

Nonnutritive sweeteners in Brazil: current use and associated factors

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Doi: <http://dx.doi.org/10.7322/jhgd.122760>

Resumo:

Introdução: O consumo de açúcares adicionados aumentou em todo o mundo. Para orientar e encorajar a implementação de políticas públicas no consumo de adoçante não nutritivo (NNS), é necessário não apenas identificar a quantidade consumida desses produtos, mas também os fatores associados ao seu consumo.

Objetivo: Este estudo teve como objetivo identificar as variáveis relacionadas ao consumo de NNS no estado de São Paulo, Brasil.

Método: Realizou-se um estudo transversal envolvendo funcionários adultos de duas universidades públicas do Estado de São Paulo, Brasil. Foi aplicado um questionário on-line contendo perguntas sobre o uso de NNSs e informações sobre características demográficas, socioeconômicas, antropométricas e de saúde. As análises estatísticas realizadas incluíram: o teste do qui-quadrado para determinar a associação entre variáveis explicativas e dependentes, adotando-se um nível de significância de $p < 0,05$ e regressão logística binária, calculando Odds-Ratio (OR) ($\alpha = 0,05$). Resultados: Participaram do estudo 1323 indivíduos. A prevalência de uso de NNS foi de 53,3%, mostrando-se maior entre indivíduos de 30 a 60 anos de idade (83,3). O teste de Qui-quadrado revelou que as variáveis gênero ($p = 0,000$), Diabetes Mellitus ($p = 0,008$), Hipertensão arterial ($p = 0,008$), dificuldade de controle de peso ($p = 0,000$), IMC ($p = 0,000$), renda ($p = 0,002$) e idade ($p = 0,000$) apresentaram associação direta e significativa com o consumo de NNS. (OR = 2,59), DM (OR = 3,32), dificuldade de controle de peso (OR = 2,29) e consumo de alimentos dietéticos (OR = 3,87). Estes resultados revelaram que as mulheres são 30% mais propensas a consumir NNS do que os homens e que estando entre os 50 e 60 anos aumenta a probabilidade de consumir estes produtos em 2,59 vezes. Além disso, sendo diabético, ter dificuldade em controlar o peso corporal e consumir dieta alimentar, aumentam a probabilidade de consumo de NNS em 3,32, 2,29 e 3,97 vezes, respectivamente.

Conclusão: A maioria da população estudada era consumidora de NNSs. As variáveis gênero, idade, DM, dificuldade em controlar o peso corporal e consumo de alimentos dietéticos foram todas associadas ao consumo de NNSs.

Palavras-chave: adoçantes não nutritivos, obesidade diabetes mellitus, peso corporal.

INTRODUCTION

Overweight and obesity represents a major challenge and a public health problem worldwide¹. Obesity has been increasing in all countries. In 2014, 39% of adults aged 18 years and older (38% of men and 40% of women) were overweight and 11% of men and 15% of women worldwide were obese². Among the environ-

mental factors associated with overweight and obesity, food it is a direct determinant the increase of both³. Given this scenario, weight loss products that use nonnutritive sweeteners (NNS) are becoming increasingly popular with consumers seeking to control body weight. Among the most popular of these items are products containing NNS that diet foods and beverages without adding calories⁴. NNS is defined as an additive that has a higher

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Suggested citation: Geraldo APG, Pinto-e-Silva MEM. Nonnutritive sweeteners in brazil: current use and associated factors. *J Hum Growth Development*. 2016; 26(2): 297-306. DOI: <http://dx.doi.org/10.7322/jhgd.122760>.

Manuscript submitted: 18 Jul 2016, accepted for publication 14 Aug 2016.

intensity of sweetness per gram than caloric sweeteners such as sucrose⁵.

The consumption of added sugars has increased worldwide⁶. Data on food consumption in Brazil point to a high prevalence in inadequate intake of free sugar, 10% above the total energy (67.0% for men and women)⁷. The latest guidelines from the World Health Organization state that the intake of sugars should not exceed 10% of the total energetic value of the diet, and preferably should not exceed 5%, in both adults and children⁸. In this context, NNS can replace the sugar sweet taste.

