Relationship between pregestational nutritional status and type of processing of foods consumed by high-risk pregnant women

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Abstract

Objectives: to relate pregestational nutritional status, maternal age and number of pregnancies to the distribution of macronutrients and micronutrients according to the type of processing of foods consumed by high-risk pregnant women.

Methods: a retrospective cross-sectional study was carried out with data from medical records of 200 pregnant women served by a public outpatient clinic in Rio Grande do Sul from 2014 to 2016.

Results: the mean percentages of lipids, monounsaturated fatty acids, polyunsaturated fatty acids and sodium intake were higher among ultra-processed foods. There was a significant inverse correlation between maternal age and total calorie intake (p=0.003) and percentage of carbohydrates (p=0.005) and proteins (p=0.037) from ultra-processed foods. There was also a significant association between pregestational nutritional status and total calorie intake (p=0.018) and percentage of carbohydrates (p=0.048) from ultra-processed foods.

Conclusions: the mean percentages of lipids, monounsaturated fatty acids, polyunsaturated fatty acids and sodium intake were higher among ultra-processed foods. It was observed that the older the maternal age of high-risk pregnant women, the lower the intake of total calories and percentages of carbohydrates and proteins from ultra-processed foods. It was also observed that pregestational nutritional status was significantly associated with the intake of total calories and percentage of carbohydrates from ultra-processed foods.

Key words *Pregnancy high-risk, Maternal health, Feeding behavior*

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Introduction

Pregnancy is the period in which nutritional needs are increased due to physiological adjustments in the maternal organism and fetal development. Therefore, adequate nutrient availability and a balanced diet are essential for this phase of life.[1] During pregnancy, both mother and the fetus may face health risks that can lead this phase to become a risk pregnancy[2] in which the most common consequences are preterm birth, prolonged pregnancy, preeclampsia and eclampsia, hemorrhages, gestational diabetes, cervical insufficiency, and even death of the fetus.[3]

Pregnant women's inadequate dietary habits potentiate risks during pregnancy[4] and have a strong impact on obstetric outcomes and clinical characteristics of the newborn.[5] Therefore, the expectant mother needs to be aware of her pregestational nutritional status, her food intake and, above all, the quality of the food sheeats.[6]

The Dietary Guidelines for the Brazilian Population classified food according to the type of processing, with natural foods being those obtained from nature that do not undergo any type of processing. Minimally processed foods are natural foods that undergo some type of processing for cleaning, removal of unwanted parts, grinding, drying and pasteurization, among others. Processed foods are natural or minimally processed foods that contain additives (sugar, salt or some substance used in cooking) to enhance flavor or increase durability. Ultra-processed foods are foods that undergo several types of processing and that are added to industrial formulations.[7]

The daily intake of natural and minimally processed foods is related to disease prevention.[8] On the other hand, the intake of processed and ultra-processed foods is related to the onset of chronic diseases given the changes in their nutritional composition. This explains the importance of having pregnant women prioritize natural foods and reduce the intake of processed foods and avoid ultra-processed foods.[9]

Healthy habits and choices, in addition to minimizing risks during pregnancy, improve the quality of fetal development and maternal nutritional status.[10] Thus, given the scarcity of publications addressing the relationship between pregnant women's nutritional status and the type of processing of the food they eat, this study aimed to relate pregestational nutritional status, maternal age and number of pregnancies to the distribution of macronutrients and micronutrients according to the type of processing of foods consumed by high-risk pregnant women.

Methods

This is a quantitative retrospective cross-sectional study of data from medical records of 300 high-risk pregnant women. The study included high-risk pregnant women aged 15 to 45 years who were referred from 2014 to 2016 for the treatment of comorbidities such as hypertension, *diabetes mellitus*, hypothyroidism, toxoplasmosis and obesity in a public outpatient clinic located in the countryside of Rio Grande do Sul. The study excluded 100 medical records that did not present complete data on a 24-hour dietary recall of a single day and information on pregestational nutritional status, age, and number of pregnancies. Thus, 200 medical records were selected for analysis. The present study was approved by a Research Ethics Committee under Approval Nº. 1.591.097 and CAAE No. 55981216.3.0000.5310.

