

Dietary intake among university students: protective foods *versus* ultra-processed foods

Ingestão alimentar entre universitários: alimentos protetores *versus* alimentos ultraprocessados

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Abstract

Objective: To analyze the dietary intake of university students according to the degree of food processing. **Methods:** Cross-sectional study of a random sample of 40 undergraduate students at the Universidade Federal de São Paulo – *campus Baixada Santista* (Federal University of São Paulo). Dietary intake was estimated by three non-consecutive 24-hour recalls. Mean intake of energy, carbohydrates, proteins, lipids, calcium, iron, sodium and dietary fiber were calculated. Each food reported was classified according to the degree of processing and organized by food group to evaluate the quality of the diet. **Results:** The mean energy intake was 1752.27 kcal (SD = 575.26 kcal), being 42.19% from unprocessed or minimally processed foods, 9.71% from processed foods, 7.09% from processed culinary ingredients and 41.01% from ultra-processed foods. There was higher contribution of unprocessed or minimally processed foods for the quotas of protein, iron and dietary fiber, and of the ultra-processed ones for carbohydrates, lipids and sodium. **Discussion:** Intake of ultra-processed foods represents almost half of the contribution to the daily energy of university students. Foods of ultra-processed group offer lower contribution of dietary fiber and micronutrients and are most likely to be of high sodium content. **Conclusions:** It is possible to project that the maintenance of this dietary profile may have negative effects on health, due to the risks associated with high consumption on ultra-processed foods.

Keywords: Industrialized Foods. Diet Quality. University Students. Food Consumption. Diet Energy.

Resumo

Objetivo: Analisar a ingestão alimentar de universitários segundo o grau de processamento dos alimentos. *Métodos:* Estudo transversal conduzido com 40 universitários adultos da Universidade Federal de São Paulo. A ingestão alimentar foi estimada por três aplicações não consecutivas do Recordatório de 24 horas; foram calculados os valores médios de energia, macronutrientes, ferro, cálcio, sódio e fibra alimentar. Os alimentos foram classificados segundo o grau de processamento e organizados por grupo alimentar para a avaliação da qualidade da dieta. *Resultados:* A média de energia foi de 1752,27 kcal (DP = 575,26 kcal), sendo 42,19% fornecidos por alimentos in natura ou minimamente processados; 9,71% por alimentos processados; 7,09% por ingredientes culinários processados e 41,01% por alimentos ultraprocessados. Houve maior contribuição dos alimentos *in natura* ou minimamente processados para as cotas de proteína, ferro e fibra alimentar; e dos ultraprocessados para carboidratos, lipídeos e sódio. *Discussão:* A ingestão de alimentos ultraprocessados representa quase a metade da contribuição para a energia diária dos universitários. Esses alimentos apresentam menor contribuição de fibra alimentar e micronutrientes e alta contribuição de sódio. *Conclusões:* É possível projetar que a manutenção desse perfil alimentar poderá implicar efeitos negativos sobre a saúde, frente aos riscos associados ao elevado consumo de alimentos ultraprocessados.

Palavras-chave: Alimentos Industrializados. Qualidade da Dieta. Estudantes Universitários. Consumo Alimentar.

Introduction

According to the *Pesquisa de Orçamentos Familiares (POF)* of 2008 and 2009,¹ the prevalence of overweight in the Brazilian population doubled in the last 30 years. This increase is mainly influenced by the reduction of physical activity and by unhealthy eating habits.²

The process of urbanization and the social, economic and cultural changes that have taken place in many countries helped to change the food habits, and the option for *fast-food* restaurant or for purchasing pre-ready or ready-to-eat foods during grocery shopping, are risen alarmingly.³

Ultra-processed foods (UP) are industrial formulations with ingredients extracted or derived from food or artificially synthesized, subjected to various stages of processing, with the aim of

making them more durable, accessible, convenient, hyperpalatable, attractive and ready for consumption. Sophisticated packaging and abusive advertising are also common for UP products.^{4,5} Food patterns marked by high UP food intake are associated with an increase in obesity and its comorbidities, characterized as the main cause of death in Brazil.⁶

These habits also contribute to the double burden of diseases due to eating errors.^{7,8} For this reason, the second edition of the Dietary Guidelines for the Brazilian Population (*Guia Alimentar para a População Brasileira*), in 2014,⁵ values the perception of the quality of food, with recommendations aimed at reducing the intake of processed and ultra-processed foods, and the preference for *in natura* and minimally processed food.

