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Association between intuitive eating and food intake in type 2 diabetes: a study based on the NOVA classification

Associação entre comer intuitivo e consumo alimentar no diabetes tipo 2: um estudo baseado na classificação NOVA

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Abstract

This work aimed to evaluate the association between intuitive eating and dietary pattern, according to the NOVA classification, in a population with type 2 diabetes mellitus (T2DM). This was an observational cross-sectional study in patients at a university hospital in Vitória-ES, Brazil. For data collection, a semi-structured questionnaire was used, and food intake was assessed by the level of processing according to the NOVA classification. Intuitive eating was assessed by the Intuitive Eating Scale-2, and 179 individuals, mostly female and elderly, were evaluated. The chance of individuals consuming unprocessed or minimally processed foods was doubled in those participants who had dieted (OR=2.149; $CI_{95\%}$=1.142-4.045; p=0.018). In contrast, eating with unconditional permission reduced the chances of participants consuming this group of foods by 52.7% (OR=0.473; $CI_{95\%}$=0.235-0.952; p=0.036). Moreover, the chances of participants consuming ultra-processed foods was increased by 2.34 times in those having T2DM for more than 10 years (OR=2.344; $CI_{95\%}$=1.114-4.933; p=0.025). When assessing intuitive eating, it was observed that eating in congruence with bodily needs reduced the chances of the individual consuming ultra-processed foods by 45% (OR=0.547; $CI_{95\%}$=0.309-0.968; p=0.038). Therefore, the subscales of intuitive eating were associated differently with food intake according to the level of food processing in individuals with T2DM.

Keywords: Eating Behavior. Intuitive Eating. Diabetes Mellitus. Food Processing. Food Classification. NOVA.

Resumo

O objetivo deste trabalho foi avaliar a associação entre alimentação intuitiva e padrão alimentar, segundo a classificação NOVA, em uma população com diabetes *mellitus* tipo 2 (DM2). Trata-se de estudo observacional transversal em pacientes atendidos em um hospital universitário de Vitória-ES, Brasil. Para a coleta de dados, foi utilizado um questionário semiestruturado, e o consumo alimentar foi avaliado pelo nível de processamento de acordo com a classificação NOVA. O comer intuitivo foi analisado pela *Intuitive Eating Scale-2*. Foram avaliados 179 indivíduos, em sua maioria mulheres e idosos. A chance de os indivíduos consumirem alimentos não processados ou minimamente processados dobrou nos participantes que tinham feito dieta (OR = 2,149; $IC_{95\%}$ = 1,142-4,045; p = 0,018). Em contraste, comer com permissão incondicional reduziu as chances de os participantes consumirem esse grupo de alimentos em 52,7% (OR = 0,473; $IC_{95\%}$ = 0,235-0,952; p = 0,036). Além disso, as chances de os participantes consumirem alimentos ultraprocessados foram 2,34 vezes maiores naqueles que tinham DM2 há mais de 10 anos (OR = 2,344; $IC_{95\%}$ = 1,114-4,933; p = 0,025). Ao avaliar o comer intuitivo, observou-se que comer em congruência com as necessidades corporais reduziu em 45% as chances de o indivíduo consumir alimentos ultraprocessados (OR = 0,547; $IC_{95\%}$ = 0,309-0,968; p = 0,038). Portanto, as subescalas do comer intuitivo foram diferentemente associadas ao consumo alimentar de acordo com o nível de processamento de alimentos em indivíduos com DM2.

Palavras-chave: Comportamento alimentar. Comer intuitivo. Diabetes *mellitus*. Processamento de alimentos. Classificação de alimentos. NOVA.

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INTRODUCTION

Globally, an estimated 462 million individuals are affected by type 2 diabetes mellitus (T2DM), corresponding to 6.28% of the World's population.[1] More than 1 million deaths were attributed to this condition in 2017 alone, ranking as the ninth leading cause of mortality.[1] Diet, physical activity and healthy weight maintenance are modifiable factors and when appropriate they can minimize these effects and prevent or treat DM.[2-4]

Several studies have been published on the relationship between diet and DM.[5-8] The main American guideline for the treatment of DM recommends a balanced diet in carbohydrates (prioritizing complex carbohydrates), rich in fiber and low in sugar, saturated fats and sodium. [9] In this context, it is relevant to observe the level of food processing, since ultra-processed foods generally have characteristics incompatible with these recommendations.[10]

Monteiro and collaborators (2010) proposed a new food classification, that has been termed "NOVA", based on the extent and purpose of processing.[11] This classification is used in the Food Guide for the Brazilian population.[12] in addition to being internationally recognized and has been used extensively in epidemiological studies on food consumption, diet quality and health conditions of individuals. This proposal classifies all foods and food products into four groups: unprocessed or minimally processed foods, processed culinary ingredients, processed foods and ultra-processed food and drink products. This classification is designed as a tool to describe food systems and dietary patterns, and how these may affect health and the risk of disease, since these characteristics directly interfere with the nutritional value of food.[11-13]

Some studies have demonstrated a relationship between the consumption of ultra-processed foods and an increased risk of various diseases,[14-16] including T2DM.[17] Therefore, qualitatively assessing the diet of individuals as a means of preventing and even treating DM is essential. An adaptive style of eating that takes into account food choices that honor the health and functioning of the body is intuitive eating, which is a practice described as a way of eating characterized by a strong connection with internal physiological hunger and satiety cues. It is therefore a nutritional approach based mainly on the perception of these signs, in addition to considering social and emotional aspects, promoting a positive attitude towards food, body, and physical activity. The main purpose of intuitive eating is to direct individuals so that they can trust their ability to recognize and differentiate their physical and emotional sensations.[18, 19] Individuals who eat intuitively choose healthy foods not because they feel pressured to do so, but because they feel that they are necessary for the proper functioning of the body.[20, 21] It was also demonstrated in a recent study that eating intuitively is associated with a lower likelihood of inadequate glycemic control in individuals with T2DM.[22]

Although some studies have already evidenced the relationship between dietary pattern according to the level of processing and illnesses in the population, no association has been made so far between intuitive eating and consumption according to the food processing in individuals with T2DM. Therefore, the objective of this work was to evaluate the association between intuitive eating and dietary pattern according to the NOVA classification in the population with T2DM.

METHODS

Design and study population

This was an observational, cross-sectional analytical study, conducted in the endocrinology department of a university hospital in Vitória/ES, Brazil. The target population consisted of adults and elderly patients of both sexes with T2DM.

Research hypotheses and the analytical plan were specified prior to data collection. The sample size calculation was performed considering the prevalence of DM in Vitória (9.7%),[23] with a significance level of 95% maximum error of 5% and losses of 20%, resulting in the need for a minimum sample of 161 participants for the study.

For participant selection, data were collected from hospital attendances in 2018 under the registration code "Diabetes/Thyroid". Repeating patients (returning patients) were excluded from all records and then those who met the research criteria were invited to participate.

The inclusion criteria included individuals aged 20 or older, with a T2DM diagnosis of more than one year, according to the International Code of Diseases (ICD10): ICD-O240 (Pre-existing diabetes mellitus, insulin-dependent), ICD-O241 (Pre-existing diabetes mellitus, non-insulin dependent) and ICD-O243 (Pre-existing diabetes mellitus, unspecified).