The pregestational nutritional status was determined using the body mass index (BMI) and its classification was based on the 1998 World Health Organization (WHO) standards, namely: malnutrition (<18.5 kg/m²), normal weight (≥18.5 and ≤24.9 kg/m²), overweight (≥ 25.0 and ≤ 29.9 kg/m²), class I obesity (≥30.0 and ≤34.9 kg/m²), class II obesity (≥35.0 and ≤39.9 kg/m²) and class III obesity (≥40.0 kg/m²).[11]

The 24-hour dietary recalls of the pregnant women were analyzed using the 2008 DietWin® software and total calories and intake of carbohydrates, proteins, lipids, sodium, and monounsaturated, polyunsaturated and saturated fats from all the foods consumed were measured. After that, the calories and percentages of each macronutrient and each micronutrient mentioned above were calculated according to the classification of each food described in the Dietary Guidelines for the Brazilian Population, which categorizes foods into: natural, minimally processed, processed and ultra-processed.[7]

Statistical analysis was performed using the Kruskal-Wallis test and Pearson's correlation analysis. Results were considered significant at a maximum significance threshold of 5%. The software used for the analyses was the SPSS (Statistical Package for the Social Sciences) version 22.0.

Results

The mean age of the pregnant women was 29.64 ± 6.82, the mean number of children was 1.92 ± 1.04,

and the mean number of pregnancies was 2.49 ± 1.5. With regard to the percentages of total calories from the different types of processing of the foods consumed by high-risk pregnant women, 47.21% were from natural/minimally processed foods, 38.07% were from ultra-processed foods, and 14.72% were from processed foods.

According to Table 1, there were higher means of total calories and percentages of carbohydrates, proteins and saturated fats from natural/minimally processed foods followed by ultra-processed and processed foods. The mean percentages of lipids and monounsaturated and polyunsaturated fats were higher among ultra-processed foods, followed by natural/minimally processed foods and processed foods. In regard to the percentage of sodium, there was a higher mean among ultra-processed foods, followed by processed foods and natural/minimally processed foods.

There was a direct correlation (Table 2) between age and percentage of carbohydrates from natural/minimally processed foods (p=0.013). There was also a significant inverse relationship between age and intake of total calories (p=0.003) and percentages of carbohydrates (p=0.005) and proteins (p=0.037) from ultra-processed foods.

There was also a correlation between pregestational nutritional status and percentage of protein from natural/minimally processed foods (p=0.021). The percentage of intake of protein from natural/minimally processed foods in Class III obese pregnant women was significantly lower when compared with overweight and class I and II obese pregnant women. There was also an association of pregestational nutritional status with total calorie intake (p=0.018) and percentage of carbohydrates (p=0.048) from ultra-processed foods. Total calorie intake and percentage of carbohydrates from ultra-processed foods were significantly higher among high-risk pregnant women with class III obesity and normal weight when compared with overweight and class II obese pregnant women. Additionally, overweight and class II obese high-risk pregnant women exhibited lowers percentages of protein from ultra-processed foods (p=0.024) when compared with those with normal weight or class I and III obesity (Table 3).

Class III obese pregnant women presented lower percentages of intake of monounsaturated (p=0.040) and saturated (p=0.034) fats from natural/minimally processed foods when compared with class II obese pregnant women (Table 4).

There was an association between pregestational nutritional status and percentage of sodium from natural/minimally processed foods (p=0.050). Class III obese pregnant women presented significantly lower percentages of intake of sodium from natural/minimally processed foods when compared with overweight or class I and II obese pregnant women (Table 5).