Among university students, preference may be given to processed and ultra-processed foods, often caused by the family's distance and lack of time for self-care due to academic activities. These situations contribute to the option for fast, practical and low-nutrient dense meals.⁹

The identification of the food consumption habits allows obtaining information for the construction of nutritional health indicators and early interventions, with the objective of improving the quality of meals and monitoring the main dietary factors.¹⁰

The objective of this study was to evaluate the food intake among university students and to verify the nutritional contribution according to the processing degree and food groups.

Methods

Study design and characterization of subjects

A cross-sectional study was carried out in a random sample of 40 young adults between 20 and 24 years of age, of both sexes and enrolled in undergraduate courses at the Universidade Federal de São Paulo, campus Baixada Santista (Federal University of São Paulo). The exclusion criteria were: not to agree with the Free and Informed Consent Form (Termo de Consentimento Livre e Esclarecido - TCLE); to be a student of the Nutrition course; to be in a diet-related health treatment.

Sample size

A preliminary study was conducted in a random sample of ten university students with the same characteristics as the study subjects, in order to establish the consumption of ultra-processed and protective foods in the group. This assay indicated a sample of 40 individuals as capable of providing results to identify the characteristics of the variables of interest of the present study, with 95% confidence.

Food intake

Students were interviewed by a non-consecutive three 24h recalls including a weekend day. The interviews were conducted by trained researchers with the intention of reducing the interviewer's bias, with a maximum interval of two weeks between the first and third measurements. The application of the survey followed the *Multiple-Pass Method*.¹¹

Components of analysis

The variables of interest were: energy and nutritional contribution of food groups according to the degree of processing; supply of energy, carbohydrates, proteins, lipids, iron, calcium, sodium, dietary fiber and energy density for the groups according to the degree of processing. Energy and macronutrients were analyzed because they are important variables in studies of consumption. Intake data regarding calcium and iron were verified due to the high prevalence of inadequate intake of these micronutrients.¹ Sodium was evaluated because of the high intake among the Brazilian population. Finally, the dietary fiber intake was evaluated as a marker of diet quality.¹

The Diet Quality Index associated with the *Digital Food Guide (DQI-DFG)*¹² was used for the classification of all foods ingested in the following food groups: Sugar and sweets; Poultry, seafoods and eggs; Beef and pork; Refined cereals and breads; Whole grains and breads, tubers and roots; Fruits; Animal Fats; Non-starchy vegetables; Legumes; Milk and dairy products; Nuts; and Vegetable oils.

DQI-DFG

All foods and ingredients of the recipes were classified into groups according to DQI-DFG¹² and organized into two components: moderation and adequacy. In the moderation components, there are the food groups that, when ingested in excess, increase the chance of developing obesity and other CNCs: sugar and sweets; beef and pork; refined cereals and breads; and animal fats.^{12,13}

In the adequacy components are the groups of foods with higher nutritional density, related to a lower risk for the onset of diseases.¹² They are: poultry, seafoods and eggs; whole grains and breads, tubers and roots; fruits; non-starchy vegetables; legumes; milk and dairy products; nuts; and vegetable oils.

Food classification according to the industrial processing

The food and ingredients of the recipes were identified according to the criteria proposed by the NOVA classification.¹⁴

Data analysis

The Nutrabem Pro system was used,¹⁵ constructed with data from the Brazilian Table of Food Composition (Tabela Brasileira de Composição dos Alimentos - TACO)¹⁶ and the *United States Department of Agriculture Database* (USDA),¹⁷ for the analysis of the dietary variables. Energy, macronutrients, iron, calcium, sodium and dietary fiber values were processed through the *Statistical Package for the Social Sciences* (SPSS) program, adopting 0.05 as level of significance.

The descriptive measures were calculated for all variables of interest. In the inferential analysis, the Pearson Linear Correlation Coefficient was calculated to compare the DQI-DFG score¹² according to energy consumption by NOVA.¹⁴

Ethical aspects

The study employed secondary data of the research *Evaluation of a mobile application for estimation of food intake*,¹⁸ approved by the Comitê de Ética da Universidade Federal de São Paulo – UNIFESP (*Ethics Committee of the Federal University of São Paulo*, process No. 921,257).

