including coronary heart disease, stroke, cardiovascular disease overall, total cancer and all-cause mortality (Aune *et al.*, 2016). Also, processed foods may contain high levels of glucose-derived advanced glycation end products, sulfites, monosodium glutamate, and heat treatments caused by food processing can produce neoformed contaminants, such as acrylamide and acrolein; finally, products in contact with plastic packaging might have bisphenol A that are associated with cardiometabolic risk (Rancière *et al.*, 2015; Srour *et al.*, 2019). All of these evidence show that processed foods and whole foods affect human physiology and metabolism differently, such as interfering with inflammatory processes and hormones related to satiety (Aune *et al.*, 2016). In addition, studies have shown other effects of food processing by promoting inflammation-related processes through diet–microbiome–host interactions (Zinocker and Lindseth, 2018). Due to these described characteristics of processed and UPF and the relationship of these to the development of CVD, both groups have been assessed in terms of cardiovascular risk (Monteiro *et al.*, 2012; Rauber *et al.*, 2015). Other studies have pointed out the relationship of both groups in the development of diseases (Canella *et al.*, 2014; Rinaldi *et al.*, 2016).

Many studies have associated food according to the degree of processing with clinical outcomes (Adams and White, 2015; Canella *et al.*, 2014; Juul *et al.*, 2018; da Costa Louzada *et al.*, 2015a, b; Melo *et al.*, 2017; Mendonça *et al.*, 2016; Monteiro *et al.*, 2018; Rauber *et al.*, 2015; Rinaldi *et al.*, 2016; Silva *et al.*, 2018). However, no studies have evaluated this association in a population where all individuals have at least one of the cardiometabolic risk factors. Given that approximately 390,400 CVD deaths are expected in Brazil by 2030 and a 50% reduction in ultra-processed consumption and increase in the same proportion of unprocessed or minimally processed foods can reduce deaths by 11% (Moreira *et al.*, 2018), the investigation of food intake by the degree of processing in individuals at risk of cardiovascular disease and possible associations is important. Furthermore, there is a need to evaluate whether the consumption of processed and UPF offers additional risks to individuals who present cardiometabolic alterations.

In view of the above, we evaluated the association of food consumption according to the degree of processing with cardiometabolic risk factors in a population with cardiovascular risk.

Methodology

Study design and sample

This study is a cross-sectional study conducted with a population in the Cardiovascular Health Care Program of the Federal University of Viçosa (PROCARDIO-UFV). The program is toward individuals in the academic community who present cardiovascular risk factors. All data were collected at baseline, defined as the first consultation (before the patient receives any nutrition intervention). The nutrition intervention methodology of PROCARDIO-UFV is available in the Brazilian Registry of Clinical Trials (ReBEC, id: RBR-5*n*4y2g), and the inclusion criteria of the study are individuals with age ≥ 20 years, of both sexes, that present CVD diagnosed or occurrence of cardiometabolic risk factors (e.g. BMI ≥ 25 kg/m^2; triglycerides ≥ 150 mg/dL; total cholesterol ≥ 200 mg/dL; HDL at low concentrations (men < 40 mg/dl and women < 50 mg/dl); systolic and diastolic blood pressure ≥ 130/≥ 85 mmHg or arterial hypertension (AH) diagnosed; glucose fasting ≥ 100 mg/DL or diabetes mellitus (DM) diagnosed and/or medical record). All the inclusion and exclusion criteria are previously described (de Almeida *et al.*, 2020).

Data collected from consultations between March 2012 and December 2017 (n = 330 individuals) were used. Three individuals were excluded due to incomplete data and two individuals due to overestimation of caloric intake (>4,000 kcal / day) (Willett, 1998) resulting in 325 individuals who participated in the study.

This study was approved by the Human Research Ethics Committee of UFV (Ref. No. 066/2012/CEPH), following Resolution CNS 466/2012, and all participants signed the Informed Consent Form (ICF).

Food consumption assessment and classification according to the degree of processing

Food consumption was assessed through a 24 h dietary recall (R24h) related to the day before consultation, and a five-step multiple-pass method was employed by trained interviewers to minimize possible sources of bias (Conway *et al.*, 2003). The portions were quantified in grams (g) with standard home measurements (Pinheiro *et al.*, 2010). Caloric intake was estimated in DietPRO® software, version 5.8, using the Brazilian Food Composition Table (TACO) (TACO, 2011).

Food was classified into four distinct groups based on the NOVA classification, which discriminates foods according to the nature, extent and purpose of processing (Monteiro *et al.*, 2016). Group 1 (unprocessed or minimally processed foods) is composed of unprocessed foods mainly edible parts of plants or animals, and minimally processed foods are unprocessed foods subjected to processes such as removal of inedible or unwanted parts, drying, dehydration, crushing or grinding, fractioning, roasting, boiling, pasteurization, refrigeration or freezing, packaging, vacuum packaging, non-alcoholic fermentation and other processes that avoid the addition of substances such as salt, sugar, oils or fats. Some examples from this group are fresh, squeezed, chilled, frozen, or dried fruits and leafy and root vegetables; grains such as brown, parboiled or white rice; legumes such as beans of all types, lentils, chickpeas; starchy roots and tubers such as potatoes and cassava, in bulk or packaged; meat, poultry, fish and sea food, whole or in the form of steaks, fillets and other cuts, or chilled or frozen; eggs; milk, pasteurized or powdered; fresh or pasteurized fruit or vegetable juices without added sugar, sweeteners or flavors; grits, flakes or flour made from corn, wheat, oats, or cassava; pasta, couscous and polenta made with flours, flakes or grits and water; tree and ground nuts and other oil seeds without added salt or sugar; herbs such as thyme and mint, fresh or dried; yoghurt with no added sugar or artificial sweeteners added; tea, coffee. Group 2 (processed culinary ingredients) consists of cooking ingredients extracted from foods in group 1 or nature such as salt mined or from seawater; sugar and molasses obtained from cane or beet; honey extracted from combs and syrup from maple trees; vegetable oils crushed from olives or seeds; butter and lard obtained from milk and pork; and starches extracted from corn and other plants. Group 3 (processed foods) is characterized by the addition of salt, sugar, oil, vinegar or other substances of Group 2 to Group 1 food items, composed mostly of two or three ingredients such as canned or bottled vegetables, fruits and legumes; salted or sugared nuts and seeds; salted, cured or smoked meats; canned fish; fruits in syrup; cheeses and unpackaged freshly made breads. Group 4 (UPF) are products that contain five or more ingredients of Group 1 foods or Group 3 foods containing additives that modify the color, odor, flavor or texture of the final product, for example, carbonated drinks; sweet or savory packaged snacks; ice cream, chocolate and candies (confectionery); mass-produced packaged breads and buns; margarines and spreads; cookies (biscuits), pastries, cakes and cake mixes; breakfast “cereals,” “cereal” and “energy” bars; “energy” drinks; milk drinks, “fruit” yoghurts and “fruit” drinks; cocoa drinks; meat and chicken extracts and “instant” sauces; ready to heat products including pre-prepared pies and pasta and pizza dishes; poultry and fish “nuggets” and “sticks”, sausages, burgers, hot dogs, and other reconstituted meat products, and powdered and packaged “instant” soups, noodles and desserts (Monteiro *et al.*, 2016). The consumption of each group was evaluated as a percentage of total energy consumption.