Discussion

The consumption of ultra-processed foods in the present study represented 38.07% of the total calories consumed by high-risk pregnant women. This percentage is lower than that found in a study carried out with young adults in the city of Pelotas, Rio Grande do Sul, which showed a consumption of 51.20%,[12] and higher than that found in a study carried out with individuals from the 2008 and 2009 Family Budget Surveys in São Paulo, which demonstrated a consumption of 21.5% of total calories.[13] This finding shows the increasing influence of ultra-processed products on Brazilian food[14] and hence the need to develop strategies to encourage the consumption by the entire population, including pregnant women, of natural/minimally processed foods.[15]

The present study demonstrated that the older the maternal age of high-risk pregnant women, the lower the intake of total calories and the percentages of carbohydrates and proteins from ultra-processed foods. This finding agrees with other studies that have shown that older pregnant women tend to eat less unhealthy snacks and fast food,[16,17] which are meals known to increase overweight and obesity[18] as they contain a large amount of sugar, fat and sodium.[19]

In the present study, class III obese high-risk pregnant women presented lower percentages of intake of protein from natural/minimally processed foods when compared with overweight or class I and II obese pregnant women. The consumption of ultra-processed foods was responsible for the second highest mean rate of total calories and percentages of carbohydrates, proteins and saturated fats consumed. Consumption of ultra-processed foods during pregnancy results in unfavorable consequences for both mother and the fetus, including the woman's excessive weight gain during pregnancy and an increase in the newborn's body fat. It is important to emphasize that the permanence of such excess weight may contribute to the development of associated comorbidities, such as type II diabetes, cardiovascular disease, mental health problems and cancer.[20]

Maternal food consumption during pregnancy is

Table 1

Characterization of total calorie intake and percentage of carbohydrates, protein, lipids, monounsaturated fatty acids, polyunsaturated fatty acids, saturated fatty acids and sodium from natural/minimally processed, processed and ultra-processed foods among high-risk pregnant women.

Variables	n	Minimum	Maximum	$\bar{X}$ ± SD
Total Kcal natural/minimally processed	200	35.01	2045.68	789.22 ± 378.27
Total Kcal processed	200	0.00	2643.81	246.03 ± 291.98
Total Kcal ultra-processed	200	0.00	3153.70	636.60 ± 557.40
% total CHO natural/minimally processed	200	3.45	100.00	50.47 ± 23.43
% total CHO processed	200	0.00	77.34	16.32 ± 15.55
% total CHO ultra-processed	200	0.00	96.55	33.21 ± 25.26
% total PTN natural/minimally processed	200	0.00	100.00	63.74 ± 27.52
% total PTN processed	200	0.00	74.81	11.82 ± 15.14
% total PTN ultra-processed	200	0.00	97.23	24.44 ± 24.47
% total LIP natural/minimally processed	200	0.00	100.00	38.21 ± 26.41
% total LIP processed	200	0.00	75.29	12.44 ± 15.34
% total LIP ultra-processed	200	0.00	99.63	49.35 ± 28.26
% total MUFA natural/minimallyprocessed	200	0.00	100.00	42.92 ± 31.91
% total MUFA processed	200	0.00	100.00	11.61 ± 18.10
% total MUFA ultra-processed	200	0.00	100.00	45.46 ± 32.26
% total PUFA natural/minimally processed	200	0.00	100.00	30.54 ± 31.86
% total PUFA processed	200	0.00	100.00	15.55 ± 21.75
% total PUFA ultra-processed	200	0.00	100.00	53.91 ± 35.87
% total SFA natural/minimally processed	200	0.00	100.00	45.10 ± 29.08
% total SFA processed	200	0.00	98.04	12.29 ± 17.33
% total SFA total ultra-processed	200	0.00	100.00	42.61 ± 28.90
% total sodium natural/minimally processed	200	0.00	100.00	22.48 ± 25.68
% total sodium processed	200	0.00	92.96	29.09 ± 27.33
% total sodium ultra-processed	200	0.00	99.89	48.43 ± 31.72

Kcal =kilocalorie; CHO=carbohydrate; PTN =protein; LIP =lipid; MUFA = monounsaturated fatty acids; PUFA=polyunsaturated fatty acids; SFA =saturated fatty acids; SD=Standard deviation.

Table 2

Association of number of pregnancies, age and pregestational nutritional status with total calorie intake and percentage of carbohydrates, protein, lipids, monounsaturated fatty acids, polyunsaturated fatty acids, saturated fatty acids and sodium from natural/minimally processed, processed and ultra-processed foods among high-risk pregnant women.