Since saccharin discovery in the late 1800s, NNS have been used by consumers for the control of blood glucose and energy consumption⁹. The literature shows that the use of dietary sweetener is higher among diabetics, hypertensive and obese individuals¹⁰.

The development of new eating habits and the current trends in production and consumption, can impact on health, environment and social¹¹. To guide and encourage the implementation of public policies on the consumption of NNS, it is necessary not only to identify the amount consumed of these products, but also the factors associated with their consumption. In this sense, the present study aimed to describe the frequency of consumption of NNS by Brazilian adults and to assess factors associated with their consumption.

METHODS

Study population

This is an observational, transversal trial, aiming to characterize the behavior in the consumption of NNS. The trial was performed with adults (aged ≥ 20 years) and the elderly; teaching staff and non-teaching staff of two public universities in the state of São Paulo, Brazil. Data collecting took place on February and March 2012. All employees were invited to participate in the research through electronic messages.

This study adopted the following eligibility criteria: adults and elderly (aged ≥ 20 years), body mass index (BMI) 18.5 – 24.99 kg/m² (appropriate weight) and BMI > 24.99 kg/m² (overweight), teaching staff and non-teaching staff of the universities involved in the trial. In addition, the study was delimited by the following criteria: prior agreement and cooperation of the directors of each institute of the universities involved and the participant's compliance with the Informed Consent present on the first page of the questionnaire.

The total number of teaching and non-teaching active employees in 2011 was 33,070. The minimum sample size was calculated using the equation: $n = Z_{\alpha/2}^2 \cdot p \cdot q / E^2$

The p and q value of 0.5 was adopted because the population proportion of NNS consumers in the state of São Paulo is not known. The confidence level established was 99%, the critical value associated with that confidence level ($Z_{\alpha/2}$) is 2.575 and the standard error stipulated for the calculation was 5%. Considering the possibility of losses, 20% were added so that there was reduction in the sample size, which finally consisted of 795 subjects.

The directorates of all units of the universities involved in the study were contacted and agreed to the disclosure of the research and participation of the employees. Thus, all employees were invited to participate in the study through electronic messages.

Anthropometry

Body Mass Index (BMI) was calculated by dividing the referred weight (kg) by referred height squared (m²). Armed with this index, the classification of the nutritional status of the participants was made in BMI percentiles per age and was categorized according to the World Health Organization¹². For subjects aged greater than or equal to 60 years, the classification was made according to Lipschitz¹³.

NNS intake

The instrument was developed based on the study of Zanini et al¹⁰. Survey Monkey (<https://pt.surveymonkey.com/>) tool was used to prepare the questionnaire. An online questionnaire was applied containing questions on the use of NNSs and information about demographic, socio-economic, anthropometric and health characteristics. The questionnaire was pre-assessed with 25 employees of a state university in the city of São Paulo and adjustments were made according to the results.

The web link of the questionnaire was made available to participants. In order not to allow a participant to answer it more than once, only one access number for each computer IP used was released.

Statistical analysis

All analyses were performed using SPSS software version 22.0. The analysis of the results was divided into two steps: (1) Characterization of sociodemographics and consumption behavior of NNS and diet food, as well as their use and knowledge, performed through ratios and means, standard deviation and medians. (2) The analysis of the determinants of consumption of NNS and diet food (dependent variables) was performed through univariate and multiple logistic regression analysis.

The survey of the features that predisposed the participant to consume NNS and industrialized light/diet products was prepared according to the following steps: initially univariate models were designed, being eligible the variables that showed an association ($p < 0.20$) by Chi-Square test for logistic regression. Independent variables that showed some association ($p < 0.20$) were transferred to the following step of multiple logistic regression, each one placed in the model by order of magnitude of odds ratio and eliminating the variables that showed no significance. The categories with odds ratios (ORs) higher than 1.0 were considered risk-predisposing factors and the categories with ORs lower than 1.0 were considered protection factors.

The research was approved by the Institutional Review Board from School of Public Health of the University of São Paulo and the participation of the subjects relied on the acceptance of the informed consent form.

