







# Consumption of free sugars and dietary sources in the diet of university students according to socioeconomic and lifestyle factors

## *Consumo de açúcar livre e fontes dietéticas na dieta de estudantes universitários segundo fatores socioeconômicos e de estilo de vida*

Paula Costa Cunha<sup>1</sup> , Paulo Rogério Melo Rodrigues<sup>1</sup> , Naiara Ferraz Moreira<sup>2</sup> , Bartira Mendes Gorgulho<sup>1</sup> , Márcia Gonçalves Ferreira<sup>1</sup> , Ana Paula Muraro<sup>3</sup> 

<sup>1</sup> Universidade Federal de Mato Grosso, Faculdade de Nutrição, Departamento de Alimentos e Nutrição. Cuiabá, MT, Brasil. Correspondence to: AP MURARO. E-mail: <muraroap@gmail.com>.

<sup>2</sup> Universidade Federal de Grande Dourados, Departamento de Ciências da Saúde. Dourados, MS, Brasil.

<sup>3</sup> Universidade Federal de Mato Grosso, Instituto de Saúde Coletiva, Departamento de Saúde Coletiva. Cuiabá, MT, Brasil.

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### ABSTRACT

#### Objective

To evaluate the consumption of free sugars and associated factors in the diet of university students entering full-time courses at a public university in Mato Grosso.

#### Methods

Cross-sectional study with students aged 16 to 26 years in the first semester of 2016, 2017, and 2018. Average sugar consumption was estimated using a 24-hour diet recall, evaluating the percentage of free sugars in total energy intake and the prevalence of consumption greater than 10.0% of total energy intake, according to socioeconomic and lifestyle variables, stratified by sex, and the foods that most contributed to its consumption.

#### Results

A total of 1,063 students were evaluated, the percentage of free sugars in the students' diet was on average 14.3% among men and 15.4% among women, with the prevalence of consumption above 10.0% also being higher among women (72.6 vs. 66.6%). There was a direct relationship between the participation of free sugars in the highest tertiles of energy intake, and the main food groups sources of sugar were desserts, juices, soft drinks, and coffee. There was a significant

association between courses outside the health sciences, tobacco use, and unsatisfactory meal consumption profile with higher consumption of free sugars among women. Among men, sugar consumption was higher among those who were not overweight compared to those who were overweight.

### Conclusion

The consumption of free sugars is high among university students, being associated with higher energy consumption, especially for sweetened beverages.

**Keywords:** Eating. Sugars. Students. Universities.

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## RESUMO

### Objetivo

Avaliar o consumo de açúcar livre e os fatores associados na alimentação de universitários ingressantes em cursos de período integral em uma universidade pública de Mato Grosso.

### Métodos

Estudo transversal com estudantes de 16 a 26 anos de idade no primeiro semestre de 2016, 2017 e 2018 (n=1.063). O consumo médio de açúcar foi estimado por meio de recordatório de 24 horas, sendo avaliada a participação do açúcar livre na ingestão energética total e a prevalência de participação do consumo superior a 10,0% da ingestão energética, segundo variáveis socioeconômicas, de estilo de vida e fatores dietéticos, estratificadas por sexo.

### Resultados

A participação do açúcar livre na dieta foi, em média, de 14,3% entre os homens e 15,4% entre as mulheres, sendo a prevalência de consumo acima de 10,0% também maior entre as mulheres (72,6 vs. 66,6%). Foi maior a participação do açúcar livre nos tercis mais elevados de ingestão energética, sendo verificado que os principais grupos de alimentos fontes foram sobremesas, sucos, refrigerantes e café. Entre as mulheres, verificou-se maior consumo de açúcar livre entre aquelas que faziam uso de tabaco e que apresentavam perfil de consumo de refeições insatisfatório. Por outro lado, menor consumo de açúcar livre foi observado entre as estudantes da área da saúde. Entre os homens, o consumo de açúcar livre foi maior entre aqueles sem excesso de peso, comparados aos com excesso.

### Conclusão

O consumo de açúcar livre foi elevado entre estudantes universitários, sendo maior entre os estudantes com maior consumo energético. Verificou-se que as bebidas adoçadas estiveram entre as principais fontes.

**Palavras-chave:** Ingestão de alimentos. Açúcares. Estudantes. Universidade.

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## INTRODUCTION

The main modifiable risk factors for Chronic Noncommunicable Diseases are smoking, physical inactivity, consumption of alcoholic beverages, and an unhealthy diet [1]. While Chronic Noncommunicable Diseases morbidity and mortality occur mainly in adulthood, exposure to risk factors begins early in life [2].

The high consumption of free sugars by the global population stands out. It has been a matter of concern to many health institutions such as the World Health Organization (WHO), which recommends ingesting less than 10% of the total daily caloric consumption, emphasizing intake below 5% to reduce and prevent the development of Chronic Noncommunicable Diseases [3].