Variables	Number of Pregnancies		Age (years)		Pregestational BMI (kg/m²)	
	r	*p*	r	*p*	r	*p*
Total Kcal natural/minimally processed	-0.069	0.338	0.017	0.808	-0.110	0.124
Total Kcal processed	-0.119	0.096	-0.019	0.792	-0.057	0.424
Total Kcal ultra-processed	-0.057	0.430	-0.211	0.003	0.039	0.586
% total CHO natural/minimally processed	0.059	0.411	0.177	0.013	-0.047	0.510
% total CHO processed	-0.120	0.093	0.053	0.458	-0.011	0.876
% total CHO ultra-processed	0.018	0.798	- 0.198	0.005	0.051	0.480
% total PTN natural/minimally processed	0.021	0.770	0.084	0.242	-0.095	0.181
% total PTN processed	-0.081	0.257	0.089	0.214	0.111	0.120
% total PTN ultra-processed	0.027	0.711	-0.149	0.037	0.040	0.574

BMI= body mass index; Kcal = kilocalorie; CHO = carbohydrate; PTN = protein; LIP = lipid; MUFA = monounsaturated fatty acids; PUFA = polyunsaturated fatty acids; SFA = saturated fatty acids; Pearson's correlation analysis; $p \leq 0.05$.

continue

Table 2 **concluded**

Association of number of pregnancies, age and pregestational nutritional status with total calorie intake and percentage of carbohydrates, protein, lipids, monounsaturated fatty acids, polyunsaturated fatty acids, saturated fatty acids and sodium from natural/minimally processed, processed and ultra-processed foods among high-risk pregnant women.

Variables	Number of Pregnancies		Age (years)		Pregestational BMI (kg/m²)	
	r	*p*	r	*p*	r	*p*
% total LIP natural/minimally processed	0.020	0.776	0.103	0.149	-0.111	0.118
% total LIP processed	-0.025	0.726	0.068	0.344	0.091	0.203
% total LIP ultra-processed	-0.005	0.939	-0.133	0.063	0.055	0.442
% total MUFA natural/minimally processed	-0.001	0.986	0.051	0.480	-0.120	0.093
% total MUFA processed	-0.037	0.605	0.081	0.259	0.126	0.076
% total MUFA ultra-processed	0.022	0.758	-0.095	0.183	0.048	0.499
% total PUFA natural/minimally processed	0.025	0.731	0.074	0.303	-0.121	0.089
% total PUFA processed	-0.049	0.496	0.076	0.287	0.087	0.223
% total PUFA ultra-processed	0.008	0.914	-0.111	0.119	0.055	0.444
% total SFA natural/minimally processed	-0.010	0.885	0.004	0.952	-0.129	0.069
% total SFA processed	-0.065	0.365	0.096	0.181	0.113	0.114
% total SFA total ultra-processed	0.049	0.491	-0.062	0.387	0.064	0.374
% total sodium natural/minimally processed	-0.015	0.832	0.048	0.503	-0.052	0.466
% total sodium processed	-0.118	0.099	0.061	0.393	-0.040	0.577
% total sodium ultra-processed	0.114	0.111	-0.092	0.199	0.076	0.284

BMI= body mass index; Kcal = kilocalorie; CHO = carbohydrate; PTN = protein; LIP = lipid; MUFA = monounsaturated fatty acids; PUFA = polyunsaturated fatty acids; SFA = saturated fatty acids; Pearson's correlation analysis; $p \leq 0.05$.

Table 3

Association of pregestational nutritional status with total calorie intake and percentage of carbohydrates and protein from natural/minimally processed, processed and ultra-processed foods among high-risk pregnant women.

Variables	BMI	n	$\bar{X}$ ± SD	*p*
Total Kcal natural/minimally processed	Malnutrition	6	756.66 ± 305.64	0.209
	Normal weight	36	819.71 ± 365.94	
	Overweight	52	803.50 ± 353.06	
	Class I Obesity	42	793.70 ± 374.48	
	Class II Obesity	29	872.28 ± 418.86	
	Class III Obesity	33	669.17 ± 403.55	
Total Kcal processed	Malnutrition	6	247.39 ± 154.67	0.971
	Normal weight	36	330.42 ± 486.02	
	Overweight	52	223.68 ± 242.00	
	Class I Obesity	42	216.28 ± 199.74	
	Class II Obesity	29	240.95 ± 269.20	
	Class III Obesity	33	222.14 ± 210.77	

continue

BMI= body mass index; Kcal =kilocalorie; CHO=carbohydrate; PTN = protein; SD=standard deviation; Kruskal-Wallis test; $p \leq 0.05$.