Participants with eating disorders, pregnant and/or lactating women, alcoholics, individuals with decompensated hypothyroidism, stage IV or V chronic kidney disease, recurrent hypoglycemia and patients on medication or appetite-altering treatments were excluded. We also excluded psychiatric and neurological patients who were unable to communicate.

Socio-demographic, clinical and lifestyle variables

Initially, participants responded to a semi-structured questionnaire providing socio-demographic data: sex; age; marital status; schooling; self-reported race/skin color and socioeconomic class.[24] Clinical data were obtained from the medical records or self-reported by the participant, i.e. T2DM duration and treatment; overweight duration; presence of comorbidities associated with T2DM (hypertension, dyslipidemia or chronic kidney disease); drug treatment for DM.

Participants were also asked about lifestyle habits, i.e. alcohol and tobacco consumption, and physical activities. They were also asked about their health (very good/good or regular/poor), presence of constipation and sleep quality. The habit of eating outside the home, if they had previously been on a diet and their body perception and satisfaction were also evaluated.

Intuitive eating assessment

Intuitive eating was assessed by the Intuitive Eating Scale-2 (IES-2) validated in Portuguese. The scale comprises questions on eating attitudes involving intuitive eating and primarily measures the tendency of individuals to follow their bodily cues to determine what, how much and when to eat. The analysis was performed on the total score, which is generated from the average score of 23 questions (the higher the score, the higher the intuitive eating) and its four components (subscales). The subscales addressed were: unconditional permission to eat the desired food when hungry, classifying the food as neutral (UPE); eating for physical and non-emotional reasons (EPR); reliance on hunger and satiety cues to determine when and how much to eat (RHSC); and congruence in food choices, allowing good body nutrition (B-FCC).[20, 25]

Food intake assessment

Food intake was assessed using a Food Frequency Questionnaire consisting of 56 food items, validated for the Brazilian population.[26]

For each of the foods, seven frequency categories were stipulated, which are: once a day, 2 or more times a day, 5 to 6 times a week, 2 to 4 times a week, 1 time a week, 1 to 3 times per month and rarely / never. The reported frequencies were transformed into daily frequencies.[27]

After calculating the weight of the frequency of consumption of each item, the analyzed foods were placed in groups established by the NOVA classification, based on the extent and purpose of their processing[11,13] and classified as unprocessed or minimally processed foods, processed foods and processed culinary ingredients and ultra-processed foods, respectively, as follows:

- Unprocessed or minimally processed foods: skimmed or semi-skimmed milk, whole milk, boiled egg, beef, pork, chicken, fresh fish, offal (liver, kidney, heart), brown rice, polished rice, beans, raw leaf, braised / cooked leaf, raw vegetables, cooked vegetables, tubers (yams, cassava, potatoes), fruits, coffee, natural juice.
- Processed culinary ingredients and processed foods (evaluated here together): yogurt, white cheese (*minas / frescal*), yellow cheese (dish / mozzarella), curd, fried egg, canned fish (sardines / tuna), processed meat (sausage, salami, ham, mortadella), meat preserved in salt (cod, dried meat / sun, *feijoada* belongings), olive oil, bacon, butter, canned goods (corn, peas, heart of palm, olives), cakes, macaroni, coffee with sugar, natural juice with sugar, curd / yogurt without or reduced in fat/sugar.
- Ultra-processed foods: salad dressing, margarine, mayonnaise, snacks (French fries), sandwiches, pizza, snacks, Cheetos, peanuts, whole bread, French bread, loaf bread, salted biscuits, sweet biscuits, ice cream, pies, jam, sweets / candies, chocolates / bonbons, artificial juice with sugar, artificial juice without sugar, normal soda, sweetener, low fat margarine, soda without sugar.

The products / dishes were evaluated as a whole, questioning which processes were used to create the basis of the food.[13] Subsequently, each NOVA food group was categorized into quartiles.

Data analysis

Data were analyzed using IBM SPSS Statistics for Windows software, version 22.0 (Armonk, NY, USA: IBM Corp). The normality of the variables was assessed by the Kolmogorov-Smirnov test. To describe the study variables, the average and median were used as a measure of central tendency, the standard deviation and interquartile range as a measure of dispersion for continuous variables and the absolute and percentage values for categorical variables. The Student's T test was used to analyze the difference between the averages, and the Mann-Whitney U test to analyze the difference between the medians. For analysis of the differences in proportions, the Chi-square (χ^2) or Fisher's exact test was used. When the qualitative variable had three or more categories, an analysis of variance (ANOVA) was performed with the Tukey post-hoc test, and the Kruskal-Wallis test with the Mann-Whitney U Test two by two were applied to identify the differences.

The binary logistic regression model was applied to assess the associations between the independent variables and the frequency of consumption of the NOVA groups (first and second quartiles versus third and fourth quartiles). The variables that had statistical significance for the frequency in the habit of consuming the foods of the NOVA groups of up to 20% in the association analyzes were tested in the multiple models, adjusted for sex. The other variables (including sociodemographic) that did not present $P < 0.2$ in the binary analyzes were not, therefore, included in this regression model. The backward variable selection method was used with a likelihood ratio test, adopting the model with the greatest adjustment according to the Hosmer-Lemeshow test, for estimating odds ratio

(OR) values and their respective confidence intervals (CI). The assumptions of an absence of multicollinearity, minimum sample size for the number of variables in the model and absence of outliers were also tested. For all analyzes, the level of significance adopted was α <5%.

Ethical considerations

The research was approved by the Research Ethics Committee (CEP) of the Federal University of Espírito Santo (UFES) (CAAE: 87981718.6.0000.5060, protocol number 2.621.801, April 25, 2018), according to Resolution number 466, 12 December 2012 from the Health Council of the Ministry of Health.[28] All procedures performed were in accordance with the ethical standards of the Declaration of Helsinki and of the Recommendations for the Conduct, Reporting, Editing and Publication of Scholarly Work in Medical Journals. All individuals were informed about the study and consented their participation by signing the consent forms.

RESULTS

All eligible patients attended by doctors in 2018 were invited to participate in this research, totaling 495 participants. Of these, 239 agreed to participate, of which 179 attended. Most participants were female (n=133; 74.3%), elderly (n=97; 54.2%) and lived together with their married partner (n=114; 63.7%). It was also observed that the majority had been diagnosed and treated for T2DM in the previous five years, had been overweight for more than 10 years and had comorbidities associated with T2DM (Table 1).

