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Association between ultra-processed food consumption and nutrient intake among low-risk pregnant women

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Abstract

Objectives: to analyze the ultra-processed foods (UPF) consumption in pregnant women's diets associated with nutrient intake.

Methods: a cross-sectional study using socioeconomic, anthropometric and food consumption data from low-risk pregnant women. Consumption of energy, macro and micronutrient were obtained through two 24-hour recalls (R24h). The UPF were identified using the NOVA classification, and the percentage of energy from this food was classified in quartiles and associated with nutrient intake. So, the ANCOVA test adjusted for age and per capita income were adopted.

Results: a total of 60 pregnant women with a mean of age of 28.44 (CI95%=27.20-29.69) years old were evaluated. The average percentage of UPF in the diet was 20.68 (CI95%=17.88-23.47). Pregnant women in the highest quartile of UPF consumption had lower protein intake (13.48g vs. 18.84g; p=0.031) and lower zinc intake (4.52mg vs. 6.18mg; p=0.045) when compared to those in the lowest quartile.

Conclusions: the results showed a negative relationship between the participation of UPF in pregnant women's diets and the intake of protein and zinc, important nutrients for the gestational period. Such findings reinforce the importance of promoting healthy eating habits during pregnancy to ensure an adequate supply of nutrients in this phase.

Key words *Maternal nutrition, Industrialized foods, Food consumption, Pregnancy, Nutrients*

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Introduction

The NOVA food classification system, developed by researchers from the University of São Paulo, Brazil, propose the categorization of food according to their purpose and degree of processing applied.[1] Food items that are processed with the addition of ingredients for industrial use are called ultra-processed food (UPF). Examples of these food include filled cookies, ice cream, instant noodles, flavored yogurts and sweetened drinks, packaged snacks, and among others.[1]

In recent years, UPF consumption has grown in Brazil, following the trend of developed countries, as demonstrated by the *Pesquisa de Orçamentos Familiares* (POF) (free translation: Household Budget Survey) carried out in the metropolitan areas of Brazil between 2002-2003 and 2017-2018.[2] The caloric participation of ultra-processed products rose from 12.6% to 18.4% between the two periods. In addition, there was a decrease in the participation of fresh and minimally processed foods.[2]

Regarding the nutritional composition, UPF present high energy density, content of sugar, sodium, total fat and saturated fat, and low amount of protein and fiber when compared to natural or minimally processed food.[3-5] Literature has shown an association between excessive consumption of UPF with obesity, chronic non-communicable diseases and metabolic syndrome.[6-9] Additionally, some studies have related the intake of these food with inadequacies of macro and micronutrients at different stages of life.[5,8,9]

It is known that during the gestational period, several physiological changes occur in the woman's body, in order to provide a favorable environment for the development of the fetus, thus increasing the demand for energy and nutrients. During this period, the energy requirement increases moderately, while the increase in nutrient demand occurs more significantly. Some nutrients, such as vitamins A, B9 (folate), B12, C, D and the minerals calcium, sodium, iron and zinc, in addition to omega-3 fatty acid, have an increased demand due to their importance for the development of pregnancy.[10,11]

It becomes evident, then, that the quality of a woman's diet, before and during pregnancy, impacts the child's growth and development and maternal health. For this reason, nutritional inadequacies in this period can compromise the evolution of pregnancy, leading to an increased chance of negative outcomes for childbirth and the newborn's health.[10,11]

In this context, the present study aimed to analyze the participation of UPF in pregnant women's diets and their association with the adequacy of important nutrients for this life cycle.

Methods

This is a cross-sectional study carried out with low-risk pregnant women who participated in the baseline of the project "Omega-3 supplementation during pregnancy to prevent depressive symptoms and possible effect on breastfeeding, child's growth and development" approved by the Research Ethics Committee of the *Universidade Federal de Minas Gerais* under number 87705018.0.0000.5149. All participants were informed about the objectives and methods of the study and signed the Informed Consent Form.

Data collection was carried out between September 2018 and July 2019 in a public prenatal clinic, located in a capital city in the Southeast region of Brazil (Belo Horizonte, Minas Gerais).

The inclusion criteria were gestational age between 22 and 24 weeks, age between 20 and 40 years, not being in a multiple pregnancy and not having a gestational risk according to the criteria established by the Brazilian Ministry of Health[12] (history of abortion, presence of infectious diseases or conditions such as hypertension, diabetes, neoplasms, and among others).

Data were collected via face-to-face interviews, with the aid of a structured questionnaire built for this research. Socioeconomic, anthropometric and food consumption information were obtained.

Socioeconomic information was assessed by age, occupation, parity, per capita income, education and marital status.