Table 3 **concluded**

Association of pregestational nutritional status with total calorie intake and percentage of carbohydrates and protein from natural/minimally processed, processed and ultra-processed foods among high-risk pregnant women.

Variables	BMI	n	$\bar{X}$ ± SD	*p*
Total Kcal ultra-processed	Malnutrition	6	813.50^{AB} ± 845.61	0.018
	Normal weight	36	715.75^{B} ± 501.80	
	Overweight	52	492.10^{A} ± 481.62	
	Class I Obesity	42	679.99^{AB} ± 517.07	
	Class II Obesity	29	457.13^{A} ± 346.46	
	Class III Obesity	33	874.19^{B} ± 760.56	
% total CHO natural/minimally processed	Malnutrition	6	46.87 ± 26.43	0.102
	Normal weight	36	47.64 ± 23.42	
	Overweight	52	54.60 ± 23.94	
	Class I Obesity	42	48.37 ± 22.40	
	Class II Obesity	29	58.43 ± 23.89	
	Class III Obesity	33	42.74 ± 20.92	
% total CHO processed	Malnutrition	6	17.10 ± 10.52	0.997
	Normal weight	36	17.15 ± 18.04	
	Overweight	52	16.55 ± 16.20	
	Class I Obesity	42	15.09 ± 13.63	
	Class II Obesity	29	16.99 ± 17.55	
	Class III Obesity	33	15.05 ± 13.04	
% total CHO ultra-processed	Malnutrition	6	36.03^{AB} ± 28.93	0.048
	Normal weight	36	35.21^{AB} ± 24.46	
	Overweight	52	28.85^{A} ± 27.56	
	Class I Obesity	42	36.53^{AB} ± 23.86	
	Class II Obesity	29	24.58^{A} ± 18.40	
	Class III Obesity	33	42.21^{B} ± 26.52	
% total PTN natural/minimally processed	Malnutrition	6	65.16^{AB} ± 31.56	0.021
	Normal weight	36	57.56^{AB} ± 30.49	
	Overweight	52	70.33^{A} ± 24.98	
	Class I Obesity	42	65.33^{A} ± 25.76	
	Class II Obesity	29	71.80^{A} ± 23.37	
	Class III Obesity	33	51.38^{B} ± 28.00	
% total PTN processed	Malnutrition	6	9.02 ± 5.02	0.914
	Normal weight	36	13.25 ± 17.01	
	Overweight	52	10.42 ± 11.61	
	Class I Obesity	42	9.12 ± 9.60	
	Class II Obesity	29	9.79 ± 12.71	
	Class III Obesity	33	16.60 ± 22.09	
% total PTN ultra-processed	Malnutrition	6	25.83^{AB} ± 29.59	0.024
	Normal weight	36	29.19^{A} ± 27.21	
	Overweight	52	19.24^{B} ± 24.56	
	Class I Obesity	42	25.55^{A} ± 22.58	
	Class II Obesity	29	18.41^{B} ± 18.03	
	Class III Obesity	33	32.03^{A} ± 26.35	

BMI= body mass index; Kcal =kilocalorie; CHO=carbohydrate; PTN = protein; SD=standard deviation; ***Values with the same letters do not differ; Kruskal-Wallis test; $p \leq 0.05$.

Table 4

Association of pregestational nutritional status with percentage of intake of lipids, monounsaturated fatty acids, polyunsaturated fatty acids and saturated fatty acids from natural/minimally processed, processed and ultra-processed foods among high-risk pregnant women.