In order for food to be classified correctly, we break down all the preparations and recipes and classify food by food. We used the documents created by Monteiro and collaborators (creators of the NOVA classification) that describe in more detail all the foods in each of the four groups (Monteiro *et al.*, 2016, 2019), when no specific food was found, these were searched in scientific papers that also used the NOVA classification. Some foods such as breads were more difficult to classify because Brazilians have a habit of consuming both breads that are considered processed (which are unpackaged freshly made breads and most commonly found in bakeries) such as French bread, and those that are ultra-processed (which are breads with added emulsifiers and found in supermarkets). Although there is no list of all foods classified in each of the four groups, the documents that exist on the NOVA classification guide researchers to classify foods in each group, and mainly because the NOVA classification was created by Brazilian researchers, the Brazilian food culture, in general, is well documented. The documents also guide some differences such as yogurt, when having sugar or artificial sweeteners added they are classified as foods in the group of unprocessed or minimally processed food, in contrast when added with sensory intensifying additives like artificial sweeteners they are in the ultra-processed group.

Cardiometabolic risk factors assessment

Weight, height and waist circumference (WC) were measured according to the PROCARDIO-UFV protocol (Silva *et al.*, 2015). Adults with Body Mass Index (BMI) $\geq$ 25.0 kg/m^2 and elderlies with BMI $\geq$ 28.0 kg/m^2 were classified as having excess weight (Opas, 2001; WHO, 2000). Abdominal obesity was defined as WC $\geq$ 90 cm and $\geq$ 80 cm for men and women, respectively (ABESO, 2016). Waist-to-hip-ratio (WHR) > 1.0 and > 0.85 for men and women, respectively (WHO, 2000). Excess body fat was evaluated as total body fat > 20% and > 30% for men and women, respectively (Bray and Bouchard, 1998) and was measured using a horizontal tetrapolar electrical bioimpedance equipment (Biodynamics® 310 model, Washington, USA) according to a specific protocol.

Blood samples were collected after a 12 h fast and the serum concentrations of glucose, HDL-c, LDL-C, total cholesterol and triglycerides were measured by a colorimetric enzymatic method. The triglyceride glucose (TyG) index was calculated by the formula: Ln [fasting triglycerides (mg/dL) $\times$ fasting plasma glucose (mg/dL) / 2] (Simental-Mendía *et al.*, 2008). Cardiometabolic risk factors were fasting glycemia $\geq$ 100 mg/dL or use of oral antidiabetics or insulin use; HDL-c < 40 mg/dL and < 50 mg/dL for men and women, respectively; LDL-c $\geq$ 160 mg/dL; total cholesterol $\geq$ 240 mg/dL; non-HDL cholesterol $\geq$ 160 mg/dL or use of statins for each of these markers; triglycerides $\geq$ 150 mg/dL or use of fibrates; and TyG index above the 75th percentile.

Blood pressure was measured by a mercury sphygmomanometer (Missouri®, São Paulo, Brazil), with an approximation of 02 mmHg (Tavares *et al.*, 2012), being considered arterial hypertension if the pressure was $\geq$140/90 mmHg or antihypertensive medication use.

Sociodemographic data assessment

We collected from medical reports information on age, sex (male or female), family income by minimum wage, education (illiterate, incomplete primary education, complete primary education, incomplete high school education, complete high school education, incomplete college education and college degree), marital status (stable union, divorced or single), clinical history (diabetes, hypertension, dyslipidemia, hepatic steatosis, and hypothyroidism), lifestyle-related to smoking (smokers, ex-smokers or non-smokers) and physical activity practice (yes/no) and use of medications.

Statistical analysis

Data were presented as median, mean $\pm$ SD (SD), or absolute and relative frequency. The normality of the variables was evaluated by the Shapiro–Wilk test. Mann–Whitney and

Kruskal–Wallis tests were performed to investigate possible differences in caloric intake (percent) of the two groups (unprocessed, minimally processed foods and culinary ingredients; and processed and UPF) according to the characteristics of the sample.

Food consumption (in % calorie) according to the degree of food processing (unprocessed or minimally processed, and culinary ingredients; processed and UPF together; and UPF) and its association with cardiometabolic risk factors was evaluated by Poisson regression analysis with robust variance through prevalence ratio (PR), adopting a significance level of 5%. The models were adjusted by sex, age, level of education, marital status and lifestyle (smoking and physical activity practice). All statistical analyses were performed using SPSS, version 22.0, and Stata, version 13.0.