Currently, sugar-added drinks are the primary dietary sources of a free sugar diet [4-6]. Longitudinal studies have shown the effects of free sugar consumption on obesity and related diseases and the beneficial effects of its reduction [6,7]. When considering populations that are most sensitive to the impact of an unhealthy diet, university students stand out as a group vulnerable to acquiring unhealthy eating behaviors, mainly because they are in the age group between adolescence and adulthood, at a period of greater independence and responsibility, academic obligations, and often suffer from the separation from family and friends [8-10].

Besides identifying the deterioration of students' eating habits, the consumption of free sugars above the global recommended levels by university students is also observed, exceeding 15% of the total energy value, generally with greater consumption among men than women and with no difference in consumption when evaluated by income [11-15].

When observing the food groups that were most common in students' diet, Bawadi et al. [16] found that sugar-added beverages, sweets, and desserts were among the main groups of free sugar food sources. Moreover, longitudinal studies show increased participation of sugar sources in the students' diet [17,18].

So far, research that evaluates the consumption of free sugar among university students and the sociodemographic, economic, and lifestyle factors associated with this consumption in Brazil are scarce and were restricted to the description of high-energy and low-nutrient food groups or to analysis of students from the health area [12,19-21,14]. Therefore, this study aims to evaluate free sugar consumption and the associated factors in freshmen's diet in a full-time course at a Brazilian public university.

## METHODS

This is a cross-sectional study, based on a longitudinal study database, with university students enrolled in a public university located in the Brazilian Midwest, nested in a dynamic cohort entitled "Longitudinal Study on the Lifestyle and Health of University Students (ELESEU)". This was a census study with students aged 16-25 years enrolled in 21 full-time courses. The data analyzed in this study were from students that were interviewed during the first semesters of 2016, 2017, and 2018, through a semi-structured questionnaire containing sociodemographic, economic, and lifestyle information, weight condition, and 24-hour diet recall (R24h) applied at the interview. More details on the study design are available in the work by Nogueira et al. [22].

Food intake was assessed by a single R24h, applied by properly trained interviewers. Students answered a single R24h regarding a weekday (typical days) or a weekend or holiday day (atypical days). Free sugar intake was assessed through the regular consumption of sugar reported by university students when starting R24h. Specifically, the students would answer the following affirmation: "I frequently use; with the following response options: sugar, sweetener, sugar and sweetener, do not use." When students reported that they habitually consumed sugar, an increase of 10g of sugar was established for each 100ml of fruit juice, coffee, coffee with milk, tea, and Yerba mate. When reporting the regular consumption of both (sugar and sweetener), 5g of sugar was added for each 100ml of the drinks mentioned above [23]. The proportion of free sugars in university students' diet was assessed, estimating the means of free sugar consumed by the population and their contribution to total energy intake.

Foods were divided into 39 groups and organized in a ranking of ten foods that contributed the most to free sugar intake among all university students to analyze R24h foods' contribution to free sugar intake [23]. These ten foods were responsible for more than 90% of the total free sugar consumption in the students' diet.

The independent variables evaluated were socioeconomic and demographic data such as age (16-19 years and 20-25 years, classified in full years), sex (female and male), with whom they lived at the time of the survey (alone, parents, relatives, fraternity), socioeconomic class based on the Economic Classification Criteria of the Brazilian Population, which considers ownership of durable consumer goods, head of the family's education level, and access to public services (such as paved streets and public water supply) [24]. Based on this assessment, in this study, individuals were

classified into three socio-economic classes (A, B and C, and D and E). The university course was also considered an independent variable: Health Sciences (Nursing, Nutrition, and Medicine), and others (Agronomy, Architecture, Biology, Computer Science, Civil Engineering, Electrical Engineering, Forest Engineering, Health Engineering, Philosophy, Physics, Geology, Mathematics, Veterinary Medicine, Psychology, Chemistry, and Animal Science).

Physical activity was evaluated by an abridged version of the International Physical Activity Questionnaire, adapted and validated for Brazil, with the information referring to one year before entering university [25]. Students were classified as presenting sufficient weekly time of physical activity when practicing at least 150 minutes of moderate or vigorous physical activity [26]. Sedentary behavior [27] was assessed by daily screen use, including TVs, computers, video games, and games, using the following question: "In general, how many hours per day do you spend on television/computer/video game/mobile games?", and the dichotomized response was "less than or equal to 4 hours" or "greater than 4 hours" [28].