RESULTS

1323 subjects participated in the study (Table 1). The average age of the population was 41.49 years old (sd =11.33). Most subjects were women (62.7%),

married (58.2%), and had more than 16 years of education (74.1%). 77.2% reported having an income ≥ 5 MW. Regarding physical activity, it was observed that the majority practiced it 2 to 3 times per week (33.3%).

Table 1: Characterization of the sample of employees of public university institutions. São Paulo, Brazil, 2012

Variable		n	%
Age	20-29 years old	235	17.8
	30-39 years old	354	26.8
	40-49 years old	370	28.0
	50-59 years old	298	22.5
	≥ 60 years old	66	5.0
Gender	Male	493	37.3
	Female	830	62.7
Marital status	Single	407	30.8
	Married	770	58.2
	Divorced	119	9.0
	Widower	27	2.0
Years of education	Up to 11 years	80	6.0
	12 to 15 years	263	19.9
	≥ 16 years	980	74.1
Physical activity	Never	307	23.2
	1 - 2 times per month	214	16.2
	1 time per week	144	10.9
	2 - 3 times per week	440	33.3
	4 - 7 times per week	218	16.5
Income	Up to 4 MW	267	20.7
	5 to 10 MW	542	42.1
	≥ 10 M	479	37.2
BMI (kg/m ²)	Up to 24.9	611	46.2
	25.0 – 29.9	470	35.5
	≥ 30.0	242	18.3
Hypertension	No	1152	87.1
	Yes	171	12.9
DM	No	1241	93.8
	Yes	82	6.2
Consumption NNS	No	612	46.3
	Yes	711	53.7
Consumption of diet food	No	605	46.5
	Yes	695	53.5

It was observed that subjects who never performed physical activities are mostly those with trouble in maintaining body weight (61.9%; $p = 0.001$) and are overweight (35.5%) or obese (24.4%) ($p = 0.009$). Physical activity practiced 5-7 times a week was more prevalent among those who have no trouble in maintaining body weight (53.2%) and eutrophic (50.9%). Only 13.3% of the obese subjects practice physical activity with that frequency. When physical practice is assessed grouping “never” to “once weekly”, the prevalence among eutrophic subjects was 45.7%, 51.5% overweight and 59.5% obese, i.e., the higher the degree of excess weight, the lower the frequency of physical activity.

53.8% had some degree of overweight (BMI ≥ 25.0). The mean weight of the sample was 74.03 kg (sd = 16.45kg) and mean BMI 26.18 (sd = 4.64), and 53.7% of the studied sample stated being consumers of NNS.

The characteristics of NNSs consumers are shown in Table 2. The consumers were mostly women (67.5%), aged between 40 and 59 years (56.7%) with a mean of 43.2 years (sd=10.86), married (60.8%) and ≥ 12 years of education (93.8%). Subjects who practice physical activity 2-3 times a week were the ones most consuming NNS. The mean weight was 72.03 kg (sd = 15.55) and the mean BMI 25.26 kg/m² (sd = 4.3). We found a prevalence of 63.3% of overweight (BMI ≥ 25.0) among NNS consumers.

Table 2: Characterization of consumers of nonnutritive sweeteners from university institutions. São Paulo, Brazil, 2012

Variable		n	%
Age	20 - 29 years old	82	11.5
	30 - 39 years old	189	26.6
	40 - 49 years old	210	29.5
	50 - 59 years old	193	27.1
	≥ 60 years old	37	5.2
Gender	Male	231	32.5
	Female	480	67.5
Marital status	Single	196	27.6
	Married	433	60.9
	Divorced	66	9.3
	Widower	16	2.3
Years of education	Up to 11 years	44	6.2
	12 - 15 years	130	18.3
	≥ 16 years	537	75.5
Physical activity	Never	162	22.8
	1 - 2 times per month	112	15.8
	1 time per week	65	9.1
	2 - 3 times per week	239	33.6
	4 - 7 times per week	133	18.7
Income	Up to 4 MW	118	17.1
	5 - 10 MW	301	43.6
	> 10 MW	271	39.3
BMI (kg/m²)	≤ 24.9	282	39.7
	25.0 – 29.9	269	37.8
	≥ 30.0	160	22.5
Diabetes Mellitus	No	641	90.2
	Yes	70	9.8
Hypertension	No	603	84.8
	Yes	108	15.2
Difficulty maintaining body weight	No	251	35.3
	Yes	460	64.7
Consumption of diet food	No	206	29.6
	Yes	490	70.4

The difficulty in maintaining body weight was reported by 64.8% of NNS consumers and among the main reasons for its use, the following stood out: “Not willing to get fat” (41.4%), “Willing to save calories to be consumed in other food” (26.8%).