Varibles	BMI	n	$\bar{X}$ ± SD	*p*
% total LIP natural/minimally processed	Malnutrition	6	44.40 ± 35.93	0.080
	Normal weight	36	35.87 ± 25.15	
	Overweight	52	42.72 ± 26.16	
	Class I Obesity	42	39.37± 27.06	
	Class II Obesity	29	43.31 ± 24.45	
	Class III Obesity	33	27.20±25.47	
% total LIP processed	Malnutrition	6	12.04±14.18	0.729
	Normal weight	36	11.03±15.48	
	Overweight	52	13.78±14.33	
	Class I Obesity	42	10.61±12.51	
	Class II Obesity	29	9.28±12.72	
	Class III Obesity	33	16.01±20.57	
% total LIPultra-processed	Malnutrition	6	43.56±35.33	0.405
	Normal weight	36	53.10±27.89	
	Overweight	52	43.50±29.17	
	Class I Obesity	42	50.02±28.77	
	Class II Obesity	29	47.41±26.51	
	Class III Obesity	33	56.78±27.32	
% total MUFA natural/minimally processed	Malnutrition	6	60.91^{AB}±41.42	0.040
	Normal weight	36	37.32^{AB}±31.02	
	Overweight	52	48.13^{AB}±29.74	
	Class I Obesity	42	43.85^{AB}±32.57	
	Class II Obesity	29	51.03^{A}±31.81	
	Class III Obesity	33	30.26^{B}±30.55	
% total MUFA processed	Malnutrition	6	12.49±15.87	0.742
	Normal weight	36	10.52±17.68	
	Overweight	52	11.47±14.73	
	Class I Obesity	42	9.19±13.93	
	Class II Obesity	29	7.72±11.68	
	Class III Obesity	33	18.02±28.45	
% total MUFAultra-processed	Malnutrition	6	26.61±31.90	0.207
	Normal weight	36	52.16±30.83	
	Overweight	52	40.41±32.23	
	Class I Obesity	42	46.96±31.81	
	Class II Obesity	29	41.25±31.05	
	Class III Obesity	33	51.72±35.48	
% total PUFA natural/minimally processed	Malnutrition	6	53.65±41.51	0.218
	Normal weight	36	26.47±32.14	
	Overweight	52	33.62±31.34	
	Class I Obesity	42	32.98±33.06	
	Class II Obesity	29	33.89±34.16	
	Class III Obesity	33	20.90±25.55	
% total PUFA processed	Malnutrition	6	14.06±12.05	0.838
	Normal weight	36	14.59±18.62	
	Overweight	52	17.92±24.48	
	Class I Obesity	42	12.80±18.86	
	Class II Obesity	29	11.17±18.06	
	Class III Obesity	33	20.50±27.90	

BMI = body mass index; Kcal =kilocalorie; LIP = lipid; MUFA = monounsaturated fatty acids; PUFA = polyunsaturated fatty acids; SFA = saturated fatty acids; SD = Standard Deviation; ***Values with the same letters do not differ; Kruskal-Wallis test; $p \leq 0.05$.

continue

Table 4 **concluded**

Association of pregestational nutritional status with percentage of intake of lipids, monounsaturated fatty acids, polyunsaturated fatty acids and saturated fatty acids from natural/minimally processed, processed and ultra-processed foods among high-risk pregnant women.

Variables	BMI	n	$\bar{X}$ ± SD	*p*
% total PUFA ultra-processed	Malnutrition	6	32.29 ± 41.83	0.414
	Normal weight	36	58.93 ± 33.45	
	Overweight	52	48.45 ± 36.12	
	Class I Obesity	42	54.22 ± 35.51	
	Class II Obesity	29	54.94 ± 36.14	
	Class III Obesity	33	58.59 ± 38.18	
% total SFA natural/minimally processed	Malnutrition	6	54.87^{AB} ± 39.23	0.034
	Normal weight	36	42.60^{AB} ± 28.99	
	Overweight	52	48.24^{AB} ± 27.83	
	Class I Obesity	42	46.75^{AB} ± 28.55	
	Class II Obesity	29	54.63^{A} ± 26.15	
	Class III Obesity	33	31.25^{B} ± 28.56	
% total SFA processed	Malnutrition	6	16.41 ± 17.97	0.777
	Normal weight	36	9.96 ± 13.42	
	Overweight	52	12.47 ± 15.00	
	Class I Obesity	42	9.70 ± 13.38	
	Class II Obesity	29	9.48 ± 12.31	
	Class III Obesity	33	18.13 ± 27.21	
% total SFA ultra-processed	Malnutrition	6	28.72 ± 38.44	0.213
	Normal weight	36	47.44 ± 28.41	
	Overweight	52	39.29 ± 30.09	
	Class I Obesity	42	43.55 ± 26.40	
	Class II Obesity	29	35.88 ± 25.18	
	Class III Obesity	33	50.62 ± 31.47	