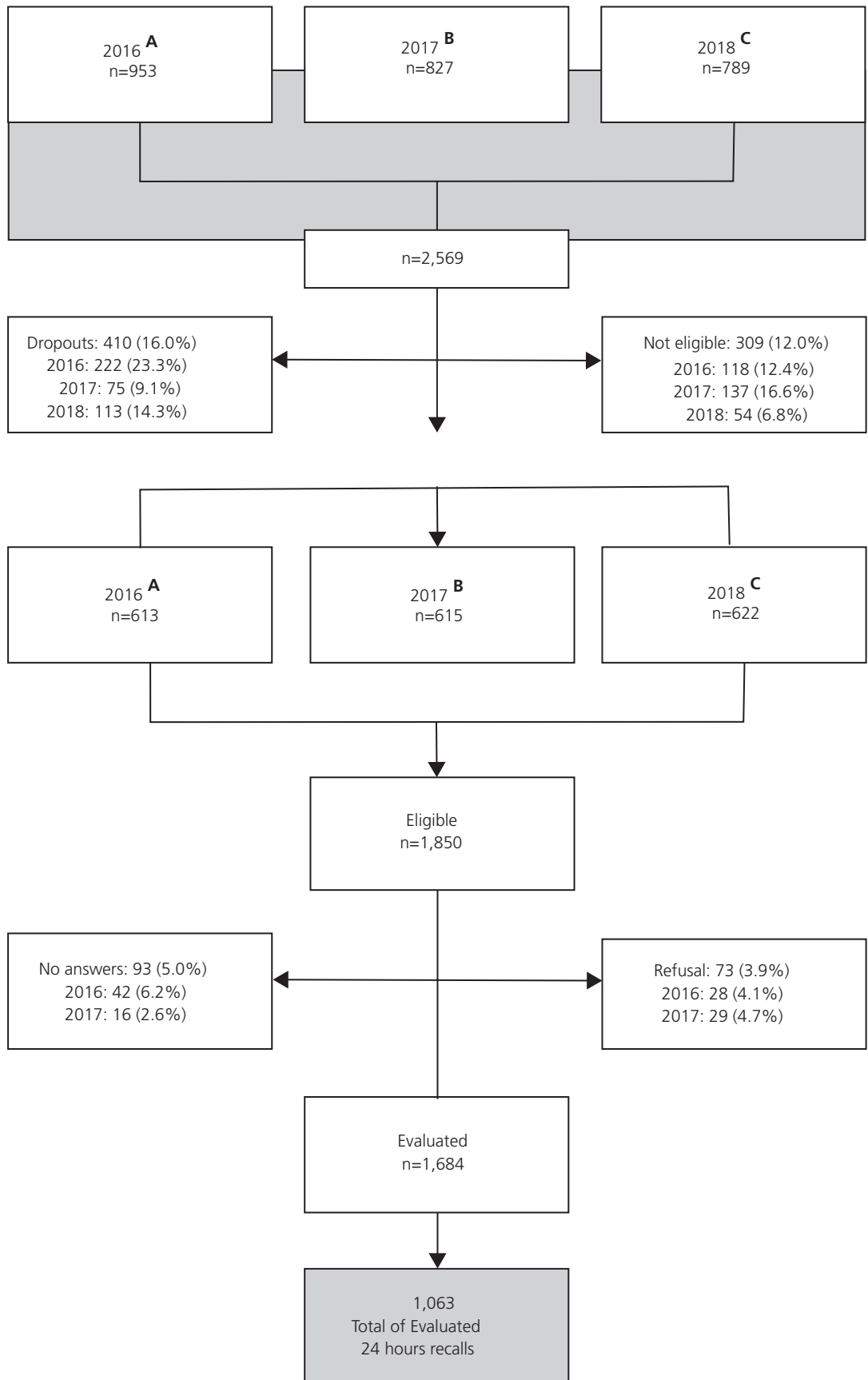
The consumption of alcoholic beverages (yes/no) was assessed considering consumption in at least one day in the last 30 days before the interview [29]. Regarding tobacco use (yes/no), students were defined as smokers when they reported smoking at least one cigarette in the last 30 days before the interview. For the meal consumption pattern (satisfactory/unsatisfactory), a satisfactory pattern was defined as the daily consumption of the three main meals (breakfast, lunch, and dinner), anything else was considered as an unsatisfactory pattern. Concerning sleep hours, the question was: "In general, how many hours do you sleep per night?", with the options "less than 8 hours" or "8 hours or more hours" [30].

Finally, the weight condition (not overweight/overweight) was assessed using the Body Mass Index (BMI -  $\text{Kg}/\text{m}^2$ ). In adolescents (up to 19 years of age), BMI for age was expressed in Z-score of the WHO reference curve, with  $< \text{Z-score} -2$  (low BMI for age),  $\geq \text{Z-score} -2$  and  $< \text{Z-score} +1$  (eutrophic),  $\geq \text{Z-score} +1$  and  $< \text{Z-score} +2$  (overweight), and  $\geq \text{Z-score} +2$  (obesity), calculated using the "WHO Anthro Plus" software [31]. For adults, the classification was according to the WHO cutoff, with  $< 18.5 \text{kg}/\text{m}^2$  (underweight), from 18.5 to  $24.9 \text{kg}/\text{m}^2$  (eutrophic), from  $25.0 \text{kg}/\text{m}^2$  to  $29.9 \text{kg}/\text{m}^2$  (overweight), and  $> 30.0 \text{kg}/\text{m}^2$  (obese) [32]. The categories were grouped into non-overweight (thinness and eutrophy) and overweight (overweight and obesity) for the analysis.