Table 3 shows the variables that were associated with the consumption of NNS. Gender, age, income, BMI, physical activity, DM, hypertension, difficulty maintaining body weight and consumption of diet food were statistically different between consumers and non-consumers.

Also according to Table 3, there was a higher proportion of females among consumers ($p = 0.001$) and the highest frequency of consumption occurs in the age group 30-59 years old ($p = 0.000$). Among subjects aged 20 to 29 years, there was a higher prevalence of non-consumers (25.0%).

The income above 4 MW was found to be associated with the consumption of NNS ($p = 0.002$), and 82.9% of consumers are in that income range. BMI ≥ 25.0 (over-

weight and obese) had a positive association with the consumption of NNS ($p = 0.001$). Among consumers, 39.7% did not have any degree of overweight, while among non-consumers this number is 1.36 times higher (53.8%).

Regarding physical activity, the highest prevalence of NNS consumers was found in frequency of 2 to 3 times per week ($p = 0.000$). In addition, in the frequency of 4 to 7 times per week the proportion of consumers was 34.5% higher compared to non-consumers.

Subjects who consume diet food showed a prevalence of consumption of NNS 2.1 times higher than those who do not consume it ($p = 0.001$). Likewise, the consumption of NNS was 1.68 times higher among subjects who have difficulty maintaining their body weight ($p = 0.001$). There was no statistically significant difference within marital status and years of education.

On Table 4, univariate and multiple logistic regression models are presented, according to factors associ-

Table 3: Distribution and association of demographic, social-economic, behavioral, nutritional and health variables with the consumption of NNSs. São Paulo, Brazil, 2012

Variable	Consumer		Non-consumer		p*
	n	%	n	%	
Gender					
Male	231	32,5	262	42,8	< 0,001
Female	480	67,5	350	57,2	
Age					
20 – 29 years old	82	11,5	153	25,0	< 0,001
30 – 39 years old	189	26,6	165	27,0	
30 – 49 years old	210	29,5	160	26,1	
50 – 59 years old	193	27,1	105	17,2	
≥ 60 years old	37	5,2	29	4,7	
Income					
Up to 4 MW	118	17,1	149	24,9	0,002
5 to 10 MW	301	43,6	241	40,3	
> 10 MW	271	39,3	208	34,8	
Physical activity					
Never	162	22,8	145	23,7	0,054
1 a 2 times per month	112	15,8	102	16,7	
1 time per week	65	9,1	79	12,9	
2 a 3 times per week	239	33,6	201	32,8	
4 a 7 times per week	133	18,7	85	13,9	
DM					
No	641	90,2	600	98,0	< 0,001
Yes	70	9,8	12	2,0	
Hypertension					
No	603	84,8	549	89,7	0,008
Yes	108	15,2	63	10,3	
Difficulty maintaining body weight					
No	251	35,3	376	61,4	< 0,001
Yes	460	64,7	236	38,6	
Consumption of diet food					
No	206	29,6	399	66,1	< 0,001
Yes	490	70,4	205	33,9	
Years of education					
Up to 11 years	44	6,2	36	5,9	0,294
12 to 15 years	130	18,3	133	21,7	
16 years or over	537	75,5	443	72,4	

* Descriptive level of the test of association by Chi-square.

ated to NNS consumption. The results showed that being diabetic, having difficulty maintaining body weight and consuming diet food increase the chance of consuming NNS in 3.32; 2.29 and 3.87 respectively. Women were 1.3 times more likely to consume NNS compared to men. In addition, subjects 50 – 59 years old were 2.59 times more likely to consume sNNS compared to subjects 20 – 29 years old. In short, subjects who reported consuming more NNS are those who are diabetic, with difficulty maintaining body weight, consuming diet food, women and mostly aged within 50 and 59 years.