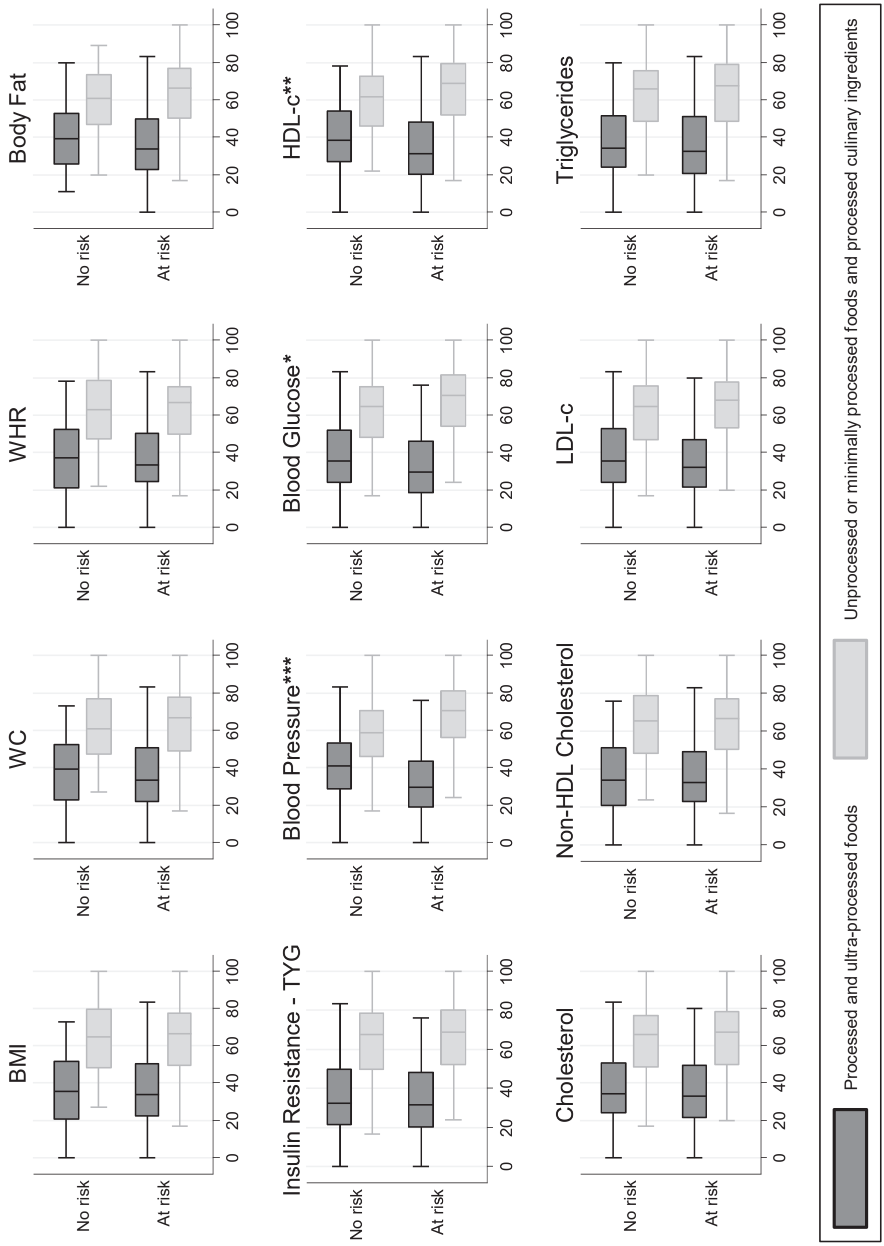
Results

A total of 325 individuals (42 ± 16 years) participated in this study, 135 (41.5%) were males and 71.6% had excessive body weight. Table 1 presents the descriptive characteristics of the samples as well as food consumption data according to the degree of processing. Also, the risk factors by food consumption according to the degree of processing are presented in Figure 1.

Table 1. Daily caloric intake (% kcal) of unprocessed or minimally processed foods and processed culinary ingredients and processed and ultra-processed foods according to sample characteristics (n = 325)

Variables	*n* (%)	Unprocessed foods and processed ingredients (% kcal ± SD)	*p*-value	Processed and ultra-processed (% kcal ± SD)	*p*-value
Sex					
Male	135 (41.5)	*68.8 ± 17.9*	*<0.001*	*31.2 ± 17.9*	*<0.001*
Female	190 (58.5)	*60.4 ± 17.7*		*39.6 ± 17.7*	
Age group					
Adults (18–59 years old)	261 (80.3)	*62.1 ± 18.2*	*<0.001*	*37.9 ± 18.2*	*<0.001*
Elderly (60–84 years old)	64 (19.7)	*71.3 ± 16.5*		*28.7 ± 16.5*	
Schooling					
Until complete primary school	69 (22.5)	*73.2 ± 17.3*[a]	*<0.001*	*26.8 ± 17.3*[a]	*<0.001*
High school (incomplete and complete)	56 (18.2)	*70.7 ± 15.2*[a]		*29.3 ± 15.2*[a]	
College education (incomplete and complete)	182 (59.3)	*58.7 ± 17.9*[b]		*41.3 ± 17.9*[b]	
Family income					
Up to 4 minimum wages	196 (67.6)	62.3 ± 18.5	0.08	37.7 ± 18.5	0.08
>4 minimum wages	94 (32.4)	66.1 ± 17.1		33.9 ± 17.1	
Marital status					
Single/divorced	160 (49.5)	*59.2 ± 18.5*	*<0.001*	*40.8 ± 18.5*	*<0.001*
Married/stable partnership	163 (50.5)	*68.6 ± 16.9*		*31.4 ± 16.9*	
Smoking					
Smoker/former smoker	100 (31.8)	*68.4 ± 17.9*	*0.01*	*31.6 ± 17.9*	*0.01*
Never smoked	214 (68.2)	*61.6 ± 17.8*		*38.4 ± 17.8*	
Physically active					
No	149 (46.4)	64.4 ± 17.8	0.56	35.5 ± 17.8	0.56
Yes	172 (53.6)	63.4 ± 18.4		36.6 ± 18.4	

Note(s): Data are expressed as mean and standard deviation. *p*-values are provided by Mann–Whitney test for variables with two categories and Kruskal–Wallis test for variables with more than two categories (post hoc Dunn–Bonferroni) in which different letters (represented by the letters "a, b") indicate statistical difference between groups. Statistical differences can be seen in Italic values



Note(s): p-values are provided by Mann–Whitney test. $*p < 0.05$; $**p < 0.01$; $***p < 0.001$

Figure 1.
Daily caloric intake (% kcal) from both groups "processed and ultra-processed foods" and "unprocessed or minimally processed foods and processed culinary ingredients" according to cardiometabolic risk factors. Data are expressed as median

When evaluated processed and UPF together, higher consumption of these foods was observed among women and adults compared to elderlies, highly educated individuals (college degree/incomplete college degree), individuals living without a partner (single, widowed or divorced), individuals who never smoked, individuals without hyperglycemia and hypertension and those with normal plasma HDL-c levels. These results were obtained before adjusting the models for confounding factors.

The mean daily caloric intake of the study population was 1733.8 kcal, being 943.2 kcal from unprocessed or minimally processed foods, 149.3 kcal from culinary ingredients, 192.8 kcal from processed foods and 448.5 kcal from UPF, representing a caloric contribution of 54.4% for unprocessed and minimally processed foods and 25.9% for UPF. Rice (9.1%), red meat (7.9%) and poultry and other types of meat (7.8%) mostly contributed to calories from unprocessed and minimally processed food, while industrialized sweets (5.4%), ultra-processed bread (4.5%) and sweet or salty packaged snacks (4.3%) were the main foods that contributed to calories from UPF (Table 2).