For data consistency analysis, double entry was performed using the Epi Info 7 software; the comparison between databases to check for possible typing errors, in Epi Info 3.5. The R24h was typed in a specific software for food consumption data, the Study of Cardiovascular Risks in Adolescents - 24-hour reminder (ERICA-REC24h) [33]. This software contains a list of foods constructed from the 2008-2009 Consumer Expenditure Survey food and beverage acquisition database, conducted by the Brazilian Institute of Geography and Statistics [34].

The 10 foods that most contributed to free sugar intake among university students were identified. The daily amounts consumed, and the proportion of total daily energy intake were calculated for these foods, and this analysis was stratified by sex (male/female) [23].

Free sugar participation in total energy intake showed an asymmetric distribution. For this reason, the descriptive analysis was performed using the median, a measure of central tendency presented in the analyses with its interquartile ranges (25th and 75th percentile value). The associations were verified through the Mann-Whitney or Kruskal-Wallis tests depending on the analyzed variable categories. The Chi-square test was used to compare proportions of students with free sugar consumption above 10% according to independent variables. The analyses were performed using the SPSS®/IBM® software, version 23.0 for Windows (SPSS Inc., Chicago, IL, USA), and the significance level of 5% was adopted.



**Figure 1** - Flowchart of inclusion of university students participating in the study in the years 2016 (A), 2017 (B) and 2018 (C). Mato Grosso (MT), Brazil, 2016-2018.

The Research Ethics Committee of the Júlio Muller University Hospital of the Federal University of Mato Grosso approved the research project under (CAAE: 42587315.4.0000.5541; opinion nº 1006/048 of 31/3/2015). Participants signed the Informed Consent Form before data collection, as soon as they were informed about the study's purposes.

## RESULTS

A total of 1,063 university students enrolled in 2016 to 2018 were evaluated during the first semester; 290 (27.3%) in 2016; 395 (37.2%) in 2017, and 378 (35.6%) in 2018 (Figure 1). The total number of participating students was obtained by considering those who completed all stages: the semi-structured questionnaire and the 24-hour recall. Of these, 50.4% were female, 47.5% belonged to socio-economic class B, 79.1% were aged 16-19 years, 73.4% declared to live with their parents or relatives, and 78.7% were enrolled in courses outside the Health Sciences (Table 1).

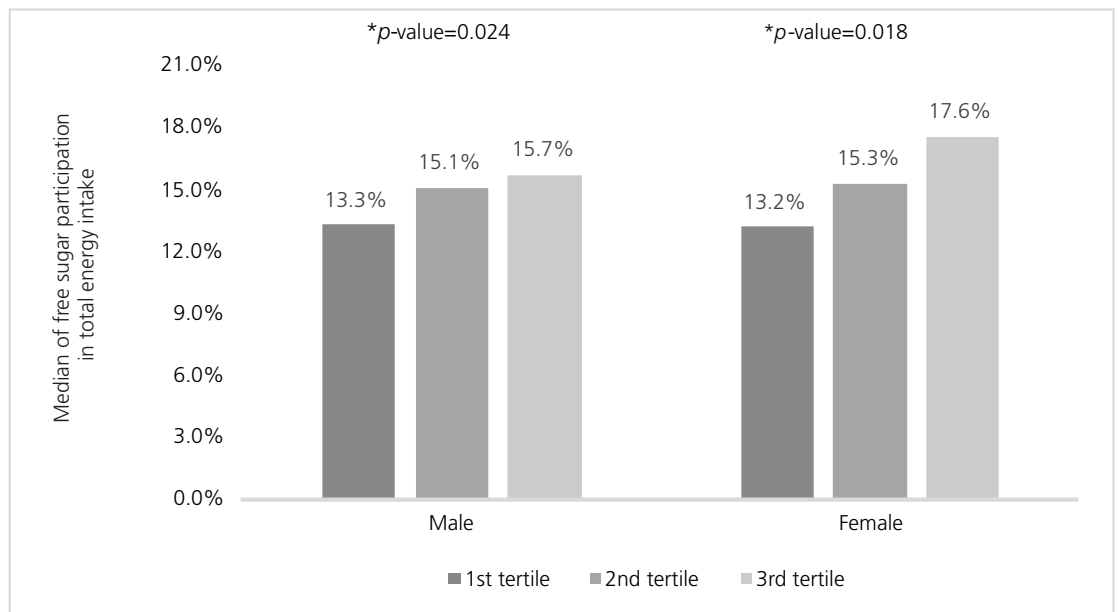
The median percentage of free sugars in the university students' diet was 14.3% among male students and 15.4% among female students. The proportion of students with free sugar percentage above 10% of the total energy intake was higher among women (72.7%) than men (66.6%,  $p=0.03$ ). Among the sociodemographic factors, a significant difference was observed in the percentage of free sugars in total energy intake, and the proportion of consumption above 10%, and was higher in female students enrolled in courses outside Health Sciences when compared to those enrolled in Health Sciences courses ( $p<0.01$  and  $p=0.02$ , respectively), as shown in Table 1. The percentage of

**Table 1** – Median and interquartile range (IQ 25-75%) of the participation of free sugars in total daily energy intake (Kcal / day) and proportion of people with consumption of free sugar above 10% of the total daily energy. According to sociodemographics and economics variables among university students. Mato Grosso (MT), Brazil, 2016-2018.