Results

A total of 40 individuals were interviewed, the majority being female (n = 34, 85%). The average energy value of the students' diet was 1752.27 kcal (SD = 575.26 kcal), and 42.19% of this value came from ingestion of *in natura* or minimally processed foods; 9.71% of processed foods; 7.09% of culinary ingredients; and 41.01% of ultra-processed foods.

Table 1 contains data on mean energy intake, macronutrients, sodium, calcium, iron, dietary fiber and energy density. The *in natura* or minimally processed foods contributed mainly to the ingestion of proteins (69.33%), iron (57.13%) and fibers (64.02%). In turn, the culinary ingredients contributed with higher energy density - 3.87 kcal / g. Among processed foods, the highest nutritional contribution was calcium (26.73%). Yet, ultra-processed foods contributed mainly to the ingestion of carbohydrates (45.44%), lipids (46.33%) and sodium (52.88%).

The energy contribution per food group and components of moderation, suitability and miscellaneous, according to the DQI-DFG,¹² classified according to NOVA¹⁴ are shown in Table 2.

Table 1. Descriptive analysis of total energy intake and nutrients according to the degree of food processing. Brazil, 2017.

Dietary variables	Total intake			Group 1 - <i>in natura</i> or minimally processed			Group 2 - culinary ingredients			Group 3 - processed			Group 4 - ultra-processed		
	Average	SD ¹	CI ²	Average	SD ¹	CI ²	Average	SD ¹	CI ²	Average	SD ¹	CI ²	Average	SD ¹	CI ²
Energy (kcal)	1752,27	575,26	739,36 (596,44 882,29)	124,17	87,96	(96,04 152,30)	170,12	149,81	(122,20 218,02)	718,62	368,73	(602,29 834,95)	718,62	368,73	(602,29 834,95)
Carbohydrate (g)	227,21	79,70	91,92 (72,28 111,55)	16,41	17,29	(10,88 21,94)	15,65	17,20	(10,15 21,15)	103,24	58,54	(84,52 121,97)	103,24	58,54	(84,52 121,97)
Protein (g)	80,98	41,85	56,15 (43,16 69,13)	0,20	0,27	(0,11 0,29)	6,96	8,08	(4,38 9,55)	17,67	10,79	(14,22 21,13)	17,67	10,79	(14,22 21,13)
Lipid (g)	57,97	22,55	16,98 (13,46 20,50)	6,68	4,65	(5,19 8,17)	7,43	7,60	(5,00 9,86)	26,88	16,90	(21,47 32,28)	26,88	16,90	(21,47 32,28)
Calcium (mg)	669,22	269,89	258,68 (220,27 297,09)	10,04	13,99	(5,57 14,52)	178,86	200,13	(114,85 242,86)	221,64	135,58	(178,28 264,99)	221,64	135,58	(178,28 264,99)
Iron (mg)	9,78	4,03	5,59 (4,39 6,78)	0,09	0,10	(0,06 0,13)	0,48	0,59	(0,29 0,67)	3,62	2,10	(2,95 4,29)	3,62	2,10	(2,95 4,29)
Sodium (mg)	1910,14	782,24	249,61 (202,45 296,77)	359,60	216,62	(290,32 428,88)	290,84	254,13	(209,56 372,11)	1010,10	709,29	(783,25 1236,94)	1010,10	709,29	(783,25 1236,94)
Fiber (g)	15,50	7,44	9,92 (7,64 12,21)	0,02	0,04	(0,01 0,04)	0,70	0,99	(0,38 1,02)	4,85	3,80	(3,63 6,07)	4,85	3,80	(3,63 6,07)
Density (kcal/g)	1,42	—	1,11	—	—	—	3,87	—	—	—	—	—	1,66	—	—

¹Standard Deviation; ²95% Confidence Interval;

Table 2. Descriptive analysis of total energy intake according to DQI-DFG food groups and according to NOVA, Brazil, 2017.