Table 1. Socio-demographic, clinical and nutritional data distributed by sex of individuals with type 2 diabetes mellitus. Vitória-ES, 2018

Variables	Sex		p-value	Total
	Male	Female		
Age (years)[&] (p50 ± IQR)	62.5 ± 9	60 ± 10	0.037	60 ± 10
Age group * (n, %)			0.089	
Adult (< 60 years)	16 (19.5)	66 (80.5)		82 (45,8)
Elderly (≥ 60 years)	30 (30.9)	67 (69.1)		97 (54,2)
Marital status * (n, %)			0.378	
Live maritally	32 (28.1)	82 (71.9)		114 (63,7)
Do not live maritally	14 (21.5)	51 (78.5)		65 (36,3)
Education (n, %)			0.874	
Up to Primary complete	32 (26.0)	91 (74.0)		123 (68,7)
Secondary complete	9 (23.1)	30 (76.9)		39 (21,8)
Higher education	5 (29.4)	12 (70.6)		17 (9,5)
Race/skin color *[1] (n, %)			0.338	
White	15 (31.3)	33 (68.8)		48 (27,0)
Non-white	31 (23.8)	99 (76.2)		130 (73,0)

Table 1. Socio-demographic, clinical and nutritional data distributed by sex of individuals with type 2 diabetes mellitus. Vitória-ES, 2018. (Continues)

Variables	Sex		p-value	Total
	Male	Female		
Socioeconomic class * 2 (n, %)			0.009	
A/B	13 (46.4)	15 (53.6)		28 (15,8)
C/D/E	32 (21.5)	117 (78.5)		149 (84,2)
T2DM time 1 (n.%)			0.220	
<5 years	17 (26.6)	47 (73.4)		64 (36,0)
5–10 years	17 (33.3)	34 (66.7)		51 (28,7)
> 10 years	12 (19.0)	51 (81.0)		63 (35,4)
T2DM treatment time 2 (n, %)			0.327	
<5 years	22 (28.2)	56 (71.8)		78 (44,1)
5–10 years	13 (29.5)	31 (70.5)		44 (24,9)
> 10 years	10 (18.2)	45 (81.8)		55 (31,1)
Overweight time 4 (n, %)			0.746	
<5 years	9 (22.0)	32 (78.0)		41 (29,9)
5–10 years	8 (26.7)	22 (73.3)		30 (21,9)
> 10 years	13 (19.7)	53 (80.3)		66 (48,2)
Comorbidities associated with T2DM * (n, %)			0.100	
No	6 (46.2)	7 (53.8)		13 (7,3)
Yes	40 (24.1)	126 (75.9)		166 (92,7)
Drug treatment for T2DM 3 (n, %)			0.652	
Insulin and oral antidiabetics	15 (26.3)	42 (73.7)		57 (32,4)
Oral antidiabetics	24 (22.4)	83 (77.6)		107 (60,8)
Insulin	4 (33.3)	8 (66.7)		12 (6,8)
Alcohol use (n, %)			<0.001	
Yes	9 (45.0)	11 (55.0)		20 (11,2)
No	17 (14.5)	100 (85.5)		117 (65,4)
In the past	20 (47.6)	22 (52.4)		42 (23,5)
Tobacco use (n, %)			<0.001	
Yes	6 (50.0)	6 (50.0)		12 (6,7)
No	13 (13.1)	86 (86.9)		99 (55,3)
In the past	27 (39.7)	41 (60.3)		68 (38,0)
Physical activity * (n, %)			0.735	
No	25 (26.9)	68 (73.1)		93 (52,0)
Yes	21 (24.4)	65 (75.6)		86 (48,0)

Table 1. Socio-demographic, clinical and nutritional data distributed by sex of individuals with type 2 diabetes mellitus. Vitória-ES, 2018. (Continues)

Variables	Sex		p-value	Total
	Male	Female		
Self-rated health * (n, %)			0.116	
Very good/Good	23 (32.4)	48 (67.6)		71 (39,7)
Regular/Poor	23 (21.3)	85 (78.7)		108 (60,3)
Constipation (n, %)			0.162	
No	42 (28.0)	108 (72.0)		150 (83,8)
Yes	4 (13.8)	25 (86.2)		29 (16,2)
Sleep quality (n, %)			0.010	
Very good/Good	29 (34.9)	54 (65.1)		83 (46,4)
Regular/Poor	17 (17.7)	79 (82.3)		96 (53,6)
Habit of eating out * (n, %)			0.999	
No	35 (25.9)	100 (74.1)		135 (75,4)
Yes	11 (25.0)	33 (75.0)		44 (24,6)
Diet * (n, %)			0.217	
No	21 (31.3)	46 (68.7)		67 (37,4)
Yes	25 (22.3)	87 (77.7)		112 (62,6)
Body perception (n, %)			0.006	
Normal	23 (41.1)	33 (58.9)		56 (31,3)
Thin or very thin	2 (22.2)	7 (77.8)		9 (5,0)
Overweight or very overweight	21 (18.4)	93 (81.6)		114 (63,7)
Body satisfaction *[1] (n, %)			0.126	
Satisfied	26 (31.3)	57 (68.7)		83 (46,6)
Dissatisfied	20 (21.1)	75 (78.9)		95 (53,4)
IES-2 Total Score # (mean ± SD)	3.2 ± 0.3	3.2 ± 0.3	0.579	3,2 ± 0,3
UPE Subscale & (p50 ± IQR)	3.5 ± 0.5	3.5 ± 0.7	0.371	3,5 ± 0,7
EPR Subscale & (p50 ± IQR)	3.0 ± 0.4	3.0 ± 0.5	0.237	3,0 ± 0,5
RHSC Subscale & (p50 ± IQR)	3.7 ± 0.7	3.7 ± 1.2	0.097	3,7 ± 1,2
B-FCC Subscale & (p50 ± IQR)	4.0 ± 0.7	4.0 ± 0.3	0.248	4,0 ± 0,3
Unprocessed or minimally processed foods			0.147	
First quartile	15 (32.6)	31 (23.3)		46 (25,7)
Second quartile	9 (19.6)	35 (26.3)		44 (24,6)
Third quartile	15 (32.6)	30 (22.6)		45 (25,1)
Fourth quartile	7 (15.2)	37 (27.8)		44 (24,6)

Table 1. Socio-demographic, clinical and nutritional data distributed by sex of individuals with type 2 diabetes mellitus. Vitória-ES, 2018. (Continues)

Variables	Sex		p-value	Total
	Male	Female		
Processed culinary ingredients and foods			0.765	
First quartile	15 (32.6)	33 (24.8)		48 (26,8)
Second quartile	10 (21.7)	32 (24.1)		42 (23,5)
Third quartile	10 (21.7)	35 (26.3)		45 (25,1)
Fourth quartile	11 (23.9)	33 (24.8)		44 (24,6)
Ultra-processed food and drink products			0.355	
First quartile	10 (21.7)	35 (26.3)		45 (25,1)
Second quartile	16 (34.8)	29 (21.8)		45 (25,1)
Third quartile	11 (23.9)	34 (25.6)		45 (25,1)
Fourth quartile	9 (19.6)	35 (26.3)		44 (24,6)

Chi-square test. * Fisher's exact test. # Student's T test for independent samples. & Mann-Whitney U test. N=179. [1] n=178, [2] n=177, [3] n=176, [4] n=137. In bold number: statistically significant values ($p < 0.05$). *Legend*: p50, median; IQR, interquartile range; n, absolute value; %, percentage value; SD, standard deviation; T2DM, Type 2 diabetes *mellitus*; IES-2: Intuitive Eating Scale - 2. UPE: Unconditional permission to eat. EPR: Eating for physical rather than emotional reasons. RHSC: Reliance on hunger and satiety cues. B-FCC: Body-Food-Choice Congruence.

Most did not use alcohol or tobacco, reported being sedentary (n=93; 52%) and were overweight/obese (n=142; 79.3%). Of the total, 112 individuals reported having previously been on a diet (n=112; 62.6%), and in relation to the assessment of intuitive eating, no differences were observed between the sexes, both in the total score and in their subscales. There was also no difference between sexes in terms of food intake according to the level of processing.

When the data were evaluated according to the consumption of unprocessed or minimally processed foods (Table 2), it was observed that having been on a diet was positively associated with this intake (p=0.025). The UPE subscale of IES-2, on the other hand, showed a negative association with the consumption of this group of foods (p=0.029).