Characteristics	General		Male (n=527)				Female (n=536)			
	n	%	Proportion of total energy intake / day		Above recommended*		Proportion of total energy intake / day		Above recommended*	
			Mdn	IQ	n	%	Mdn	IQ	n	%
Total			14.3	(8.1;20.8)	351	66.6	15.4	(9.1;22.3)	389	72.7
Age range										
16 to 19 years	841	79.1	14.7	(8.3;20.9)	282	68.1	15.7	(9.4;22.5)	389	73.1
20 to 25 years	222	20.9	13.4	(6.7;20.3)	69	61.1	14.5	(8.1;21.5)	77	70.6
p-value <sup>a</sup>	-		0.25		0.16		0.41		0.61	
Social-Economic class <sup>b,d</sup>										
A	171	16.1	13.8	(7.5;20.7)	60	61.9	13.0	(9.0;20.6)	50	67.6
B	505	47.5	14.6	(7.8;21.4)	164	67.2	16.0	(10.0;22.8)	197	75.5
C, D and E	363	34.1	14.3	(9.0;20.4)	120	68.2	15.5	(8.1;22.5)	133	71.1
p-value <sup>a</sup>	-		0.85		0.54		0.12		0.33	
Who do you live with <sup>d</sup>										
Alone	122	11.5	16.1	(8.1;20.4)	49	69.0	13.6	(8.7;22.2)	36	70.6
Parents or relatives	780	73.4	14.0	(7.8;20.8)	242	64.4	15.5	(9.1;21.8)	291	72.0
Fraternity or others	160	15.1	14.6	(10.2;21.2)	60	75.9	17.3	(9.9;24.7)	62	76.5
p-value <sup>a</sup>	-		0.29		0.13		0.26		0.67	
Area of study <sup>e</sup>										
Health Sciences	226	21.3	15.2	(7.8;20.0)	48	69.6	13.6	(8.6;20.3)	103	65.6
Others	837	78.7	14.3	(8.3;21.0)	303	66.2	16.1	(9.8;23.3)	286	75.5
p-value <sup>a</sup>	-		0.72		0.58		<0.01		0.02	

Note: \*Above 10% of the total daily energy intake. <sup>a</sup>p-value associated with the Mann Whitney or Kruskal Wallis test for median and Chi-square for proportions; <sup>b</sup>According to the Brazilian Association of Research Companies [31]; <sup>c</sup>Health Sciences: Nursing, Medicine, and Nutrition; Others: Agronomy, Architecture, Biology, Computer Sciences, Civil Engineering, Electrical Engineering, Forest Engineering, Sanitary Engineering, Philosophy, Physics, Geology, Mathematics, Veterinary Medicine, Psychology, Chemistry, and Animal Science; <sup>d</sup>Variable with missing data- Race/color: 4; Social-Economic Class: 24; Who you live with: 1 student. Mdn: Median.

free sugars in the total daily energy value was highest among the highest tertiles of energy intake (positive trend), in both genders (Figure 2).



**Figure 2** – Percentage (%) of free sugar in the total energy intake (in tertile) of university students, according to sex. Mato Grosso (MT), Brazil, 2016-2018.

Note: \**p*-value as per Kruskal-Wallis test (different letters indicate significant differences between groups – *p*-value <0.05).

The percentage of free sugars in total energy intake and its proportion with intake above 10% was higher among female students who reported smoking and those with unsatisfactory meal consumption patterns. For men, the percentage of free sugars in total energy intake was higher among students who were not overweight (Table 2).

**Table 2** – Median and interquartile range (IQ 25-75%) of the percentage of free sugar in total daily energy intake and proportion of people with consumption above 10% of total daily energy, according to lifestyle and weight condition variables among university students. Mato Grosso (MT), Brazil, 2016-2018.

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Characteristics	General		Male (n=527)				Female (n=536)			
	n	%	Proportion of total energy intake / day		Above recommended*		Proportion of total energy intake / day		Above recommended*	
			Mdn	IQ	n	%	Mdn	IQ	n	%
<b>Physical Activity<sup>b,d</sup></b>										
Sufficient	753	70.8	14.6	(8.0; 21.0)	257	66.1	15.4	(8.9;21.8)	262	72.0
Insufficient	306	28.8	13.7	(8.4;20.6)	92	67.6	15.7	(9.7;24.2)	126	74.1
<i>p</i> -value <sup>a</sup>			0.92		0.73		0.50		0.60	
<b>Sedentary behaviors<sup>d</sup></b>										
≤4 hour / day	789	25.7	14.1	(8.1;20.7)	261	66.2	15.8	(9.1;22.0)	289	73.2
>4 hour / day	273	74.2	14.9	(8.3;21.5)	90	67.7	14.9	(9.2;22.9)	100	71.4
<i>p</i> -value <sup>a</sup>			0.45		0.76		0.68		0.69	
<b>Smoking<sup>e</sup></b>										
No	934	87.9	14.3	(8.0;20.8)	303	66.9	14.7	(8.7;22.2)	341	70.9
Yes	129	12.1	14.1	(8.2;20.8)	48	64.9	18.8	(13.1;24.2)	48	87.3
<i>p</i> -value <sup>a</sup>			0.88		0.73		0.01		0.01	
<b>Consumption of alcoholic beverages<sup>f</sup></b>										
No	464	43.7	14.8	(8.0;21.2)	144	67.0	14.4	(8.8;22.9)	176	70.7
Yes	599	56.3	14.0	(8.2;20.4)	207	66.3	16.0	(9.7;21.8)	213	74.2
<i>p</i> -value <sup>a</sup>			0.88		0.88		0.52		0.36	