When consumption was evaluated based on the type of meal, we observed a higher consumption of unprocessed and minimally processed foods at lunch and dinner, and UPF at breakfast and snack time (Figure 2).

In relation to cardiometabolic risk factors, after adjustments, the consumption of unprocessed or minimally processed foods and culinary ingredients was negatively associated with WHR (PR = 0.995; p-value = 0.049), WC (PR = 0.997; p-value = 0.02) and high total cholesterol (PR = 0.992; p-value = 0.047), whereas the consumption of processed and UPF was positively associated with WHR (PR = 1.005; p-value = 0.049), WC (PR = 1.003, p-value = 0.02) and total cholesterol (PR = 1.008, p-value = 0.047). Thus, it is noted that one percentage point increase in processed and ultra-processed food consumption is associated with an increase in the prevalence of abdominal obesity (0.3% by WC and 0.5% by WHR) and a zero point eight percentage points increase in total cholesterol (Appendix 1 data).

When assessing the consumption of UPF alone, after adjustments, positive associations were found with excessive body weight (PR = 1.004; p-value = 0.04), and abdominal obesity, WHR (PR = 1.005; p-value = 0.04), WC (PR = 1.004; p-value = 0.004), WHtR (PR = 1.003; p-value = 0.03) (Table 3).

Discussion

In the present study, which assesses a population at cardiovascular risk, individuals who consumed higher proportions of UPF had a higher prevalence of excess body weight and abdominal obesity. When the consumption of processed and UPF was evaluated together, in addition to abdominal obesity, an association was found with hypercholesterolemia. Obesity, especially abdominal fat (subcutaneous and intra-abdominal), is one of the main factors associated with cardiovascular risk. However, few studies have evaluated the association between food intake according to the degree of processing and abdominal obesity (Nasreddine *et al.*, 2018; Steele *et al.*, 2019; Tavares *et al.*, 2012); most investigations evaluate overall obesity based on BMI (Adams and White, 2015; Canella *et al.*, 2014; Juul and Hemmingsson, 2015; da Costa Louzada *et al.*, 2015a, b; Monteiro *et al.*, 2018; Rauber *et al.*, 2015).

It is known that unprocessed or minimally processed foods are inversely associated with glycemic response and positively associated with satiety (Hall *et al.*, 2019), unlike processed and UPF (Fardet, 2016). The high glycemic load of the latter leads to an increase in insulin production and consequent body weight gain (Ludwig, 2002). In addition, added sugars, mainly fructose, induce lipogenesis leading to an accumulation of fat in the liver and adipose tissue (Chong *et al.*, 2007; Parks *et al.*, 2018). According to data from several countries, the intake of added and free sugars increases among the quintiles of UPF (Julia *et al.*, 2018; da Costa Louzada *et al.*, 2015a, b; Moubarac *et al.*, 2017; Rauber *et al.*, 2018; Steele *et al.*, 2017).

Foods by degree of processing	Kcal Mean	SD	Average energy intake (%)
Unprocessed or minimally processed foods	943.2	437.9	54.4
Rice	158.5	119.8	9.1
Red meat	137.0	218.6	7.9
Poultry and others types of meat	135.6	201.8	7.8
Bean	107.9	109.3	6.2
Fruits	92.9	119.7	5.4
Other cereals	90.2	163.8	5.2
Milk and yogurt	77.6	101.2	4.5
Vegetables	33.0	42.8	1.9
Roots and tubers	22.7	68.2	1.3
Coffee and tea	19.7	25.9	1.1
Fruit or vegetable juices	19.0	51.6	1.1
Eggs	18.5	46.7	1.1
Others*	30.6	93.7	1.8
Processed culinary ingredients	149.3	122.7	8.6
Vegetable oil	74.2	63.9	4.3
Sugar	48.1	66.4	2.8
Animal fat	24.8	72.6	1.4
Others†	2.2	17.0	0.1
Processed foods	192.8	185.0	11.1
French bread	127.6	143.2	7.4
Processed cheeses	49.5	91.6	2.8
Wine and beer	8.4	45.6	0.5
Others ‡	7.4	39.4	0.4
Ultra-processed foods	448.5	411.2	25.9
Industrialized sweets	94.4	159.9	5.4
Ultra-processed breads	78.0	114.0	4.5
Sweet or salty packaged snacks	73.8	144.4	4.3
Ready meals	46.1	159.7	2.7
Margarines and spreads	37.3	112.9	2.1
Ultra-processed meats§	33.9	99.7	2.0
Milk drinks	26.0	55.9	1.5
Ultra-processed cheeses (curd cheese and cheddar)	18.0	48.9	1.0
Industrialized juices	13.8	40.7	0.8
Soft drinks	13.2	48.1	0.8
Condiments/meat and chicken extracts and instant sauces	8.9	29.6	0.5
Others|	5.2	27.7	0.3

Note(s): *Others: Nuts and seeds; spices and aromatic herbs fresh or dried; fishes and sea food; other legumes; offal; water; mushrooms
†Others: Starches extracted from corn and other plants; honey, salt
‡Others: Canned/bottled vegetables, fruits and legumes; salted, cured, or smoked meats; canned fish; salted or sugared nuts and seeds
§Ultra-processed meats: Mortadella; ham; sausage; nuggets; burgers
|Others: Breakfast cereals; alcoholic drinks followed by distillation as whisky, gin, rum and vodka; energy drinks and fruit drinks

Table 2.
Caloric contribution of food groups and subgroups on daily energy intake

In turn, high saturated and trans fat consumption increases the levels of total and LDL cholesterol (Mensink *et al.*, 2003), although in several countries small variation in fat intake has been observed between quartiles/quintiles of UPF (Julia *et al.*, 2018; Moubarac *et al.*, 2017; Rauber *et al.*, 2018; Steele *et al.*, 2017). In contrast, higher saturated and trans fat intake in Brazil was associated with higher consumption of processed and UPF (da Costa Louzada *et al.*, 2015a, b), which reinforces the association found in our study. In addition, an