Table 2. Socio-demographic, clinical and nutritional data distributed according to the consumption of unprocessed or minimally processed foods of individuals with type 2 diabetes mellitus. Vitória-ES, 2018.

Variables	Unprocessed or minimally processed foods				p-value
	First quartile	Second quartile	Third quartile	Fourth quartile	
Age (years) # (p50 ± IQR)	60 ± 11	60 ± 10	60 ± 8	63 ± 13	0.471
Age group (n, %)					0.707
Adult (< 60 years)	21 (25.6)	22 (26.8)	22 (26.8)	17 (20.7)	
Elderly (≥ 60 years)	25 (25.8)	22 (22.7)	23 (23.7)	27 (27.8)	

Table 2. Socio-demographic, clinical and nutritional data distributed according to the consumption of unprocessed or minimally processed foods of individuals with type 2 diabetes mellitus. Vitória-ES, 2018. (Continues)

Variables	Unprocessed or minimally processed foods				p-value
	First quartile	Second quartile	Third quartile	Fourth quartile	
Marital status (n, %)					0.056
Live maritally	25 (21.9)	30 (26.3)	35 (30.7)	24 (21.1)	
Do not live maritally	21 (32.3)	14 (21.5)	10 (15.4)	20 (30.8)	
Education (n, %)					0.868
Up to Primary complete	33 (26.8)	30 (24.4)	32 (26.0)	28 (22.8)	
Secondary complete	10 (25.6)	11 (28.2)	8 (20.5)	10 (25.6)	
Higher education	3 (17.6)	3 (17.6)	5 (29.4)	6 (35.3)	
Race/skin color [1] (n, %)					0.684
White	12 (25.0)	9 (18.8)	14 (29.2)	13 (27.1)	
Non-white	33 (25.4)	35 (26.9)	31 (23.8)	31 (23.8)	
Socioeconomic class [2] (n, %)					0.086
A/B	5 (17.9)	10 (35.7)	10 (35.7)	3 (10.7)	
C/D/E	40 (26.8)	33 (22.1)	35 (23.5)	41 (27.5)	
T2DM time [1] (n, %)					0.471
<5 years	19 (29.7)	19 (29.7)	12 (18.8)	14 (21.9)	
5–10 years	10 (19.6)	14 (27.5)	15 (29.4)	12 (23.5)	
> 10 years	16 (25.4)	11 (17.5)	18 (28.6)	18 (28.6)	
T2DM treatment time [2] (n, %)					0.225
<5 years	25 (32.1)	22 (28.2)	15 (19.2)	16 (20.5)	
5–10 years	6 (13.6)	12 (27.3)	14 (31.8)	12 (27.3)	
> 10 years	14 (25.5)	10 (18.2)	16 (29.1)	15 (27.3)	
Overweight time [4] (n, %)					0.810
<5 years	11 (26.8)	12 (29.3)	11 (26.8)	7 (17.1)	
5–10 years	5 (16.7)	7 (23.3)	9 (30.0)	9 (30.0)	
> 10 years	16 (24.2)	17 (25.8)	15 (22.7)	18 (27.3)	
Comorbidities associated with T2DM (n, %)					0.247
No	3 (23.1)	1 (7.7)	6 (46.2)	3 (23.1)	
Yes	43 (25.9)	43 (25.9)	39 (23.5)	41 (24.7)	
Drug treatment for T2DM [3] (n, %)					0.413
Insulin and oral antidiabetics	13 (22.8)	12 (21.1)	18 (31.6)	14 (24.6)	
Oral antidiabetics	28 (26.2)	31 (29.0)	21 (19.6)	27 (25.2)	
Insulin	3 (25.0)	1 (8.3)	5 (41.7)	3 (25.0)	

Table 2. Socio-demographic, clinical and nutritional data distributed according to the consumption of unprocessed or minimally processed foods of individuals with type 2 diabetes mellitus. Vitória-ES, 2018. (Continues)

Variables	Unprocessed or minimally processed foods				p-value
	First quartile	Second quartile	Third quartile	Fourth quartile	
Alcohol use (n, %)					0.058
Yes	8 (40.0)	3 (15.0)	4 (20.0)	5 (25.0)	
No	30 (25.6)	29 (24.8)	24 (20.5)	34 (29.1)	
In the past	8 (19.0)	12 (28.6)	17 (40.5)	5 (11.9)	
Tobacco use (n, %)					0.297
Yes	6 (50.0)	1 (8.3)	3 (25.0)	2 (16.7)	
No	23 (23.2)	25 (25.3)	22 (22.2)	29 (29.3)	
In the past	17 (25.0)	18 (26.5)	20 (29.4)	13 (19.1)	
Physical activity (n, %)					0.215
No	30 (32.3)	21 (22.6)	22 (23.7)	20 (21.5)	
Yes	16 (18.6)	23 (26.7)	23 (26.7)	24 (27.9)	
Self-rated health (n, %)					0.607
Very good/Good	18 (25.4)	21 (29.6)	17 (23.9)	15 (21.1)	
Regular/Poor	28 (25.9)	23 (21.3)	28 (25.9)	29 (26.9)	
Constipation (n, %)					0.827
No	39 (26.0)	35 (23.3)	39 (26.0)	37 (24.7)	
Yes	7 (24.1)	9 (31.0)	6 (20.7)	7 (24.1)	
Sleep quality (n, %)					0.807
Very good/Good	21 (25.3)	21 (25.3)	23 (27.7)	18 (21.7)	
Regular/Poor	25 (26.0)	23 (24.0)	22 (22.9)	26 (27.1)	
Habit of eating out (n, %)					0.216
No	37 (27.4)	28 (20.7)	35 (25.9)	35 (25.9)	
Yes	9 (20.5)	16 (36.4)	10 (22.7)	9 (20.5)	
Diet * (n, %)					0.025
No	25 (37.3)	17 (25.4)	14 (20.9)	11 (16.4)	
Yes	21 (18.8)	27 (24.1)	31 (27.7)	33 (29.5)	
Body perception (n, %)					0.562
Normal	19 (33.9)	11 (19.6)	15 (26.8)	11 (19.6)	
Thin or very thin	1 (11.1)	2 (22.2)	3 (33.3)	3 (33.3)	
Overweight or very overweight	26 (22.8)	31 (27.2)	27 (23.7)	30 (26.3)	

Table 2. Socio-demographic, clinical and nutritional data distributed according to the consumption of unprocessed or minimally processed foods of individuals with type 2 diabetes mellitus. Vitória-ES, 2018. (Continues)

Variables	Unprocessed or minimally processed foods				p-value
	First quartile	Second quartile	Third quartile	Fourth quartile	
Body satisfaction [1] (n, %)					0.562
Satisfied	21 (25.3)	23 (27.7)	22 (26.5)	17 (20.5)	
Dissatisfied	25 (26.3)	20 (21.1)	23 (24.2)	27 (28.4)	
IES-2 Total Score * (mean ± SD)	3.2 ± 0.3	3.3 ± 0.3	3.2 ± 0.3	3.2 ± 0.3	0.677
UPE Subscale # (p50 ± IQR)	3.7 ± 0.7	3.5 ± 0.7	3.5 ± 0.5	3.3 ± 0.7	**0.029**[a]
EPR Subscale # (p50 ± IQR)	3.0 ± 0.5	3.0 ± 0.5	3.0 ± 0.4	3.0 ± 0.4	0.563
RHSC Subscale # (p50 ± IQR)	3.3 ± 1.3	3.7 ± 1.0	3.5 ± 1.2	3.7 ± 1.1	0.390
B-FCC Subscale # (p50 ± IQR)	4.0 ± 0.7	4.0 ± 0.0	4.0 ± 0.7	4.0 ± 0.0	0.187