Regarding anthropometry, pre-gestational weight, current weight and height were collected. The pre-gestational weight was reported by the participant, while the current weight was measured with the aid of a digital Líder® platform scale model P-200C, with a capacity from 2 to 200 kilograms and accuracy of 100 grams. Height was obtained using a stadiometer attached to the scale. The pre-gestational Body Mass Index (BMI=kg/m^2) was calculated and classified according to the WHO criteria.[13] To classify the gestational BMI, the curve of Atalah *et al*.[14] was used.

Food consumption was obtained through two 24-hour recalls (R24h), applied on non-consecutive days, with a maximum interval of one week between them, the first being during the face-to-face interview and the second by telephone. In order to minimize losses in the collection of R24h via telephone, at least three attempts were made to contact each day shift (morning, afternoon and night).

All food and beverages consumed on the previous day were expressed in household measures, which were later converted into grams or milligrams.[15]

The total caloric intake, the caloric percentage from UPF and the intake of macro and micronutrients were obtained by the average of the values referring to the two days of food consumption, being computed with the aid of the Brasil Nutri® software, according to the methodology adopted in the last POF.[2]

The percentage of daily caloric intake from UPF was obtained by classifying the food listed in the R24h according to the NOVA classification. In this classification, UPF is considered to be industrial forms resulting from the processof a mixture of substances extracted from food (oils, starch, sugar, etc.), derived from food constituents (hydrogenated fat, modified starch, etc.) or synthesized in the laboratory (synthetic vitamins and minerals, colorings, flavors, flavor enhancers and additives used to improve sensory properties).[1]

After that, the participants were classified in quartiles of the participation of the UPF to the total caloric value of the diet. Next, the association of these quartiles with energy, macro and micronutrient intake was evaluated. Fibers, carbohydrates, proteins, lipids and omega-3 fatty acids were evaluated. The micronutrients evaluated were vitamins A, folate, B12, C, D, E and the minerals calcium, sodium, iron and zinc. The content of macronutrients and omega-3 were expressed as a percentage of the total caloric value and micronutrients were expressed in mg or µg/1,000Kcal.

Using Epi Info™ 3.5.1 software, the minimum need for 59 participants was estimated, using the average percentage of UPF intake obtained in a previous study,[16] 95% confidence level, 5% error, formula for descriptive purposes and finite population. The database was built using the Epi Info™ 3.5.1 program by means of double typing and appropriate consistency analyzes were performed. Statistical analyzes were performed using the Statistical Package for the Social Sciences (SPSS) version 19.0 and Stata® version 11 software.

Initially, the Shapiro-Wilk test was applied to assess the adherence of numerical variables to the normal distribution. Then, descriptive analysis was performed by estimating frequencies, means and 95% confidence intervals (CI95%). The difference between the averages of nutrient consumption according to the quartiles of UPF consumption was evaluated using the ANCOVA test with Bonferroni correction, adjusted by age and per capita income. For all analyses, a significance level of 5% was adopted.

Results

Sixty pregnant women with a mean of 28.44 (CI95%=27.20-29.69) years of age, gestational age of 23.00 (CI95%=22.64-23.36) weeks and per capita income of 776.41 (CI95%=661.4-891.41) reais. The other characteristics of the sample are presented in Table 1.

Table 1

Sample characteristics

Variables	N	%	CI95%
Age (years)			
20-25	17	28.3	18.0 – 41.9
26-35	39	65.0	50.7 – 75.8
36-40	4	6.7	0.2 – 13.1
Per capita income(minimum wage)			
<0.5	14	25.5	13.5 – 37.3
0.5-1.0	26	47.3	33.6 – 60.8
>1.0	15	27.2	15.1 – 39.4
Profissional occupation			
Paidwork	32	53.3	40.3 – 66.3
Student	6	10.0	2.1 – 17.8
Housewife	16	26.7	15.1 – 38.1
Unemployed	6	10.0	2.1 – 17.8
Marital status			
Married/stableunion	41	71.9	60.0 – 84.0
Single/divorced	16	28.1	16.0 – 40.0
Education level			
Elementary school	5	8.3	1.1 – 15.5
High school	37	61.7	49.0 – 74.3
Higher education	18	30.0	18.0 – 41.9
Parity (child)			
0	31	51.7	35.0 – 61.0
≥1	29	48.3	39.0 – 65.0
Pre-gestacional BMI			
Low weight	3	5.0	0.7 – 10.6
Adequate	32	53.4	40.3 – 66.3
Overweight	25	41.6	28.8 – 54.5
Current BMI			
Low weight	6	10.0	2.1 – 17.8
Adequate	26	43.3	30.4 – 56.2
Overweight	28	46.7	33.6 – 59.6

CI = Confidential Interval; BMI = Body Mass Index; Minimum wage (2018-2019): ≈ R$980.