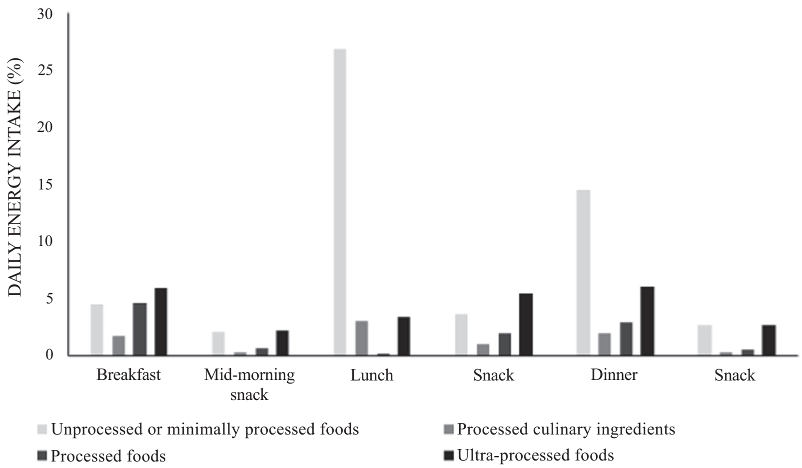


Figure 2.
Daily caloric intake (%) according to the degree of processed foods between meals. Data expressed as mean

intervention study also found an association between unprocessed food consumption and a reduction in total cholesterol, which converges with our findings (Hall *et al.*, 2019).

Considering our results, it is worth making some considerations about processed and UPF consumption in the study population. French bread, a low-cost bread available to all (Aplevicz *et al.*, 2014; Ferreira *et al.*, 2019), is a traditional food in Brazil, and it is therefore not surprising that it was the most consumed processed food. Similar findings have been reported in other studies conducted in Brazil (da Costa Louzada *et al.*, 2015a, b). The most consumed ultra-processed food was sweets which are largely consumed by the Brazilian population. In this context, French bread, sweets and cookies are foods rich in sugar, have a high glycemic load and the latter is rich in fat. The consumption of the mentioned foods may contribute to weight gain, as well as cardiometabolic alterations, such as hypercholesterolemia and greater accumulation of abdominal fat (Stinson *et al.*, 2018).

In general, culinary ingredients are used in the preparation of unprocessed or minimally processed foods (Monteiro *et al.*, 2012), previously stated as nutritionally rich, with a low glycemic response and high satiety (Fardet, 2016), which explains the inverse association of both food groups with the cardiometabolic risk factors studied. It is worth noting that the proportion of energy from unprocessed and minimally processed foods was high (54.4%); however, this value was low (25.9%) for UPF contrary to other countries where UPF were higher in proportion than unprocessed foods (Adams and White, 2015; Baraldi *et al.*, 2018; Juul *et al.*, 2018; Nasreddine *et al.*, 2018). The differences observed may also be related to the fact that our study was conducted in a small city with few fast-food chains.

Most studies conducted with the Brazilian population reported a greater contribution of unprocessed or minimally processed foods and a lower contribution of UPF, in agreement with our results (Alves-Santos *et al.*, 2016; da Costa Louzada *et al.*, 2015a, b; Silva *et al.*, 2018). Unprocessed or minimally processed foods that mainly contributed to caloric intake were rice, beef and beans, major components of the diet of most Brazilians (Barbosa, 2007), which resulted in their higher participation. Another aspect worth noting is that the subjects of the study have some form of pathology and undergo medical follow-up; due to this fact, they may be more informed about the role of food in preventing diseases and thus, make healthy food choices due to the concern with their cardiometabolic risk factors. This fact can be a source of study bias since the study is cross-sectional and this type of study is liable to reverse causality. It is impossible to know if the health status of the participant influenced

Table 3. Associations between the percentage of energy from ultra-processed foods and processed and ultra-processed foods group and cardiometabolic risk factors (n=325)

Cardiometabolic risk factors	Ultra-processed foods Model 1 PR (p-value) (95% CI)	Model 2 PR (p-value) (95% CI)	Processed and ultra-processed foods Model 1 PR (p-value) (95% CI)	Model 2 PR (p-value) (95% CI)
Excessive body weight	1.002 (0.156) (0.999–1.007)	*1.004 (0.04) (1.000–1.008)*	1.002 (0.42) (0.998–1.006)	1.002 (0.23) (0.998–1.007)
Excessive body fat	0.999 (0.71) (0.995–1.004)	0.999 (0.95) (0.995–1.004)	1.000 (0.82) (0.996–1.005)	1.000 (0.98) (0.996–1.004)
Abdominal obesity (WHR)	1.003 (0.12) (0.999–1.008)	*1.005 (0.04) (1.000–1.010)*	1.004 (0.09) (0.999–1.008)	*1.005 (0.049) (1.000–1.010)*
Abdominal obesity (WC)	*1.003 (0.02) (1.000–1.006)*	*1.004 (0.004) (1.001–1.007)*	1.002 (0.08) (0.999–1.005)	*1.003 (0.02) (1.000–1.006)*
Abdominal obesity (WHtR)	1.002 (0.93) (0.999–1.005)	*1.003 (0.03) (1.000–1.006)*	1.002 (0.15) (0.999–1.004)	1.003 (0.052) (0.999–1.005)
Insulin resistance (TYG)	1.006 (0.29) (0.994–1.019)	1.007 (0.29) (0.994–1.019)	1.006 (0.35) (0.994–1.018)	1.009 (0.15) (0.997–1.021)
Insulin resistance (HOMA-IR)	0.995 (0.50) (0.979–1.010)	0.993 (0.35) (0.977–1.008)	0.996 (0.56) (0.982–1.010)	0.993 (0.34) (0.978–1.008)
Hypertension	0.998 (0.49) (0.993–1.003)	0.999 (0.80) (0.994–1.005)	0.998 (0.56) (0.994–1.003)	1.000 (0.96) (0.995–1.005)
Hyperglycemia	1.005 (0.240) (0.997–1.013)	1.006 (0.15) (0.998–1.013)	1.001 (0.69) (0.994–1.009)	1.005 (0.20) (0.997–1.013)
Low HDL	1.003 (0.28) (0.997–1.009)	1.004 (0.19) (0.998–1.010)	0.999 (0.68) (0.993–1.004)	1.001 (0.75) (0.995–1.007)
Hypercholesterolemia	1.002 (0.56) (0.995–1.010)	1.004 (0.32) (0.996–1.012)	1.006 (0.13) (0.998–1.013)	*1.008 (0.047) (1.000–1.016)*
High non-HDL cholesterol	1.002 (0.44) (0.997–1.008)	1.003 (0.31) (0.997–1.009)	1.004 (0.11) (0.998–1.010)	1.005 (0.09) (0.999–1.011)
High LDL	1.000 (0.90) (0.993–1.008)	1.002 (0.66) (0.993–1.011)	1.002 (0.55) (0.995–1.010)	1.004 (0.28) (0.996–1.013)
Hipertriglyceridemia	0.998 (0.65) (0.990–1.006)	1.000 (0.94) (0.992–1.008)	0.999 (0.88) (0.992–1.007)	1.002 (0.64) (0.994–1.010)

Note(s): PR, prevalence ratio; WHR, waist-to-hip-ratio; WC, waist circumference; WHtR, waist-to-height-ratio
Association evaluated by Poisson regression models, using robust variance
Model 1: Adjusted by sex and age
Model 2: Model 1 + schooling, marital status, smoking and physical activity
Statistical differences can be seen in Italic values

their diet or the contrary. Because of this, the impact on the association results may have been attenuated.