**Table 2** – Median and interquartile range (IQ 25-75%) of the percentage of free sugar in total daily energy intake and proportion of people with consumption above 10% of total daily energy, according to lifestyle and weight condition variables among university students. Mato Grosso (MT), Brazil, 2016-2018.

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Characteristics	General		Male (n=527)				Female (n=536)			
			Proportion of total energy intake / day		Above recommended*		Proportion of total energy intake / day		Above recommended*	
	n	%	Mdn	IQ	n	%	Mdn	IQ	n	%
Pattern of meal consumption										
Satisfactory	217	20.4	13.1	(7.7;19.6)	76	60.8	12.5	(8.2;19.0)	59	64.1
Unsatisfactory	846	79.6	14.7	(8.4;21.4)	275	68.4	16.1	(9.8;23.2)	330	74.3
<i>p</i> -value <sup>a</sup>			0.06		0.11		<0.01		0.04	
Hours of Sleep										
≥8 hours	785	73.8	13.7	(7.9;20.8)	261	65.4	14.6	(8.7;21.9)	274	71.0
<8 hours	276	26.0	15.4	(8.8;20.9)	90	70.3	17.6	(10.3;23.7)	114	77.0
<i>p</i> -value <sup>a</sup>			0.34		0.31		0.12		0.16	
Weight condition										
Without excess weight	825	77.6	14.7	(8.7;21.1)	78	60.9	15.1	(9.1;21.9)	350	66.5
Overweight	236	22.2	13.3	(6.4;19.7)	350	66.5	16.1	(8.8;24.2)	309	72.4
<i>p</i> -value <sup>a</sup>			0.03		0.12		0.29		0.87	

Note: \*Above 10% of the total daily energy intake. <sup>a</sup>*p*-value associated with the Mann Whitney or Kruskal Wallis test for median and Chi-square for proportions; <sup>b</sup> IPAQ: International Physical Activity Questionnaire, sufficient physical activity level was considered to be at least 150 minutes per week of moderate or vigorous physical activity [33]; <sup>c</sup>Consumption at least once in the last 30 days; <sup>d</sup>Variable with missing data-Physical activity and sedentary behaviors: 1; smoking: 15 students. Mdn: Median.

When analyzing R24h foods' contribution to free sugar intake, foods were divided into 39 groups and organized in a ranking of 10 foods that contributed most to free sugar intake among all university students. These 10 foods were responsible for more than 90.0% of the total free sugar consumption in the evaluated students' diet. Sweets and desserts, soft drinks, and juices were the first three food groups in the general ranking and by sex, contributing with approximately 60.0% of free sugar intake in both sexes (Figure 3). The group of sweets and desserts was first in the ranking among women, ranking third for men (24.2% vs. 20.0%). On the other hand, soft drinks and juices ranked first in males and third in females (20.5% vs. 13.6%).