Food Groups	Total intake		Group 1 - <i>in natura</i> or minimally processed			Group 2 - culinary ingredients			Group 3 - processed			Group 4 - ultra- processed			
	Average	SD ¹	%	Average	SD ¹	Average	SD ¹	Average	SD ¹	Average	SD ¹	Average	SD ¹	Average	SD ¹
<i>Components of moderation</i>	1015,90	450,82	57,11	306,15	301,59	90,26	89,51	62,55	77,40	556,94	339,91				
Sugar and sweets	349,04	226,06	19,76	0,63	4,00	40,88	46,21	11,08	35,26	296,45	207,76				
Beef and pork	182,25	143,20	10,54	101,12	96,62	--	--	0,58	3,70	80,55	104,97				
Refined cereals and breads	439,55	303,10	24,23	204,38	284,73	22,28	63,81	50,89	68,84	161,99	161,57				
Animal Fat	45,04	51,14	2,58	--	--	27,10	34,96	--	--	17,94	37,98				
<i>Adequacy components</i>	694,50	284,53	40,59	425,78	218,72	33,62	28,49	89,98	99,74	145,12	123,93				
Poultry, seafoods and eggs	188,09	207,53	10,13	172,55	198,00	--	--	4,02	21,62	11,51	59,79				
Whole grains and breads, tubers and roots	95,34	119,54	5,69	38,26	56,37	--	--	8,31	37,64	48,77	97,73				
Fruits	62,51	59,01	4,31	52,57	52,43	--	--	--	--	9,93	24,07				
Non-starchy vegetables	27,11	16,50	1,66	18,33	12,16	--	--	1,47	4,01	7,30	9,63				
Legumes	75,66	115,99	4,55	75,56	115,66	--	--	0,10	0,62	--	--				
Milk and dairy products	169,46	103,84	9,92	64,88	52,56	--	--	64,12	76,38	40,45	36,52				
Nuts	3,79	11,26	0,25	3,60	10,93	--	--	0,19	1,20	--	--				
Vegetable oils	72,53	60,77	4,05	--	--	33,62	28,49	11,77	40,26	27,15	36,75				
<i>Miscellaneous</i>	41,88	49,68	2,30	7,44	9,64	0,29	0,68	17,58	42,22	16,57	25,31				

¹Standard Deviation;

Pearson's Linear Correlation Coefficients for the DQI-DFG score¹² according to the NOVA classification¹⁴ showed that all groups presented weak correlations. However, group 1 - *in natura* and minimally processed foods - has a positive correlation coefficient ($r = 0.31$), indicating that the higher the consumption of *in natura* and minimally processed foods, the higher the DQI-DFG score.¹² On the opposite, the DQI-DFG¹² score decreases as the energy intake of culinary ingredients ($r = -0.17$), processed food ($r = -0.28$), and ultra-processed food ($r = -0.48$) increases.

Discussion

In this study, almost half of the students' daily energy intake came from ingestion of ultra-processed foods. Considering the high intake of risk components, such as lipids and sodium, and the lower intake of micronutrients such as iron, and dietary fiber from ultra-processed foods, it is possible to project that the maintenance of this consumption profile could generate negative effects on health, considering the risks associated with ultra-processed food.^{19,20}

Foods are complex structures composed of nutrients and bioactive compounds, and the single analysis of nutrient intake does not consider the synergy of these components in food matrices.²⁰⁻²² Despite the relevance of international guidelines related to nutritional recommendations,²³⁻²⁸ assessing dietary intake from the food perspective tends to broaden knowledge about consumption patterns and their long-term effects on health.²⁰⁻²²

Ultra-processed foods

According to Bielemann et al.,² more than half (51.2%) of the daily energy intake of 4,297 young adults participating in the Pelotas-RS cohort in 1982 was attributed to the ingestion of ultra-processed foods, especially the groups of sweets, sugars and breads. In the present study, 57.11% of average energy intake come from the moderation components, which increase the chances of developing obesity and CNCD, when consumed in excess.^{12,13,19,29-31}

Report by WHO³² points out that ultra-processed foods are presented to the population as practical and healthy options. However, in addition to poor nutritional quality, they also stimulate the habit of small snacks between meals, increasing the chance of excessive energy intake.^{30,31} Excess intake can also be explained as these foods act similarly to substances that cause addiction by activating physiological brain processes that lead to behavioral adaptations comparable to those generated by drug abuse.^{33,34}

The contribution of calcium attributed to ultra-processed foods (33,12%) was similar to *in natura* and minimally processed food (38.65%), as it is related to the ingestion of both ultra-processed cheeses (cottage cheese, *cheddar cheese*, ricotta cream, *cream cheese*) and sugary milk drinks, as well as natural milks and yogurts. When studying the impact of ultra-processed foods on the micronutrient content in Brazil, Louzada et al.⁴ also presented higher calcium concentration for the group of ultra-processed foods.