DISCUSSION

The findings of the present work showed that the magnitude of the frequency (53.5%) of use of NNS found in this study is much higher than that found in the Bra-

zilian literature. These findings contrast with the results found by Zanini et al.¹⁰, which found prevalence of NNS use of 19.0% in subjects from Pelotas (RS), being higher for women. It is likely that this difference is because those are studies performed in different Brazilian regions, with cultural differences that influence eating habits, a more balanced male to female ratio and lower prevalence of high income in the study in Pelotas.

Information on the amounts of NNS in beverages and foods is limited and not easily accessible⁵ making it difficult to compare the data obtained in this study with other populations. Bär and Biermann¹⁴ estimated that in 1992 35.9% of the participants ingested one or more NNSs on the examination day.

The prevalence of DM among NNS consumers was 9.8% in the studied sample, showing that the intake of NNS is not restricted to people with diabetes, who often replace sugar with NNS.

Table 4: Analysis of univariate and multiple logistic regression, according to factors associated to consumption of NNSs, São Paulo, Brazil, 2012

Variables	Categories	Univariate		Final model and the block	
		OR raw	CI _{95%}	OR adjusted	CI _{95%}
Income	Up to 4 MW	1,0	-	-	-
	5-10 MW	1,58	1,17 – 2,12	-	-
	> 10 MW	1,64	1,22 – 2,22	-	-
Gender	Male	1,0	-	1,0	-
	Female	1,55	1,24 – 1,95	1,30	1,01 – 1,69
Age group	20 – 29 years old	1,0	-	1,0	-
	30 – 39 years old	2,14	1,52 – 3,00	1,81	1,24 – 2,63
	40 – 49 years old	2,45	1,75 – 3,43	1,96	1,35 – 2,85
	50 – 59 years old	3,43	2,40 – 4,91	2,59	1,73 – 3,86
	≥ 60 years old	2,38	1,37 – 4,15	1,94	1,05 – 6,30
DM	No	1,0	-	-	-
	Yes	5,46	2,93–10,17	1,0	-
Hypertension	No	1,0	-	3,32	1,71 – 6,43
	Yes	1,56	1,12 – 2,17	-	-
Difficulty maintaining Body weight	No	1,0	-	-	-
	Yes	2,92	2,33 – 3,65	1,0	-
BMI (kg/m ²)	≤ 24.9	1,0	-	2,29	1,79 – 2,93
	25,9 – 29.9	1,56	1,22 – 1,99	-	-
	≥ 30.0	2,28	1,67 – 3,10	-	-
Physical activity	Never	1,0	-	-	-
	1- 2 times/month	0,98	0,69 – 1,39	-	-
	1 time/week	0,74	0,49 – 1,10	-	-
	2- 3 times/week	1,06	0,80 – 1,42	-	-
	4-7 times/week	1,40	0,98 – 1,99	-	-
Consumption of diet food	No	1,0	-	1,0	-
	Yes	4,63	3,66 – 5,85	3,87	3,03
Years of education	Up to 11 years	1,0	-	-	- 4,95
	12 – 15 years	0,80	0,48 – 1,32	-	-
	≥ 16 years	0,99	0,63 – 1,57	-	-
Marital status	Single	1,0	-	-	-
	Married	1,38	1,09 – 1,76	-	-
	Widower	1,57	0,71 – 3,46	-	-
	Divorced	1,34	0,89 – 2,02	-	-

The results on the factors associated with consumption of NNS found by Zanini et al.¹⁰ in the city of Pelotas, Brazil, were similar to the results in this study, where it was observed that the prevalence of consumption of NNS was higher among women with higher socioeconomic status (classes A and B) and overweight. However, the results were not in agreement with regard to marital status, since the authors found that divorced subjects and widowers were the largest consumers of NNS, while in the present study there was no significant statistical difference for this variable.

A survey that examined the trends in consumption of foods and beverages with NNS among Americans aged ≥2 years by using the U.S. Department of Agriculture Nationwide Food Consumption Survey for 1965, 1977 to 1978, and 1989 to 1991 and the National Health and Nutrition Examination Survey (NHANES) for 1999 to 2000, 2001 to 2002, and 2003 to 2004 found that the consump-

tion of NNS in both beverages and foods increased over time. The survey data indicate that, on any given day, 15% of the U.S. population consumed NNS in 2003 to 2004 in comparison with 3% in 1965¹⁵.