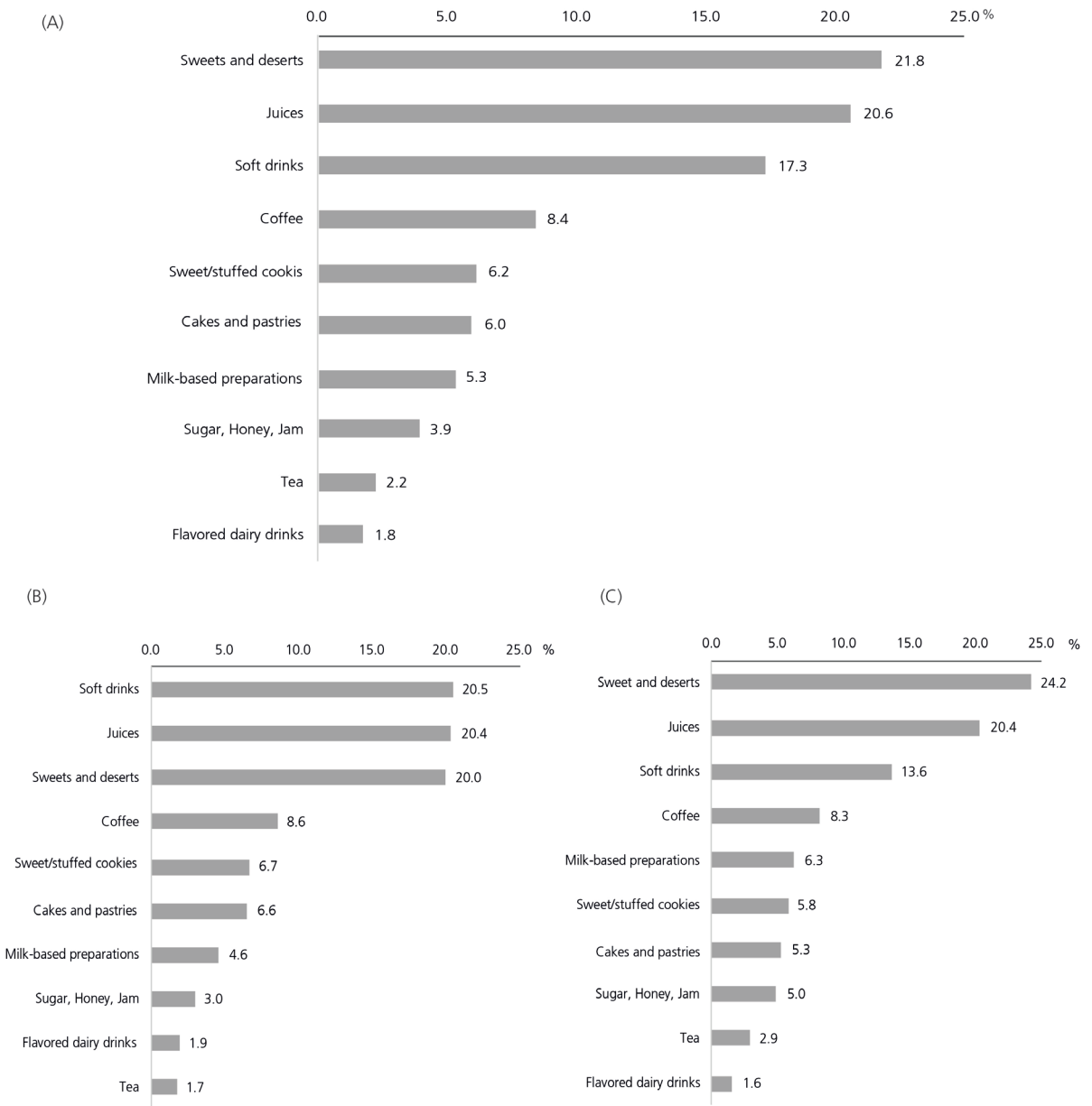
## DISCUSSION

Free sugar consumption by university students was high, with a higher proportion of consumption above recommended values among female students (72.6%) when compared to males (66.6%). There was a direct relationship between free sugar participation in the most considerable tertiles of energy intake. The main food source groups were sweets and desserts, juices, soft drinks, and coffee, with little variation in food groups' ranking between sexes.

This study showed, for the first time, the consumption of free sugar among Brazilian university students and the association with sociodemographic and lifestyle factors, with greater consumption in general in women, smokers, those who studied in areas outside Health Sciences, and with an unsatisfactory dietary pattern. Regarding men, only the weight condition was associated with free sugar consumption and was higher for individuals who were not overweight.

The results of the present study are important, once it was carried out in a young age group and in view of the evidence that sugar consumption is related to obesity and other chronic diseases. Reducing the consumption of foods rich in free sugars is one of the recommendations of the Food Guide for the Brazilian Population and for preventive action on chronic disease [1]; therefore, the identification of the main sources and the socioeconomic and lifestyle factors associated with higher





**Figure 3** – Percentage of the 10 foods that most contributed to the intake of free sugars among all university students (A), male students (B), and female students (C). Mato Grosso (MT), Brazil, 2016-2018.

free sugar consumption should aid in the planning of strategies for the promotion of a better diet of this population which, in turn, is in a favorable environment for nutritional education actions.

The contribution of free sugars to students’ total energy intake (14.3% and 15.4% of the total energy between men and women, respectively) was similar to that observed in previous studies carried out with university students. Nakhooda and Wiles [35] observed the average of 14.2% of the total energy intake among university students from South Africa and, among Brazilian students, this average was of 15,4% as per Fernandes et al. [12].

However, it is noteworthy that free sugar percentages observed in this study was higher than that of the Brazilian population in general, estimated by the National Food Survey in 2008-2009,

which was 7.2% of the total energy intake [4]. Baker et al. [36] show that beverages contribute nearly as much caloric sweeteners as ultra-processed food across all income levels, considering the free sugar's excessive participation of energy according to the WHO recommendation (<10% of total energy).

Regarding the analysis of the primary sources of sugar in the students' diets, the groups "sweets and desserts" and "juices and soft drinks" remained in the first three positions of the ranking, contributing with approximately 60.0% of free sugar consumption, which is similar to other studies with Brazilian university students [20,37]. Perez et al. [20] highlighted a high prevalence of daily consumption of sweetened beverages (46.2%), sweets (24.9%), and cookies or "packaged" snacks (17.9%) among university students. Similar to other studies that also indicate the strong presence of soft drinks, sweets, and desserts in university students' diets [12,37].