The World Health Organization³⁵ recommends that sodium intake would be 2g per day, which is in agreement with the average result found in this study (1.9g), slightly higher than the value of 1.5g indicated by the *Institute of Medicine*.²⁴ The highest percentage (52.88%) was originated by ultra-processed foods, confirming the need of reducing the sodium content added by the industry to processed or ultra-processed foods.⁴

Protective foods

In natura and minimally processed foods are important for the maintenance of health by providing nutrients that help in the prevention of diseases related to eating habits.^{12,14,19}

Adequate intake of food of plant origin offers quality to the food standard, given the amount of fiber, micronutrients and bioactive compounds present in these foods. Foods of animal origin are important because they are sources of proteins of high biological value and of most essential vitamins and minerals. The frequent ingestion of fresh food in most meals, especially those of vegetable origin and with moderate amounts of food of animal origin, confers the balance of important nutrients to human health and promotes more sustainable food systems.⁵

Although *beef and pork* belong to Group 1 (*in natura* or minimally processed food), frequent consumption is associated with an increase in the incidence of colorectal cancer, the third most common type and the fourth cause of cancer death.³⁶ Evidence also suggests that the high intake of processed meat is related to the worsening of cardiovascular diseases.³⁷ As these foods have a high concentration of iron,^{1,25,26} the content of this micronutrient for Group 1 was higher when compared to the other groups (57.13%), as well as in the study conducted by Monteiro et al.¹⁹

On average, 40.59% of the energy comes from the adequacy components. The legumes and particularly beans, food belonging to the Brazilian food habits, are present in this group.¹ Beans, together with rice, provide about a quarter of the available energy in the diet of Brazilian people, constituting a source of essential amino acids and dietary fiber, among other important nutrients.⁵

The study of Reis et al.³⁸, conducted with 299 university students from the city of São Paulo, identified that the usual intake of vegetables in this group occurred only in one main meal; for fruit, the intake was four times a week.

The findings presented in this study are similar, since the energy contribution of both groups was lower than a portion proposed by DQI-DFG.¹² Therefore, low consumption of fruits and vegetables, cereals and whole-grain breads justifies the low value of dietary fiber intake. Daily intakes of dietary fiber of at least 30g are associated with the prevention of CNC^{39,40} which are twice that observed intake in the present study.

The average energy density derived from Group 2 (culinary ingredients) was the highest (3.87kcal / g), considering the foods that comprise it: vegetable oils, lard, butter and sugars. The consumption of ingredients with high energy density increases the intake of sugars, sodium and fats, food components associated with risk for chronic diseases.^{41,42}

Conclusion

Intake of ultra-processed foods represents almost half of the contribution to the daily energy of university students in this study. There was greater contribution of *in natura* or minimally processed foods to the quotas of protein, iron and dietary fiber; of processed culinary ingredients for energy density; and ultra-processed for carbohydrates, lipids and sodium.

Health education strategies are needed in order to promote the autonomy of the subject for more adequate food choices. In this sense, food guides are use full nutrition education tools which stimulate increased intake of fresh and poorly processed foods as alternatives to ultra-processed foods.

Within the perspective of the study, it is relevant that the universities incorporate mechanisms of application of these strategies, offering safe and healthy foods in their canteens and university restaurants.

Contributors

Mescoloto SB participated in the conception and design of the work; data collection and interpretation; writing and critical review of the article, and approval of the version to be published. Caivano S participated in the conception and design of the work; interpretation of data; writing and critical review of the article, and approval of the version to be published; Duarte MH participated in the conception and design of the work; collection of data; writing of the article, and approval of the version to be published; Domene SMA participated in the conception and design of the work; writing and critical review of the article, and approval of the version to be published.

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