An unprecedented observation of this study was the evaluation of the food consumption according to the meal of the day. Higher consumption of unprocessed and minimally processed was observed at lunch and dinner, which is expected, although this consumption was lower at dinner compared to lunch. A hypothesis is that the habit of eating real food at dinner has been replaced by the high consumption of bread, cheeses, margarine and cookies, which are not usually eaten at lunch. At breakfast, the high consumption of processed and UPF is due to the higher consumption of bread, margarine and Minas Gerais cheese, while during snack time, this trend is related to the high consumption of bread, cookies (cream-cracker and maisena) and cereal bars (data not shown), which are typically present in the breakfast and snack of Brazilians. It is hoped that future studies evaluate which meals of the day account for the frequent consumption of these foods to elucidate their relationship with cardiometabolic risk factors, which is also important for the implementation of effective strategies.

The most consumed processed and UPF were bread and sweets that may have contributed to their higher consumption among women due to greater craving for carbohydrates (Abdella *et al.*, 2019). This fact can be seen in Appendix 2 of this paper, which shows that in our study population the consumption of bread and sweets was 315.8 kcal (19.5%) by women and 277.7 kcal (14.7%) by men (Appendixes 2 and 3 data). The higher consumption of processed and UPF among younger individuals compared to older individuals can be related to nutrition transition from traditional dietary patterns to more western patterns over generations (Bezerra *et al.*, 2013; Popkin and Drewnowski, 1997; Schnabel *et al.*, 2019; Srour *et al.*, 2019; Steele *et al.*, 2019). This finding corroborates with a previous study conducted with the same population as the present study, which identified that older people had a better diet quality based on the Healthy Eating Index (HEI) (Silveira *et al.*, 2019). As observed in our samples and other studies (Bezerra *et al.*, 2015; Schnabel *et al.*, 2019), single individuals reported eating out frequently, which may also explain the higher consumption of processed and UPF among this population group since these foods are mostly eaten outside the home (Bezerra *et al.*, 2013).

Our study has some limitations, it was conducted based on information collected with just one R24h that does not demonstrate a habitual intake, despite being considered valid (Willett, 1998) and extensively used in epidemiological studies (Baraldi *et al.*, 2018; Fiolet *et al.*, 2018; Juul *et al.*, 2018). Another limitation may have been the assessment of physical activity, as they only report whether they practice or not, which is not the best method of assessment. It is known that physical activity is a protective factor for cardiometabolic risk and this may have attenuated the association between processed and UPF consumption and cardiometabolic risk. Despite this, it is important to note that we have adjusted this variable in the final regression model. Also, the consumption of processed and UPF may have been underestimated since underreporting is common among populations with excess weight, which is a type of systematic misreporting and it may also have contributed to attenuate the associations found between processed and UPF with cardiometabolic risk factors (Lissner *et al.*, 2000). Regarding the classification of foods, although there is no list with all foods classified according to the degree of processing and this can cause a misclassification, all preparations and recipes were broken down into their ingredients to be able to classify each food, we use the most recent materials on the NOVA classification, and several scientific articles, including those published by the group of researchers who created this classification to support us.

The positive points of the study consist of the use of R24H, an open-ended food questionnaire, and a multi-pass method by trained researchers that provided extensive details on foods consumed. To the best of our knowledge, this study is the first to evaluate the distribution of unprocessed or minimally processed foods, culinary ingredients, processed and UPF based on meals of the day. Given that no studies have evaluated the food consumption of individuals at risk of cardiovascular disease according to the degree of processing, our findings contribute to knowledge on nutrition strategies for this population.

Conclusion

Findings from this study suggest that the consumption of unprocessed or minimally processed foods and culinary ingredients was inversely associated with abdominal obesity and hypercholesterolemia, while the consumption of processed and UPF had a direct association. In addition, the consumption of UPF when evaluated alone was positively associated with excess weight and abdominal obesity. Thus, the profile of target groups and meal composition should be taken into consideration when implementing nutrition education strategies aimed at improving eating habits. Also, it is necessary more studies, mainly longitudinal and controlled researches to analyze the consumption of processed and UPF in individuals already diagnosed with cardiovascular risk.

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Appendix 1

Table A1. Associations between the percentage of energy from unprocessed or minimally processed foods and processed culinary ingredients group and processed and ultra-processed foods group and cardiometabolic risk factors ($n = 325$)