BMI = body mass index; Kcal =kilocalorie; LIP = lipid; MUFA = monounsaturated fatty acids; PUFA = polyunsaturated fatty acids; SFA = saturated fatty acids; SD = Standard Deviation; ***Values with the same letters do not differ; Kruskal-Wallis test; $p \leq 0.05$.

Table 5

Association of pregestational nutritional status with percentage of intake of sodium from natural/minimally processed, processed and ultra-processed foods among high-risk pregnant women.

Variables	BMI	n	$\bar{X}$ ± SD	*p*
% total sodium natural/minimally processed	Malnutrition	6	18.53^{AB} ± 19.93	0.050
	Normal weight	36	17.99^{AB} ± 20.18	
	Overweight	52	25.17^{A} ± 27.34	
	Class I Obesity	42	25.95^{A} ± 26.53	
	Class II Obesity	29	28.85^{A} ± 30.12	
	Class III Obesity	33	14.52^{B} ± 23.14	
% total sodium processed	Malnutrition	6	28.26 ± 22.54	0.787
	Normal weight	36	28.73 ± 26.31	
	Overweight	52	33.88 ± 29.56	
	Class I Obesity	42	24.02 ± 23.43	
	Class II Obesity	29	26.83 ± 27.14	
	Class III Obesity	33	27.57 ± 28.85	

BMI = body mass index; Kcal =kilocalorie; SD=standard deviation; ***Values with the same letters do not differ; Kruskal-Wallis test; $p \leq 0.05$.

continue

Table 5 **concluded**

Association of pregestational nutritional status with percentage of intake of sodium from natural/minimally processed, processed and ultra-processed foods among high-risk pregnant women.

Variables	BMI	n	$\bar{X}$ ± SD	*p*
% total sodium ultra-processed	Malnutrition	6	53.22 ± 41.89	0.228
	Normal weight	36	53.28 ± 28.23	
	Overweight	52	40.96 ± 33.89	
	Class I Obesity	42	50.03 ± 30.05	
	Class II Obesity	29	44.33 ± 31.73	
	Class III Obesity	33	57.91 ± 30.39	

BMI = body mass index; Kcal =kilocalorie; SD=standard deviation; ***Values with the same letters do not differ; Kruskal-Wallis test; $p \leq 0.05$.

responsible for promoting the neurodevelopment of children, which reinforces the importance of having a healthy lifestyle before pregnancy even begins.[21] Thus, prenatal care is of fundamental importance to encourage, guide and motivate pregnant women by promoting healthy eating habits[22] and by monitoring the health of the mother and the fetus.[21] In a study on the healthy eating index of Brazilian pregnant women, the overall dietary intake of pregnant women was assessed based on three food groups(vegetables, fruits and beans and other protein-rich vegetables), two ratios (red/white meat and polyunsaturated/saturated fat) and five nutrients (fiber, trans fat, calcium, folate and iron) and it was found that most of them lacked dietary intake improvements, thus showing the need to deliver food education at this stage of life.[23]

In the present study, class III obese and normal weight high-risk pregnant women presented a higher intake of total calories and higher percentages of carbohydrates from ultra-processed foods when compared with overweight and class II obese pregnant women, that is, the consumption of ultra-processed foods may not be related only to the nutritional status of pregnant women. Social mobility improvement, lifestyle and high levels of education are some of the factors that suggest a greater access to ultra-processed foods; in addition, these same factors can influence individuals' physical inactivity.[12]

Overweight and class II obese high-risk pregnant women consumed significantly lower percentages of protein from ultra-processed foods compared with normal weight and class I and III obese pregnant women. According to results found in the present study, this relationship occurred because overweight and class II obese high-risk pregnant women consumed higher percentages of protein from natural/minimally processed foods.