In Brazil, the participation of “added sugars” (from refined sugar and processed foods) available in Brazilian households is 16.7% of total calories⁷ exceeding the maximum limit of 10% recommended by the World Health Organization. This research found that scenario in all income classes. However, when only refined sugar is considered, the participation is lower in the upper income quintile. In the present study, we found that the prevalence of consumption of NNSs is higher among subjects with income ≥ five minimum wages (R\$ 1,230.00), suggesting that in higher income ranges, refined sugar may be being replaced by NNS.

In recent years, the ideal image of women has become unrealistically thin, while the ideal image of men

has become unrealistically muscular. The exposure to these unrealistic models is associated with body dissatisfaction in both women and men, particularly among those who engage in social comparison and internalize the ideals. The body types shown in the media as ideal vary more for men than women, and there is more frequent depiction of objectified images of women compared to men. Thus, there is sociocultural pressure to aspire to unrealistic body ideals, especially for women¹⁶.

The results from this work showed that women are the largest consumers of NNS, probably due to the higher concern with aesthetics, which motivates them to not want to get fat, and thus replace the sugar by NNSs. It should be noted, however, that women (21.6%) have affinity for the sweet taste, according to data from Surveillance System for Protective and Risk Factors via Telephone Survey (VIGITEL) for the state of São Paulo¹⁷.

It is noteworthy that subjects who are overweight and have difficulty maintaining body weight consume more NNS compared to eutrophic ones, however it is not possible to establish a causality relationship, i.e., we cannot state whether subjects consume NNS because they are overweight or whether it is the consumption of NNS that can contribute to body weight gain.

The strategy of replacing sucrose with NNSs is widely used by subjects because of the known potential for reducing caloric intake from diet foods and beverages, maintaining a high acceptability standard¹⁸. If non-nutritive sweeteners are used as substitutes for higher energy yielding sweeteners, they can have the potential to aid in weight management¹⁵.

Findings regarding the effects of NNSs on energy intake and body weight have been controversial. Most studies indicate that several NNSs may assist with obesity and type 2 diabetes. Other studies suggest that several NNSs may lead to weight gain^{19,20}. The sweet taste dissociated from the caloric content of the food can cause activation of mechanisms of food reward, and may boost the desire for sugar²⁰. Feijó et al.²¹ studied the effect on body weight of addition of NNS to the diet of rats and found that greater weight gain was promoted by the use of saccharin or aspartame compared to sucrose²²⁻²⁴, and that this weight gain was not related to calorie intake. Swithers et al.²⁵ suggest that there are negative consequences for weight control from the consumption of NNS, especially among subjects who use them to control body weight and women who consume a "westernized" diet.

Many NNS consumers do not exercise. This shows the need for proper guidance on the importance of lifestyle changes for loss or maintenance of body weight. It is important to highlight that the replacement of added sugar with NNS alone may not result in weight loss, since physical exercise is essential for the treatment of obesity²³. The use of NNS can provide benefits toward weight reduction in the individual patient, and may depend on the characteristics of their baseline diet, associated changes, or dietary compensation involved with ingestion of NNS, and the degree of compliance with a more complete weight loss program²⁴. This information is of great importance for health professionals to guide efficiently the inclusion of NNS in the diet of the subjects and highlights the need for

a multidisciplinary team in the treatment of obesity.

The higher frequency of physical activity was associated with consumption of NNS. This fact is relevant, since these individuals combine physical exercises to NNS consumption possibly for the control of body weight. However, consumption of NNS is not determinant in the practice of physical activity, since many consumers are not considered active.

The multiple regression analysis identified gender, age, DM, difficulty in maintaining weight and the consumption of dietary foods as variables associated with consumption of NNS. In the construction of the regression analysis, it can be seen that when the variables included difficulty maintaining weight and BMI classification, the latter variable would lose significance, because both are closely related.

The consumption of diet food was the most important element in the regression, followed by DM, the difficulty in maintaining weight and age group between 50 and 59 years old.