Cardiometabolic risk factors	Unprocessed/minimally processed foods and processed culinary ingredients Model 1 PR (*p*-value) (95% CI)	Model 2 PR (*p*-value) (95% CI)	Processed and ultra-processed foods Model 1 PR (*p*-value) (95% CI)	Model 2 PR (*p*-value) (95% CI)
Excessive body weight	0.998 (0.42) (0.994–1.002)	0.997 (0.23) (0.993–1.002)	1.002 (0.42) (0.998–1.006)	1.002 (0.23) (0.998–1.007)
Excessive body fat	0.999 (0.82) (0.995–1.004)	0.999 (0.98) (0.996–1.004)	1.000 (0.82) (0.996–1.005)	1.000 (0.98) (0.996–1.004)
Abdominal obesity (WHR)	0.996 (0.09) (0.992–1.001)	*0.995 (0.049) (0.990–0.999)*	1.004 (0.09) (0.999–1.008)	*1.005 (0.049) (1.000–1.010)*
Abdominal obesity (WC)	0.998 (0.08) (0.995–1.000)	*0.997 (0.02) (0.994–0.999)*	1.002 (0.08) (0.999–1.005)	*1.003 (0.02) (1.000–1.006)*
Abdominal obesity (WHtR)	0.998 (0.15) (0.996–1.000)	0.997 (0.052) (0.995–1.000)	1.002 (0.15) (0.999–1.004)	1.003 (0.052) (0.999–1.005)
Insulin resistance (TYG)	0.994 (0.35) (0.983–1.006)	0.991 (0.15) (0.980–1.003)	1.006 (0.35) (0.994–1.018)	1.009 (0.15) (0.997–1.021)
Insulin resistance (HOMA-IR)	1.004 (0.56) (0.990–1.018)	1.007 (0.34) (0.992–1.022)	0.996 (0.56) (0.982–1.010)	0.993 (0.34) (0.978–1.008)
Hypertension	1.001 (0.56) (0.997–1.006)	0.999 (0.96) (0.995–1.005)	0.998 (0.56) (0.994–1.003)	1.000 (0.96) (0.995–1.005)
Hyperglycemia	0.998 (0.69) (0.991–1.006)	0.995 (0.20) (0.987–1.003)	1.001 (0.69) (0.994–1.009)	1.005 (0.20) (0.997–1.013)
Low HDL	1.001 (0.68) (0.996–1.007)	0.999 (0.75) (0.993–1.005)	0.999 (0.68) (0.993–1.004)	1.001 (0.75) (0.995–1.007)
Hypercholesterolemia	0.994 (0.13) (0.987–1.002)	*0.992 (0.047) (0.984–0.999)*	1.006 (0.13) (0.998–1.013)	*1.008 (0.047) (1.000–1.016)*
High non-HDL cholesterol	0.996 (0.11) (0.990–1.001)	0.995 (0.09) (0.989–1.000)	1.004 (0.11) (0.998–1.010)	1.005 (0.09) (0.999–1.011)
High LDL	0.998 (0.55) (0.990–1.005)	0.995 (0.28) (0.987–1.004)	1.002 (0.55) (0.995–1.010)	1.004 (0.28) (0.996–1.013)
Hipertriglyceridemia	1.000 (0.88) (0.993–1.008)	0.998 (0.64) (0.991–1.006)	0.999 (0.88) (0.992–1.007)	1.002 (0.64) (0.994–1.010)

Note(s): PR, prevalence ratio; WHR, waist-to-hip-ratio; WC, waist circumference; WHtR, waist-to-height-ratio
Association evaluated by Poisson regression models, using robust variance.
Model 1: Adjusted by sex and age.
Model 2: Model 1 + schooling, marital status, smoking and physical activity

Appendix 2

Foods by degree of processing	Kcal Mean	SD	Average energy intake (%)
Unprocessed or minimally processed foods	*828.2*	*363.4*	*51.0*
Rice	121.9	89.2	7.5
Red meat	110.5	190.0	6.8
Poultry and others types of meat	115.3	171.4	7.1
Bean	76.1	70.4	4.7
Fruits	96.2	108.0	5.9
Other cereals	88.0	149.2	5.4
Milk and yogurt	80.1	110.3	4.9
Vegetables	29.7	38.0	1.8
Roots and tubers	20.6	65.3	1.3
Coffee and tea	20.6	31.1	1.3
Fruit or vegetable juices	13.9	42.0	0.9
Eggs	19.1	41.9	1.2
Others*	36.2	112.1	2.2
Processed culinary ingredients	*128.6*	*103.0*	*7.9*
Vegetable oil	61.0	51.8	3.8
Sugar	44.4	58.6	2.7
Animal fat	21.6	70.7	1.3
Others†	1.5	9.9	0.1
Processed foods	*186.0*	*175.6*	*11.5*
French bread	119.7	132.9	7.4
Processed cheeses	54.4	95.9	3.4
Wine and beer	5.3	36.1	0.3
Others ‡	6.6	41.6	0.4
Ultra-processed foods	*479.6*	*405.0*	*29.6*
Industrialized sweets	108.2	164.9	6.7
Ultra-processed breads	87.9	121.4	5.4
Sweet or salty packaged snacks	62.8	115.2	3.9
Ready meals	54.0	170.7	3.3
Margarines and spreads	30.9	61.0	1.9
Ultra-processed meats§	35.9	99.8	2.2
Milk drinks	33.1	61.7	2.0
Ultra-processed cheeses (curd cheese and cheddar)	24.1	59.4	1.5
Industrialized juices	12.8	42.7	0.8
Soft drinks	13.3	48.1	0.8
Condiments/meat and chicken extracts and instant sauces	11.0	31.5	0.7
Others|	5.5	27.8	0.3

Note(s): *Others: Nuts and seeds; spices and aromatic herbs fresh or dried; fishes and sea food; other legumes; offal; water; mushrooms
†Others: Starches extracted from corn and other plants; honey, salt
‡Others: Canned/bottled vegetables, fruits and legumes; salted, cured, or smoked meats; canned fish; salted or sugared nuts and seeds
§Ultra-processed meats: Mortadella; ham; sausage; nuggets; burgers
|Others: Breakfast cereals; alcoholic drinks followed by distillation as whisky, gin, rum and vodka; energy drinks and fruit drinks

Table A2. Caloric contribution of food groups and subgroups on daily energy intake by women

Appendix 3

Foods by degree of processing	Kcal Mean	SD	Average energy intake (%)
Unprocessed or minimally processed foods	*1105.2*	*480.6*	*58.5*
Rice	210.2	137.1	11.1
Red meat	174.2	248.8	9.2
Poultry and others types of meat	164.1	235.1	8.7
Bean	152.8	135.4	8.1
Fruits	88.2	134.4	4.7
Other cereals	93.3	182.4	4.9
Milk and yogurt	74.0	86.6	3.9
Vegetables	37.6	48.4	2.0
Roots and tubers	25.8	71.8	1.4
Coffee and tea	18.6	15.7	1.0
Fruit or vegetable juices	26.2	62.0	1.4
Eggs	17.6	52.7	0.9
Others*	22.7	57.7	1.2
Processed culinary ingredients	*178.5*	*140.8*	*9.4*
Vegetable oil	92.8	73.9	4.9
Sugar	53.4	75.8	2.8
Animal fat	29.2	75.1	1.5
Others†	3.1	15.0	0.2
Processed foods	*202.4*	*197.0*	*10.7*
French bread	138.7	155.9	7.3
Processed cheeses	42.6	84.6	2.3
Wine and beer	12.7	56.0	0.7
Others ‡	8.5	36.1	0.4
Ultra-processed foods	*404.7*	*415.8*	*21.4*
Industrialized sweets	75.0	150.4	4.0
Ultra-processed breads	64.0	101.0	3.4
Sweet or salty packaged snacks	89.2	176.5	4.7
Ready meals	34.9	142.2	1.8
Margarines and spreads	46.3	159.1	2.5
Ultra-processed meats§	31.1	99.5	1.6
Milk drinks	15.9	44.7	0.8
Ultra-processed cheeses (curd cheese and cheddar)	9.3	25.7	0.5
Industrialized juices	15.2	37.6	0.8
Soft drinks	13.0	48.1	0.8
Condiments/meat and chicken extracts and instant sauces	6.0	26.5	0.3
Others|	4.7	27.6	0.2