Chi-square test. * ANOVA, with Tukey HSD post-hoc test. # Kruskal-Wallis test, with Mann-Whitney U test two by two to identify the differences. [a] Difference between 1st and 4th quartile. N=179. [1] n=178, [2] n=177, [3] n=176, [4] n=137. In bold number: statistically significant values ($p < 0.05$). *Legend*: p50, median; IQR, interquartile range; n, absolute value; %, percentage value; SD, standard deviation; T2DM, Type 2 diabetes *mellitus*; IES-2: Intuitive Eating Scale - 2. UPE: Unconditional permission to eat. EPR: Eating for physical rather than emotional reasons. RHSC: Reliance on hunger and satiety cues. B-FCC: Body-Food-Choice Congruence

The data were also distributed according to the consumption of processed food and processed culinary ingredients (Table 3), and it was observed that only the consumption of alcoholic beverages was associated with the intake of this group of foods (p=0.048), being higher among those who consume or have already consumed alcohol.

Table 3. Socio-demographic, clinical and nutritional data distributed according to the consumption of processed culinary ingredients and processed foods of individuals with type 2 diabetes mellitus. Vitória-ES, 2018..

Variables	Processed culinary ingredients and processed foods				p-value
	First quartile	Second quartile	Third quartile	Fourth quartile	
Age (years)# (p50 ± IQR)	61 ± 10	59 ± 8	62 ± 11	59 ± 10	0.387
Age group (n, %)					0.400
Adult (< 60 years)	22 (26.8)	22 (26.8)	16 (19.5	22 (26.8)	
Elderly (≥ 60 years)	26 (26.8)	20 (20.6)	29 (29.9	22 (22.7)	
Marital status (n, %)					0.231
Live maritally	32 (28.1)	28 (24.6)	23 (20.2	31 (27.2)	
Do not live maritally	16 (24.6)	14 (21.5)	22 (33.8	13 (20.0)	
Education (n, %)					0.214
Up to Primary complete	37 (30.1)	27 (22.0)	35 (28.5	24 (19.5)	
Secondary complete	7 (17.9)	10 (25.6)	8 (20.5)	14 (35.9)	
Higher education	4 (23.5)	5 (29.4)	2 (11.8)	6 (35.3)	

Table 3. Socio-demographic, clinical and nutritional data distributed according to the consumption of processed culinary ingredients and processed foods of individuals with type 2 diabetes mellitus. Vitória-ES, 2018. (Continues).

Variables	Processed culinary ingredients and processed foods				p-value
	First quartile	Second quartile	Third quartile	Fourth quartile	
Race/skin color [1] (n, %)					0.920
White	12 (25.0)	10 (20.8)	13 (27.1)	13 (27.1)	
Non-white	35 (26.9)	32 (24.6)	32 (24.6)	31 (23.8)	
Socioeconomic class [2] (n, %)					0.225
A/B	5 (17.9)	6 (21.4)	6 (21.4)	11 (39.3)	
C/D/E	43 (28.9)	36 (24.2)	38 (25.5)	32 (21.5)	
T2DM time [1] (n, %)					0.445
<5 years	13 (20.3)	17 (26.6)	16 (25.0)	18 (28.1)	
5–10 years	16 (31.4)	7 (13.7)	15 (29.4)	13 (25.5)	
> 10 years	18 (28.6)	18 (28.6)	14 (22.2)	13 (20.6)	
T2DM treatment time [2] (n, %)					0.112
<5 years	18 (23.1)	22 (28.2)	18 (23.1)	20 (25.6)	
5–10 years	14 (31.8)	3 (6.8)	13 (29.5)	14 (31.8)	
> 10 years	14 (25.5)	17 (30.9)	14 (25.5)	10 (18.2)	
Overweight time [4] (n, %)					0.658
<5 years	11 (26.8)	8 (19.5)	11 (26.8)	11 (26.8)	
5–10 years	6 (20.0)	6 (20.0)	6 (20.0)	12 (40.0)	
> 10 years	13 (19.7)	19 (28.8)	18 (27.3)	16 (24.2)	
Comorbidities associated with T2DM (n, %)					0.222
No	5 (38.5)	0 (0.0)	4 (30.8)	4 (30.8)	
Yes	43 (25.9)	42 (25.3)	41 (24.7)	40 (24.1)	
Drug treatment for T2DM [3] (n, %)					0.594
Insulin and oral antidiabetics	14 (24.6)	15 (26.3)	17 (29.8)	11 (19.3)	
Oral antidiabetics	30 (28.0)	21 (19.6)	27 (25.2)	29 (27.1)	
Insulin	3 (25.0)	4 (33.3)	1 (8.3)	4 (33.3)	
Alcohol use (n, %)					0.048
Yes	2 (10.0)	9 (45.0)	3 (15.0)	6 (30.0)	
No	39 (33.3)	23 (19.7)	30 (25.6)	25 (21.4)	
In the past	7 (16.7)	10 (23.8)	12 (28.6)	13 (31.0)	
Tobacco use (n, %)					0.751
Yes	3 (25.0)	3 (25.0)	4 (33.3)	2 (16.7)	
No	29 (29.3)	26 (26.3)	22 (22.2)	22 (22.2)	
In the past	16 (23.5)	13 (19.1)	19 (27.9)	20 (29.4)	

Table 3. Socio-demographic, clinical and nutritional data distributed according to the consumption of processed culinary ingredients and processed foods of individuals with type 2 diabetes mellitus. Vitória-ES, 2018. (Continues)

Variables	Processed culinary ingredients and processed foods				p-value
	First quartile	Second quartile	Third quartile	Fourth quartile	
Physical activity (n, %)					0.452
No	22 (23.7)	20 (21.5)	24 (25.8)	27 (29.0)	
Yes	26 (30.2)	22 (25.6)	21 (24.4)	17 (19.8)	
Self-rated health (n, %)					0.566
Very good/Good	20 (28.2)	19 (26.8)	14 (19.7)	18 (25.4)	
Regular/Poor	28 (25.9)	23 (21.3)	31 (28.7)	26 (24.1)	
Constipation (n, %)					0.783
No	39 (26.0)	35 (23.3)	37 (24.7)	39 (26.0)	
Yes	9 (31.0)	7 (24.1)	8 (27.6)	5 (17.2)	
Sleep quality (n, %)					0.930
Very good/Good	22 (26.5)	18 (21.7)	21 (25.3)	22 (26.5)	
Regular/Poor	26 (27.1)	24 (25.0)	24 (25.0)	22 (22.9)	
Habit of eating out (n, %)					0.361
No	38 (28.1)	34 (25.2)	34 (25.2)	29 (21.5)	
Yes	10 (22.7)	8 (18.2)	11 (25.0	15 (34.1)	
Diet * (n, %)					0.775
No	18 (26.9)	13 (19.4)	18 (26.9)	18 (26.9)	
Yes	30 (26.8)	29 (25.9)	27 (24.1)	26 (23.2)	
Body perception (n, %)					0.408
Normal	17 (30.4)	16 (28.6)	11 (19.6)	12 (21.4)	
Thin or very thin	3 (33.3)	0 (0.0)	2 (22.2)	4 (44.4)	
Overweight or very overweight	28 (24.6)	26 (22.8)	32 (28.1)	28 (24.6)	
Body satisfaction [1] (n, %)					0.165
Satisfied	29 (34.9)	17 (20.5)	18 (21.7)	19 (22.9)	
Dissatisfied	19 (20.0)	25 (26.3)	26 (27.4)	25 (26.3)	
IES-2 Total Score * (mean ± SD)	3.2 ± 0.3	3.3 ± 0.3	3.2 ± 0.4	3.2 ± 0.3	0.392
UPE Subscale # (p50 ± IQR)	3.5 ± 0.8	3.5 ± 0.5	3.5 ± 0.5	3.5 ± 0.5	0.987
EPR Subscale # (p50 ± IQR)	2.9 ± 0.3	3.0 ± 0.5	3.0 ± 0.4	3.0 ± 0.4	0.132
RHSC Subscale # (p50 ± IQR)	3.7 ± 1.2	3.8 ± 1.2	3.3 ± 1.0	3.7 ± 1.2	0.840
B-FCC Subscale # (p50 ± IQR)	4.0 ± 0.0	4.0 ± 0.3	4.0 ± 0.7	4.0 ± 0.0	0.116