It was also observed that class III obese pregnant women consumed significantly lower percentages of monounsaturated and saturated fatty acids from in natura/minimally processed foods compared with-class II obese pregnant women. This finding indicates that class III obese pregnant women consumed higher percentages of saturated and monounsaturated fatty acids from ultra-processed foods. Therefore, interventions and actions should be carried out during prenatal care in order to promote and encourage the consumption of natural foods, as well as reinforce the importance of healthy habits[24] and, mainly, inform pregnant women about how much their nutritional status influences the baby's health. Pregnant women who have a BMI that suggests obesity tend to have greater complications during childbirth and maternal complications such as gestational diabetes and hypertensive syndrome and are more likely to experience perinatal complications such as macrosomia and low Apgar score in the first minute.[25]

The present study demonstrated that class III obese pregnant women exhibited a significantly lower percentage of sodium intake from natural/minimally processed foods when compared with overweight and class I and II obese pregnant women, i.e., class III obese pregnant women consumed higher percentages of sodium from ultra-processed foods. It was also possible to identify that the overall mean percentages of lipids, monounsaturated fatty acids, polyunsaturated fatty acids and sodium were higher among ultra-processed foods, which may be related to the strong influence of marketing on the eating habits of the population[14] and to the fact that these foods are well accepted due to their taste, have a long shelf life and are practical, as they can be consumed at any time and place.[26] Therefore, nutritional follow-up is essential for the definition of a diet that meets nutritional demands.[2]

During pregnancy, there is a greater predisposition to positive changes in maternal food choices,

which are driven by the desire for a healthy outcome in the baby's life.[27] A cohort study in Rio de Janeiro analyzed the type of food processing and changes in food consumption before and during pregnancy and concluded that the consumption of ultra-processed foods decreased and the consumption of natural/minimally processed foods increased from the period before pregnancy and throughout pregnancy, thus emphasizing the importance of nutritional follow-up during pregnancy.[28] Despite that, the vast majority of women continue to consume foods rich in sugar, saturated fat and sodium during pregnancy.[19] Such habits may be related to the increase in overweight and obesity[5] as well as heighten the predisposition of chronic diseases[29] such as *diabetes mellitus*, which is associated with high rates of perinatal morbidity and mortality.[3]

A simple way to reduce the chances of developing chronic diseases and improve maternal and neonatal health in the short and long term is – in addition to getting prenatal care – to reduce the consumption of ultra-processed foods.[19] The consumption of this kind of food should be reduced because they are rich in saturated fat, trans fat and free sugar and poor in fiber and protein when compared with natural/minimally processed foods.[9,30] A diet based on natural and minimally processed foods may even prevent diseases.[8]

One of the limitations of this study may have been the use of a single dietary recall from each high-risk pregnant woman. In addition, the dietary recall was based on secondary data and hence there may have been underestimation or overestimation of habitual consumption. This study is expected to contribute to the improvement of the care of pregnant women and to the evolution of scientific knowledge, thus improving health education and strengthening current public policies in the field of maternal and child health.

In the present study, the mean percentages of intake of lipids, monounsaturated fatty acids, polyunsaturated fatty acids and sodium were higher among ultra-processed foods. It was also observed that the older the maternal age of high-risk pregnant women, the lower the intake of total calories and the percentages of carbohydrates and proteins from ultra-processed foods. Finally, it was observed that pregestational nutritional status is significantly associated with the intake of total calories and percentage of carbohydrates from ultra-processed foods.

Thus, the study confirmed that the consumption of ultra-processed foods is present among high-risk pregnant women, which makes it necessary to develop nutrition education actions and strengthen existing public policies in the field of maternal and child health in order to raise women's awareness of how much their food consumption and habits may affect their children's lives in the short and long term.

Author's contribuition

Fernandes DC was responsible for the conception of the study, the selection of the articles to be included within the manuscript, for the organization, data interpretation and for the writing of the article. Carreno I e Silva AA contributed with the final revision of the manuscript. Guerra TB helped with the typing of the database. Adami FS contributed with the conception of the study, data interpretation, revision of the writing and was responsible by the exchange of correspondence. All authors approved the final version of the manuscript.

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