Regarding nutritional status, 41.6% (n=25) of the participants were overweight before the pregnancy, and 46.7% (n=28) currently. There was no association between pre-pregnancy and current nutritional status with UPF intake ($p>0.05$).

The mean energy percentage of UPF in the diet was 20.68% (CI95%=17.88-23.47). The analysis of energy intake, macro and micronutrients in the diet according to the quartiles of energy from the UPF is presented in Table 2.

Pregnant women in the highest quartile of UPF consumption had lower protein intake (13.48g *vs*. 18.84g; p=0.031) and lower zinc intake (4.52mg *vs*. 6.18mg; p=0.045) when compared to those in the lowest quartile.

Discussion

The present study found an average UPF participation of approximately 20% of total calories ingested among women at usual risk. The greater participation of UPF was associated with a reduced intake of proteins and zinc.

Table 2

Means of energy and nutrient intake according to the quartiles of ultra-processed food participation in total energy consumption

	Quartiles of ultra-processed food consumption Adjusted means (CI95%)				p*
	1st Quartile	2nd Quartile (12,8-18,4%)	3rd Quartile (18,4-27,3%)	4th Quartile (>27,3%)	
Energy (Kcal)	1983.90 (1641.59-2326.22)	2184.37 (1831.86-2536.89)	2156.59 (1836.62-2476.57)	2162.88 (1814.93-2510.84)	0.836
Carbohydrates (%)	46.36 (40.23-52.49)	52.06 (45.74-58.37)	49.50 (43.77-55.23)	53.21 (46.98-59.44)	0.420
Proteins (%)	18.84 (16.27-21.40)[a]	15.56 (12.92-18.20)	15.36 (12.96-17.76)	13.48 (10.87-16.09)[a]	0.031
Lipids (%)	35.10 (30.66-39.53)	33.52 (28.95-38.09)	36.30 (32.16-40.45)	34.59 (30.08-39.10)	0.834
Omega 3 (%)	0.62 (0.45-0.79)	0.74 (0.56-0.91)	0.60 (0.44-0.76)	0.70 (0.53-0.87)	0.622
Fiber (g/1,000Kcal)	9.44 (7.26-11.62)	10.83 (8.58-13.07)	10.16 (8.12-12.19)	9.26 (7.04-11.47)	0.745
Vitamin A (µg/1,000Kcal)	503.09 (278.33-727.85)	265.40 (33.94-496.85)	260.59 (50.50-470.68)	219.79 (86.77-448.25)	0.288
Vitamin C (mg/1,000Kcal)	73.32 (42.56-104.09)	48.37 (15.54-81.19)	41.74 (13.01-70.47)	53.68 (22.49-84.87)	0.503
Vitamin D (µg/1,000Kcal)	1.45 (0.97-1.94)	1.31 (0.80-1.81)	1.90 (1.43-2.37)	1.34 (0.84-1.83)	0.273
Vitamin E (mg/1,000Kcal)	2.11 (1.68-2.53)	2.61 (2.17-3.05)	1.95 (1.55-2.35)	1.99 (1.56-2.42)	0.127
Vitamin B12 (mg/1,000Kcal)	1.54 (1.01-2.07)	1.55 (1.05-2.06)	2.12 (1.65-2.58)	1.47 (0.97-1.98)	0.197
Folate (mg/1,000Kcal)	137.23 (108.61-165.85)	143.06 (113.58-172.53)	128.72 (101.96-155.47)	121.92 (92.83-151.01)	0.746
Sodium (mg/1,000Kcal)	824.20 (590.71-1057.69)	755.15 (514.71-995.60)	884.73 (666.48-1102.98)	902.10 (664.77-1139.44)	0.811
Calcium (mg/1,000Kcal)	318.06 (231.69-404.44)	280.39 (191.44-369.34)	357.95(277.21-438.69)	340.72 (252.92-428.52)	0.608
Iron (mg/1,000Kcal)	5.96 (5.14-6.77)	5.88 (5.04-6.72)	5.45 (4.69-6.21)	4.99 (4.17-5.82)	0.330
Zinc (mg/1,000Kcal)	6.18 (5.35-7.02)[a]	5.28 (4.42-6.14)	5.68 (4.88-6.49)	4.52 (3.68-5.37)[a]	0.045

CI = Confidential Interval; *ANCOVA with Bonferroni correction; adjusted by age and per capita income. Mean values with common letters in the same row are statistically different ($p<0.05$).