Chi-square test. * ANOVA, with Tukey HSD post-hoc test. # Kruskal-Wallis test, with Mann-Whitney U test two by two to identify the differences. [a] Difference between 1st and 4th quartile. N=179. [1] n=178, [2] n=177, [3] n=176, [4] n=137. In bold number: statistically significant values ($p < 0.05$). *Legend*: p50, median; IQR, interquartile range; n, absolute value; %, percentage value; SD, standard deviation; T2DM, Type 2 diabetes *mellitus*; IES-2: Intuitive Eating Scale - 2. UPE: Unconditional permission to eat. EPR: Eating for physical rather than emotional reasons. RHSC: Reliance on hunger and satiety cues. B-FCC: Body-Food-Choice Congruence.

The consumption of ultra-processed foods (Table 4) was higher among individuals who had comorbidities associated with T2DM (p=0.018) and better sleep quality (p=0.042). In addition, there was an association between the consumption of this group of foods and the B-FCC subscale of IES-2 (p=0.017).

Table 4. Socio-demographic, clinical and nutritional data distributed according to the consumption of ultra-processed foods of individuals with type 2 diabetes mellitus. Vitória-ES, 2018.

Variables	Ultra-processed foods				p-value
	First quartile	Second quartile	Third quartile	Fourth quartile	
Age (years)# (p50 ± IQR)	60 ± 10	59 ± 10	60 ± 10	62 ± 10	0.493
Age group (n, %)					0.768
Adult (< 60 years)	18 (22.0)	23 (28.0)	21 (25.6)	20 (24.4)	
Elderly (≥ 60 years)	27 (27.8)	22 (22.7)	24 (24.7)	24 (24.7)	
Marital status (n, %)					0.472
Live maritally	27 (23.7)	28 (24.6)	33 (28.9)	26 (22.8)	
Do not live maritally	18 (27.7)	17 (26.2)	12 (18.5)	18 (27.7)	
Education (n, %)					0.453
Up to Primary complete	36 (29.3)	28 (22.8)	28 (22.8)	31 (25.2)	
Secondary complete	7 (17.9)	13 (33.3)	11 (28.2)	8 (20.5)	
Higher education	2 (11.8)	4 (23.5)	6 (35.3)	5 (29.4)	
Race/skin color [1] (n, %)					0.684
White	9 (18.8)	12 (25.0)	14 (29.2)	13 (27.1)	
Non-white	35 (26.9)	33 (25.4)	31 (23.8)	31 (23.8)	
Socioeconomic class [2] (n, %)					0.808
A/B	7 (25.0)	8 (28.6)	8 (28.6)	5 (17.9)	
C/D/E	37 (24.8)	36 (24.2)	37 (24.8)	39 (26.2)	
T2DM time [1] (n, %)					0.141
<5 years	15 (23.4)	23 (35.9)	15 (23.4)	11 (17.2)	
5–10 years	17 (33.3)	10 (19.6)	12 (23.5)	12 (23.5)	
> 10 years	13 (20.6)	12 (19.0)	18 (28.6)	20 (31.7)	
T2DM treatment time [2] (n, %)					0.223
<5 years	19 (24.4)	27 (34.6)	16 (20.5)	16 (20.5)	
5–10 years	14 (31.8)	8 (18.2)	11 (25.0)	11 (25.0)	
> 10 years	12 (21.8)	10 (18.2)	18 (32.7)	15 (27.3)	

Table 4. Socio-demographic, clinical and nutritional data distributed according to the consumption of ultra-processed foods of individuals with type 2 diabetes mellitus. Vitória-ES, 2018.(Continues)

Variables	Ultra-processed foods				p-value
	First quartile	Second quartile	Third quartile	Fourth quartile	
Overweight time [4] (n, %)					0.984
<5 years	10 (24.4)	12 (29.3)	11 (26.8)	8 (19.5)	
5–10 years	9 (30.0)	8 (26.7)	6 (20.0)	7 (23.3)	
> 10 years	15 (22.7)	20 (30.3)	16 (24.2)	15 (22.7)	
Comorbidities associated with T2DM (n, %)					**0.018**
No	1 (7.7)	8 (61.5)	2 (15.4)	2 (15.4)	
Yes	44 (26.5)	37 (22.3)	43 (25.9)	42 (25.3)	
Drug treatment for T2DM [3] (n, %)					0.219
Insulin and oral antidiabetics	15 (26.3)	10 (17.5)	14 (24.6)	18 (31.6)	
Oral antidiabetics	24 (22.4)	33 (30.8)	28 (26.2)	22 (20.6)	
Insulin	5 (41.7)	1 (8.3)	2 (16.7)	4 (33.3)	
Alcohol use (n, %)					0.056
Yes	4 (20.0)	5 (25.0)	3 (15.0)	8 (40.0)	
No	36 (30.8)	30 (25.6)	25 (21.4)	26 (22.2)	
In the past	5 (11.9)	10 (23.8)	17 (40.5)	10 (23.8)	
Tobacco use (n, %)					0.809
Yes	4 (33.3)	4 (33.3)	2 (16.7)	2 (16.7)	
No	27 (27.3)	23 (23.2)	23 (23.2)	26 (26.3)	
In the past	14 (20.6)	18 (26.5)	20 (29.4)	16 (23.5)	
Physical activity (n, %)					0.953
No	22 (23.7)	23 (24.7)	24 (25.8)	24 (25.8)	
Yes	23 (26.7)	22 (25.6)	21 (24.4)	20 (23.3)	
Self-rated health (n, %)					0.784
Very good/Good	20 (28.2)	19 (26.8)	16 (22.5)	16 (22.5)	
Regular/Poor	25 (23.1)	26 (24.1)	29 (26.9)	28 (25.9)	
Constipation (n, %)					0.502
No	37 (24.7)	40 (26.7)	35 (23.3)	38 (25.3)	
Yes	8 (27.6)	5 (17.2)	10 (34.5)	6 (20.7)	
Sleep quality (n, %)					**0.042**
Very good/Good	18 (21.7)	23 (27.7)	15 (18.1)	27 (32.5)	
Regular/Poor	27 (28.1)	22 (22.9)	30 (31.3)	17 (17.7)	
Habit of eating out (n, %)					0.184
No	35 (25.9)	34 (25.2)	29 (21.5)	37 (27.4)	
Yes	10 (22.7)	11 (25.0)	16 (36.4)	7 (15.9)	