Note(s): *Others: Nuts and seeds; spices and aromatic herbs fresh or dried; fishes and sea food; other legumes; offal; water; mushrooms
†Others: Starches extracted from corn and other plants; honey, salt
‡Others: Canned/bottled vegetables, fruits and legumes; salted, cured, or smoked meats; canned fish; salted or sugared nuts and seeds
§Ultra-processed meats: Mortadella; ham; sausage; nuggets; burgers
|Others: Breakfast cereals; alcoholic drinks followed by distillation as whisky, gin, rum and vodka; energy drinks and fruit drinks

Table A3. Caloric contribution of food groups and subgroups on daily energy intake by men

Appendix 4

Foods by degree of processing	Kcal Mean	SD	Average energy intake (%)
Unprocessed or minimally processed foods	*938.8*	*443.4*	*52.9*
Rice	154.4	121.1	8.7
Red meat	139.3	229.9	7.8
Poultry and others types of meat	134.6	200.9	7.6
Bean	101.7	103.4	5.7
Fruits	87.2	112.3	4.9
Other cereals	98.1	172.6	5.5
Milk and yogurt	78.8	102.8	4.4
Vegetables	32.4	44.9	1.8
Roots and tubers	23.1	72.3	1.3
Coffee and tea	18.8	27.7	1.1
Fruit or vegetable juices	21.0	54.4	1.2
Eggs	19.3	46.8	1.1
Others*	330.1	96.9	1.7
Processed culinary ingredients	*152.9*	*127.0*	*8.6*
Vegetable oil	72.8	62.1	4.1
Sugar	49.5	66.1	2.8
Animal fat	28.1	79.3	1.6
Others†	2.5	13.4	0.1
Processed foods	*192.9*	*186.7*	*10.9*
French bread	128.4	148.5	7.2
Processed cheeses	47.7	89.6	2.7
Wine and beer	7.9	45.3	0.4
Others ‡	8.9	43.5	0.5
Ultra-processed foods	*491.6*	*404.1*	*27.7*
Industrialized sweets	109.1	169.4	6.1
Ultra-processed breads	84.9	118.6	4.8
Sweet or salty packaged snacks	74.6	148.7	4.2
Ready meals	53.0	174.7	3.0
Margarines and spreads	34.4	63.9	1.9
Ultra-processed meats§	40.3	109.4	2.3
Milk drinks	29.1	59.5	1.6
Ultra-processed cheeses (curd cheese and cheddar)	20.9	53.5	1.2
Industrialized juices	16.0	44.1	0.9
Soft drinks	14.7	48.1	0.8
Condiments/meat and chicken extracts and instant sauces	9.3	28.8	0.5
Others|	5.4	28.5	0.3

Note(s): *Others: Nuts and seeds; spices and aromatic herbs fresh or dried; fishes and sea food; other legumes; offal; water; mushrooms
†Others: Starches extracted from corn and other plants; honey, salt
‡Others: Canned/bottled vegetables, fruits and legumes; salted, cured, or smoked meats; canned fish; salted or sugared nuts and seeds
§Ultra-processed meats: Mortadella; ham; sausage; nuggets; burgers
|Others: Breakfast cereals; alcoholic drinks followed by distillation as whisky, gin, rum and vodka; energy drinks and fruit drinks

Table A4. Caloric contribution of food groups and subgroups on daily energy intake by adults

Appendix 5

Foods by degree of processing	Kcal Mean	SD	Average energy intake (%)
Unprocessed or minimally processed foods	*961.4*	*414.1*	*61.6*
Rice	175.6	112.8	11.3
Red meat	127.5	164.7	8.2
Poultry and others types of meat	139.7	205.3	8.9
Bean	133.6	127.4	8.6
Fruits	116.0	144.0	7.4
Other cereals	57.8	116.5	3.7
Milk and yogurt	72.5	94.4	4.6
Vegetables	35.3	32.9	2.3
Roots and tubers	21.1	47.7	1.4
Coffee and tea	23.4	15.9	1.5
Fruit or vegetable juices	10.9	37.3	0.7
Eggs	15.2	46.0	1.0
Others*	32.8	79.3	2.1
Processed culinary ingredients	*134.6*	*101.7*	*8.6*
Vegetable oil	79.8	70.4	5.1
Sugar	42.8	67.5	2.7
Animal fat	11.3	30.9	0.7
Others†	0.7	5.8	0.0
Processed foods	*192.4*	*177.9*	*12.3*
French bread	124.1	119.0	8.0
Processed cheeses	56.7	98.8	3.6
Wine and beer	10.2	46.8	0.7
Others ‡	1.4	10.9	0.1
Ultra-processed foods	*272.5*	*392.3*	*17.5*
Industrialized sweets	34.4	91.3	2.2
Ultra-processed breads	49.6	87.3	3.2
Sweet or salty packaged snacks	70.7	125.3	4.5
Ready meals	18.0	64.6	1.2
Margarines and spreads	49.4	219.0	3.2
Ultra-processed meats§	7.8	28.0	0.5
Milk drinks	13.2	34.9	0.8
Ultra-processed cheeses (curd cheese and cheddar)	5.9	17.7	0.4
Industrialized juices	4.7	19.3	0.3
Soft drinks	7.2	48.1	0.8
Condiments/meat and chicken extracts and instant sauces	7.3	32.8	0.5
Others|	4.3	24.2	0.3

Note(s): *Others: Nuts and seeds; spices and aromatic herbs fresh or dried; fishes and sea food; other legumes; offal; water; mushrooms
†Others: Starches extracted from corn and other plants; honey, salt
‡Others: Canned/bottled vegetables, fruits and legumes; salted, cured, or smoked meats; canned fish; salted or sugared nuts and seeds
§Ultra-processed meats: Mortadella; ham; sausage; nuggets; burgers
|Others: Breakfast cereals; alcoholic drinks followed by distillation as whisky, gin, rum and vodka; energy drinks and fruit drinks

Table A5.
Caloric contribution of food groups and subgroups on daily energy intake by elderly