The average UPF participation found in the present study was lower than that found in other studies conducted with pregnant women. A cross-sectional study carried out in Brazil with 785 women between the 24-39 gestational weeks identified an average contribution of 32% of the total energy consumed from UPF.[16] In a prospective investigation that followed 365 Brazilian low risk pregnant women from the first to third trimesters of pregnancy, it was noted that UPF represented 24.6% of total energy intake.[17] In the Brazilian adult population (n=32898), Louzada *et al*.[3] showed a percentage contribution of 20.4% to energy consumption arising from the UPF.

In addition to the high participation of UPF in the diet, recent studies demonstrate an association between the intake of these food and the development of overweight and obesity[5,8] and during pregnancy, excessive UPF consumption are related to excessive gestational weight gain, which is associated with greater risk of gestational diabetes (GD), preeclampsia and greater postpartum weight retention.[17-19]

A lower protein intake was observed among women in the highest quartile of UPF, when compared to those in the lowest quartile. It is recognized that UPF, in general, have a lower protein content when compared to natural or minimally processed food[3,5] and the inverse relationship between UPF and protein consumption was also found in previous studies.[20-22] It is noteworthy that UPF are often added with sugar and fats, in order to preserve or make the product more palatable, which leads to a lower participation of proteins in its composition.[3,5]

It is known that, during pregnancy, protein requirements are increased: the RDA for adult pregnant women is 71g/day, while for non-pregnant women in the same age group is 46g/day.[23] This is due to the fundamental role played by the protein in the development of the placenta, in the hypertrophy of maternal tissues and in the expansion of blood volume; factors that directly influence the growth of the fetus.[24]

Regarding the association found between the greater participation of UPF in the diet and the lower intake of zinc, it is noteworthy that this association has also been significantly demonstrated in other studies.[8,15,25] It is recognized that zinc participates of numerous structural and biochemical functions, being essential for reproduction and maturation, hormonal regulation of cell division, tissue repair, immune response and the functioning of cell membranes.[26]

Zinc deficiency, a nutrient present in smaller amounts in UPF when compared to natural and minimally processed food, is among the most relevant nutritional problems worldwide and has a high prevalence among the maternal and child population.[8,26] The importance of zinc for the healthy development of pregnancy can be observed by the 37.5% increase in the requirement for this nutrient during the gestational period.[23,27] It is noteworthy that its deficiency is related to spontaneous abortions, intrauterine growth restriction, preterm birth, preeclampsia, fetal immune impairment, neural tube defects, and abnormal organ development.[26,27]

According to Louzada *et al*.,[8] not only the content of zinc, but also of micronutrients in UPF tends to be lower, often being less than half of the content found *in natura* food. This is mainly due to the extensive degree of industrial processing that leads to the loss of nutrients from basic food. This fact assumes great relevance when considering that these nutrients play critical roles in the processes of cell signaling, hormone production, immune response and the development and maintenance of vital functions.[8]

These facts added to the results found in this study reinforce the unfavorable impact of UPF consumption and the importance of promoting healthy food during pregnancy. It is noteworthy that this is related to the recommendations of the new *Guia Alimentar para População Brasileira*[28] (free translation: Food Guide for the Brazilian Population), an official document, released by the Ministry of Health, which addresses the concepts and recommendations of healthy food. It advocates the importance of a diet based on natural and minimally processed food with the moderate consumption of processed food and guides the avoidance of UPF. Therefore, adherence to the recommendations of the *Guia Alimentar para População Brasileira* can contribute to improve the quality of food consumption by pregnant women and to the development of food and nutrition education actions and strategies to promote adequate and healthy food.

The present study has a cross-sectional design as a limitation, considering that food intake changes during the pregnancy cycle, and its prospective evaluation is important. However, this work stands out for evaluating the association between the caloric participation of UPF and nutrient intake among pregnant women, considering the scarcity of studies on this topic in the gestational period.

The results presented showed an unfavorable relationship between the participation of UPF in the diet and the intake of proteins and zinc among pregnant women at usual risk. Therefore, there is a need to strengthen and expand food and nutrition education programs and actions, with a focus on promoting health for pregnant women, prioritizing the recommendations of the new edition of the *Guia Alimentar para População Brasileira*, which advocates a diet based on natural or minimally processed food and with low UPF participation.

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Authors' contribution

Silva AC and Corrêa MJG participated in data collection, and tabulation and writing of the manuscript. Sousa TM participated in the design, supervision of data collection and tabulation, statistical analysis, writing and review of the manuscript. Santos LC participated in the design, study coordination, and final critical review of the manuscript. All authors approved the final version of the article and declared that there was no conflict of interest.

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