Table 4. Socio-demographic, clinical and nutritional data distributed according to the consumption of ultra-processed foods of individuals with type 2 diabetes mellitus. Vitória-ES, 2018. (Continues)

Variables	Ultra-processed foods				p-value
	First quartile	Second quartile	Third quartile	Fourth quartile	
Diet * (n, %)					0.199
No	20 (29.9)	19 (28.4)	11 (16.4)	17 (25.4)	
Yes	25 (22.3)	26 (23.2)	34 (30.4)	27 (24.1)	
Body perception (n, %)					0.332
Normal	14 (25.0)	15 (26.8)	17 (30.4)	10 (17.9)	
Thin or very thin	0 (0.0)	2 (22.2)	4 (44.4)	3 (33.3)	
Overweight or very overweight	31 (27.2)	28 (24.6)	24 (21.1)	31 (27.2)	
Body satisfaction [1] (n, %)					0.911
Satisfied	20 (24.1)	23 (27.7)	20 (24.1)	20 (24.1)	
Dissatisfied	25 (26.3)	22 (23.2)	25 (26.3)	23 (24.2)	
IES-2 Total Score * (mean ± SD)	3.2 ± 0.3	3.2 ± 0.3	3.2 ± 0.3	3.2 ± 0.3	0.980
UPE Subscale # (p50 ± IQR)	3.5 ± 0.8	3.7 ± 0.5	3.5 ± 0.7	3.5 ± 0.5	0.894
EPR Subscale # (p50 ± IQR)	3.0 ± 0.6	3.0 ± 0.4	3.0 ± 0.5	3.0 ± 0.5	0.502
RHSC Subscale # (p50 ± IQR)	3.8 ± 1.0	3.3 ± 1.0	3.7 ± 1.2	3.4 ± 1.1	0.344
B-FCC Subscale # (p50 ± IQR)	4.0 ± 0.0	4.0 ± 0.3	4.0 ± 0.3	4.0 ± 0.7	**0.017[a]**

Chi-square test. * ANOVA, with Tukey HSD post-hoc test. # Kruskal-Wallis test, with Mann-Whitney U test two by two to identify the differences. [a] Difference between 1st and 4th quartile. N=179. [1] n=178, [2] n=177, [3] n=176, [4] n=137. In bold number: statistically significant values ($p < 0.05$). *Legend*: p50, median; IQR, interquartile range; n, absolute value; %, percentage value; SD, standard deviation; T2DM, Type 2 diabetes *mellitus*; IES-2: Intuitive Eating Scale - 2. UPE: Unconditional permission to eat. EPR: Eating for physical rather than emotional reasons. RHSC: Reliance on hunger and satiety cues. B-FCC: Body-Food-Choice Congruence.

When analyzing the data in the logistic regression model (Table 5), it was observed that having dieted doubled the chances of individuals consuming unprocessed or minimally processed foods (OR=2.149; CI=1.142-4.045; p=0.018). In contrast, eating with unconditional permission reduced the chances of participants consuming this group of foods by 52.7% (OR=0.473; CI=0.235-0.952; p=0.036).

Table 5. Multiple analysis of consumption of food groups according to NOVA classification of individuals with type 2 diabetes mellitus. Vitória-ES, 2018..

Variables	Crude		Adjusted	
	p-value	OR ($CI_{95\%}$)	p-value	OR ($CI_{95\%}$)
Unprocessed or minimally processed foods [a]				
Marital status				
Live maritally		1		1
Do not live maritally	0.471	0.799 (0.432-1.471)	0.421	0.769 (0.405-1.460)

Table 5. Multiple analysis of consumption of food groups according to NOVA classification of individuals with type 2 diabetes mellitus. Vitória-ES, 2018..(Continues)

Variables	Crude		Adjusted	
	p-value	OR ($CI_{95\%}$)	p-value	OR ($CI_{95\%}$)
Unprocessed or minimally processed foods [a]				
Diet				
No		1		1
Yes	**0.011**	2.240 (1.204-4.167)	**0.018**	2.149 (1.142-4.045)
UPE Subscale	0.054	0.519 (0.267-1.011)	**0.036**	0.473 (0.235-0.952)
Processed culinary ingredients and processed foods [b]				
T2DM treatment time				
<5 years		1		1
5–10 years	0.180	1.672 (0.788-3.546)	0.175	1.700 (0.789-3.662)
> 10 years	0.563	0.815 (0.407-1.631)	0.544	0.803 (0.396-1.630)
Alcohol use				
Yes		1		1
No	0.868	1.084 (0.418-2.811)	0.899	1.065 (0.400-2.841)
In the past	0.285	1.797 (0.613-5.266)	0.282	1.827 (0.609-5.480)
B-FCC Subscale	0.139	0.666 (0.389-1.141)	0.167	0.679 (0.392-1.176)
Ultra-processed foods [c]				
T2DM time				
<5 years		1		1
5–10 years	0.490	1.299 (0.618-2.730)	0.411	1.393 (0.632-3.068)
> 10 years	**0.027**	2.222 (1.093-4.517)	**0.025**	2.344 (1.114-4.933)
Alcohol use				
Yes		1		1
No	0.346	0.632 (0.244-1.641)	0.186	0.495 (0.174-1.404)
In the past	0.484	1.473 (0.498-4.353)	0.369	1.687 (0.540-5.272)
B-FCC Subscale	0.057	0.586 (0.338-1.015)	**0.038**	0.547 (0.309-0.968)

Binary logistic regression crude and adjusted. Backward method for variable selection: likelihood ratio test, adjusted for sex. Variables with P < 0.2 in the binary analyzes were entered in the initial model. N=179. Only the variables maintained in the backward selection are shown in the table. Model adjusted according to Hosmer-Lemeshow test: [a] 0,924; [b] 0,924; [c] 0,871. In bold: statistically significant values (p < 0.05). Legend: T2DM: Type 2 Diabetes Mellitus. UPE: Unconditional permission to eat. B-FCC: Body-Food-Choice Congruence. OR: Odds Ratio. CI95%: 95% confidence interval.

Regarding the consumption of ultra-processed foods, having had T2DM for longer than 10 years increased the chances of eating this group of foods by 2.34 times (OR=2.344; CI=1.114-4.933; p=0.025). When assessing intuitive eating, it was observed that eating in congruence with bodily needs (subscale B-FCC) reduced the chances of the individual consuming ultra-processed foods by 45% (OR=0.547; CI=0.309-0.968; p=0.038).

DISCUSSION

This is the first study, to date, to highlight the relationship between intuitive eating and food intake according to the level of processing in individuals with T2DM. Our findings indicate that this association occurs differently according to each subscale of intuitive eating and each group of the NOVA classification, used in this study to group food according to the level of processing.