The presence of these food groups was also highlighted in the consumption habits of the Brazilian population from the 2017-2018 National Food Survey analysis, with a higher participation of ultra-processed foods among adolescents (corresponding to ¼ of the calories in the diet) followed by adults, highlighting the reality of university students, since more than 70% of the population evaluated in this study were adolescents [38].

The highest proportion of free sugar consumption above 10% among female students was also found in the results by Al-Qahtani et al. [39]. They emphasized that, compared to male students, female college students showed inadequate eating habits for sweets and other food groups and preferred to exchange meals for snacks, usually represented by ready-to-eat foods, with greater energy density and high free sugar content. This is consistent with the unsatisfactory meal consumption profile associated with greater participation of free sugars in the diet among female students. Among the possible explanations is that the foods replacing students' daily meals are often rich in free sugars, – like fast foods and sugary drinks.

The food groups that stood out as sources of free sugars were also among the most consumed among Brazilian adolescents, as found by the National School Health Survey, which showed a high frequency of sweets, soft drinks, and ultra-processed foods [40]. Among Brazilian adults, the results of the Surveillance of Risk and Protection Factors for Chronic Diseases by Telephone Survey (Vigitel Survey) [41] showed regular consumption (five or more days a week) of soft drinks by 15.0% of the population and was higher among men (18.3%) than women (12.3%). Rauber et al. [42] found a similar trend in a longitudinal study based on the United Kingdom's population, with a more significant contribution of ultra-processed foods associated with greater consumption of free sugars with direct association according to the increase in the quintiles of intake.

It was noted that free sugar consumption was higher among female students who smoked. Similar results were observed for students of both sexes by Bawadi et al. [16] and Lee et al. [43]. Among the possible explanations, one could presume that smokers have less perception of taste for sweet foods and, therefore, eat more of this group of foods [44].

Concerning the students' area of study, a significant association was observed in women enrolled in courses in the health area with a higher concern towards the ingestion of ultra-processed foods. However, Benaich et al. [13] identified, among students from Morocco, high free sugar consumption regardless of their area of study.

Higher free sugar consumption among male students who are not overweight compared to those who are may be related to reverse causality. That is, overweight individuals may adopt changes

in eating habits in order to control their weight. It may also be associated with dissatisfaction with body image and health concerns, as shown in some studies [45,46].

One limitation of this study is that exact amounts of table sugar consumption was not directly obtained; thus, the amount of sugar in coffee, tea, and fruit-based drinks was standardized to 10% for people who only used sugar and 5% for sugar plus artificial sweetener. Therefore, sugar intake could be based on biased estimates. Furthermore, due the cross-sectional design, this study does not determine the causality of high free sugar consumption among university students, and the absence of statistically significant differences may have been influenced by the homogeneous population. Regarding the analysis of dietary data, although it is not possible to assess habitual consumption with a single recall, an R24h has the advantage of detailing the consumption data, thus providing reliable information for population averages [47,48].

This study shows the participation of free sugars in the diet of university students. Its originality is a strong point since it considers, in addition to the percentages of this component in the students' diet and its primary dietary sources, sociodemographic, economic, and lifestyle factors associated with that participation. These results also contribute to the knowledge about food habits in this population, which is still scarce in Brazil as witnessed during bibliographic research. The results of this study are also significant in the context of current public food and nutrition policies as they corroborate ideas that underlie planning and decision-making in this field, such as, for example, the new rule on nutritional labeling of packaged foods and the constant debate about the taxation of beverages with high sugar content, like soft drinks, in order to show that preventive intervention tends to be easier, less expensive, and potentially more effective [49-51].

Thus, the university proves to be a favorable setting for developing public policies to promote health and healthy eating, since an unhealthy lifestyle in the university population is evident. Therefore, along with measures implemented by the government, such as taxation on sugary foods, there should be further research for improving food warning labels, standardizing portion sizes, and expanding pro-health education. In addition, more funding could be directed to higher education institutions to ensure adequate nutrition for university students. Also, the promotion of food quality awareness campaigns for students could help them make better dietary choices, equipping them with some knowledge they will take throughout adulthood.

## CONCLUSION

The study shows high participation of free sugars in university students' diet, being higher among women and among the highest tertiles of total energy intake. Among its main sources, besides sweets and desserts, are sweetened beverages (juices, soft drinks, and coffee) and ultra-processed foods (cookies). This study reflects a current picture of university students' food intake and provides data that could serve as a basis for future actions to promote healthy eating and raise awareness in this group about the risk of excessive consumption.

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## CONTRIBUTORS

PC CUNHA wrote this study, reviewed the literature, and performed the analysis. PRM RODRIGUES and AP MURARO proposed the study analysis, performed the revision of the analysis, and reviewed the literature. NF MOREIRA, BM GORGULHO, and MG FERREIRA performed the critical review of the manuscript and helped with the discussion section. All authors contributed to multiple revisions of the article. All authors read and approved the final manuscript.