Concern about the increasing prevalence of diabetes is relevant, due to its increasing prevalence.[1] Modern lifestyles have long been suspected as the major influence in this trend, with the implication that modification of daily routines can prevent or substantially alter the course of DM and other associated metabolic abnormalities.[4] In this context, food intake according to its level of processing stands out, due to the different nutritional characteristics found in each of these levels.[13]

Our study showed that dieters were twice as likely to consume unprocessed or minimally processed foods. When the participants were asked about dieting, it was explained that they were guidelines for the treatment of the disease or weight loss. The guidelines on diabetic nutrition, when carried out by qualified health professionals, are based on specific recommendations in order to promote better dietary practices. This includes adequate consumption of fruits, vegetables, oilseeds and lean meats, and low consumption of processed foods.[4,9] Therefore, adherence to these guidelines can promote greater consumption of unprocessed and minimally processed foods, as observed in our study. A study carried out in an adult population in southeastern Brazil, revealed that individuals who adhered to a dietary pattern based on a diet rich in vegetables, fruits, cereals and tubers, reduced their chances of developing metabolic syndrome, which has insulin resistance as one of its components.[29] As it was not specified in our study how long the patient had been on a diet, a more detailed temporal evaluation of this question was not possible, and further studies are needed to carry out this assessment.

In addition, the association between the UPE subscale of intuitive eating and a lower consumption of this food group by diabetics was demonstrated. The data suggest that eating with unconditional permission reduced the chance of diabetics consuming unprocessed and minimally processed foods. The UPE subscale reflects individuals' willingness to eat when hungry (i.e., not trying to stave off hunger) and refusal to label certain foods as forbidden.[20]

The negative association between this subscale and diet quality has been documented in the literature. Camilleri et al.,[30] in a large French population-based study, demonstrated that higher UPE scores were associated with a higher energy and unhealthier food intake, together with lower fruit, vegetable, and whole-grain intake. Horwath et al.[31] found similar results, in a study carried out with 5,238 adults from Switzerland. They showed that the UPE subscale moderately correlated with poorer quality diet scores, and, in particular, high scores on this subscale were positively correlated with a lower consumption of vegetables, fruits and whole grains.[31] Also in agreement, Barad et al.[32] demonstrated, in a study conducted in the United States, that the UPE subscale was negatively associated with fruit and vegetable intake. All of these studies corroborate the findings in the present study.

Camilleri et al.[30] suggested that people who give themselves unconditional permission to eat might be less prone to be preoccupied with food and lose control over eating than people who restrict their food intake. Conversely, it is suggested that when individuals eat without food rules or restrictions, they tend to eat fewer fruits and vegetables. These data show that the relationship between intuitive eating and fruit and vegetable intake is complex, and that subscale scores rather than the total IES-2 score may be more informative when assessing the relationship between intuitive eating behaviors and fruit and vegetable intake.[32]

No association was observed between intuitive eating (total score and subscales) and consumption of processed culinary ingredients and processed foods. This result was already expected, since the components of these two groups represent, when added, one third of the total calories available for consumption by the Brazilian population.[33] Unprocessed and minimally processed foods are often consumed in culinary preparations that largely need to go through cooking processes that include the use of processed culinary ingredients. Therefore, it is expected that there will be no negative perceptions about its consumption. According to Monteiro et al.,[13] processed foods can be consumed in small quantities, as ingredients of culinary preparations or as part of meals based on unprocessed or minimally processed foods.

Regarding the consumption of ultra-processed foods, associations were observed between the time since T2DM diagnosis and the B-FCC subscale of intuitive eating. Ultra-processed foods are formulations of ingredients, mostly of exclusive industrial use, that result from a series of industrial processes (hence 'ultra-processed'), usually with many ingredients. Such ingredients often include those also used in processed foods, such as sugar, oils, fats, salt, anti-oxidants, stabilizers, and preservatives.[13,34]

Several studies have demonstrated the relationship between the consumption of ultra-processed foods and the increased risk of various diseases, such as cancer,[14] cardiovascular diseases[15] and overweight and obesity.[16] A recent population-based prospective cohort study by Srour et al.,[17] (2020), conducted with 104,707 participants, demonstrated an association between the ingestion of ultra-processed foods and a higher risk of developing T2DM. The authors of this study postulate that these findings can be explained by the worse nutritional quality of ultra-processed foods, the use of additives that are still controversial and contamination due to the prolonged contact of the packaging with the food (i.e., exposure to endocrine disruptors), in addition to the formation of metabolites during processing.

It was observed that having had T2DM for longer than 10 years increased the chances of eating this group of foods. It is believed that adherence to treatment can decrease over the course of the disease, and this includes a worsening in the quality of the diet. Ramos and Ferreira[35] demonstrated the existence of a correlation between the time since T2DM diagnosis and adherence to treatment, that is, the longer the duration of illness presented by the participant, the higher the level of glycated hemoglobin, indicating a lower rate of adherence to drug treatment, diet therapy and lifestyle.

In assessing the association between intuitive eating and the consumption of ultra-processed foods, it was observed that eating in congruence with bodily needs reduced the chances of consuming ultra-processed foods. The B-FCC subscale is related to the practice of "gentle nutrition", one of the ten principles of intuitive eating. It assesses the extent to which individuals make their choices in accordance with their bodily needs.[20] This principle reflects the tendency to choose nutritious foods that promote health, body function and well-being, while satisfying the taste buds. Individuals who demonstrate high congruency between bodily needs and food choices do not feel pressured to eat healthy foods; they choose to do so because they feel it is what their body needs.[21]

A recently published study showed that eating according to your bodily needs (B-FCC subscale) was associated with an almost 66% less chance of diabetics presenting inadequacy in glycemic control,[22] suggesting the importance of combining the approach based on intuitive eating with other treatments to promote better metabolic control in T2DM.

Knowing, therefore, the negative impact of the consumption of ultra-processed foods on health, including for individuals with T2DM, it is important to develop public policies that recommend limiting the intake of this group of foods. Based on our study, we suggest that the application of intuitive eating-based approaches, mainly working with the awareness of food choices according bodily needs, may be useful to promote the ingestion of a qualitatively more adequate diet by diabetics, and thus possibly improving the prognosis of this disease.

Our findings demonstrated an association between intuitive eating and food intake in type 2 diabetics, but the study has some limitations. Because it is a cross-sectional research, it is not possible to determine causality. Another limitation is the use of data on the frequency of consumption, without quantitative intake assessment in the questionnaire used. Furthermore, the use of this type of questionnaire may have a memory bias. This food frequency questionnaire still has the limitation that it was not developed exclusively for individuals with diabetes, but the food groups are the same in questionnaires validated for this population. In addition, although adequate to meet the sample calculation requirements and all eligible patients from the site were invited, the relatively small number of participants is another limitation.

CONCLUSION

Our work showed that subscales of intuitive eating were differently associated with food intake according to the level of processing in individuals with T2DM. Eating with unconditional permission in this group, as compared to dieting, showed a negative association with consumption of unprocessed or minimally processed foods. However, eating in congruence with bodily needs reduced the chances of diabetics consuming ultra-processed foods, which are extremely harmful to health. Therefore, working with this concept can be an auxiliary strategy in order to promote more adequate food intake by this population.

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Soares FLP participation in the idealization of the study design, in data collection, analysis and interpretation; participation in writing the study and participation in the final review and approval of the manuscript for submission. Ramos MH participation in the idealization of the study design, in data collection, analysis and interpretation. Cattafesta M participation in data collection, analysis and interpretation; participation in the final review and approval of the manuscript for submission. Salaroli LB participation in the idealization of the study desig, participation in data collection, analysis and interpretation; and participation in the final review and approval of the manuscript for submission.

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