Consumption of diet food increases by 3.87 times the chance of consuming NNS. In fact, most of the diet food consumers in the studied sample also consume NNS. Possibly these subjects combine the use of these two products to control their calorie intake and/or treatment of DM.

The presence of DM greatly increases the chance of consuming NNS. This is because the use of this product is usually part of the dietary recommendations for the treatment of this disease. At this time, there is plausibility for a health benefit from replacing added sugars and the calories they provide with NNS for the purpose of glycemic control and diabetes prevention or management²⁵.

Having difficulty maintaining body weight increases the chance of consuming NNS, probably because subjects who have this characteristic replace sugar with NNS to decrease calorie intake. This result highlights the importance of studying the eating attitudes, including individuals who are overweight, for proper guidance on the use of NNS replacing sugar. According to the American Dietetic Association, dysfunctional eating attitudes involve rigid notions of healthy eating, guilt, fear and anxiety related to food choices²⁶.

In terms of age group, the greater chance of consuming NNS is in the range 50-59 years old (2.59 times), although all age groups showed an increased chance in the consumption of these products compared to those aged 20 to 29 years. In the studied sample, it was observed that the higher prevalence of obesity and DM was found in the age group with the highest chance of consuming NNS (50-59 years old). Of all the diseases, type 2 diabetes mellitus is the disease most affecting a large number of elderly subjects and its complications take a major toll on the quality of life of the elderly and the healthcare costs to the society²⁷.

In view of these results, we can say that, in the studied sample, with the increase in the age, the greater the need to control body weight and DM, and thus the consumption of NNS and diet food is increased.

Moreover, the chance of women to consume NNS is 30% higher compared to men. As already mentioned, women have greater concern with aesthetics and

are under pressure that the social environment imposes with the standards of beauty set out, represented as a thin body. This fact justifies the increased use of these products by women.

Some limitations of the study should be considered. Based on the results of this study, with a cross-sectional design and non-probabilistic and very specific sample (non-teaching staff and teaching staff from universities), the data obtained cannot be extrapolate for the entire adult population of the state of São Paulo. Moreover, we used data related to variables that suffer many influences in this type of collection, such as body weight, height and morbidity. It is noteworthy that the validation of anthropometric data was performed to minimize this bias.

The questionnaire, administered online, also sets a limitation in the study, such as the sample being limited

to those who have internet access, the impersonality and the lower reliability of the data. On the other hand, Galante and Colli²⁸ claim that computerized questionnaires completed on the Internet are easily used and have several advantages, such as immediate verification of inconsistencies in the answer or missed fields. In fact, these benefits of using the online questionnaire are relevant, especially in samples with a lot of individuals or when it is necessary to get data from distant populations.

Based on the results obtained it can be concluded that the frequency of NNS consumption is high, with more than half of the population studied consuming these products. The greater chance of consuming them is among females, aged 50 years and above and who seek these products to control body weight or Diabetes Mellitus.

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Abstract:

Introduction: The consumption of added sugars has increased worldwide. To guide and encourage the implementation of public policies on the consumption of nonnutritive sweetener (NNS), it is necessary not only to identify the amount consumed of these products, but also the factors associated with their consumption.

Objective: This study aimed to identify the variables related to NNS consumption in São Paulo state, Brazil.

Method: A cross-sectional study involving adult employees of two public Universities in São Paulo state, Brazil, was conducted. An online questionnaire was applied containing questions on the use of NNSs and information about demographic, socioeconomic, anthropometric and health characteristics. The statistical analyses performed included: the Chi-square test to determine association between explanatory and dependent variables, adopting a level of significance of $p < 0.05$, and binary logistic regression calculating the Odds-Ratio (OR) ($\alpha = 0.05$). Results: A total of 1323 individuals took part in the study. The prevalence of NNS use was 53.3%, proving higher among individuals between 30 and 60 years of age (83.3). The Chi-squared test revealed that the variables gender ($p = 0.000$), Diabetes Mellitus (DM) ($p = 0.000$), arterial hypertension ($p = 0.008$), difficulty controlling weight ($p = 0.000$), BMI ($p = 0.000$), income ($p = 0.002$) and age ($p = 0.000$) had a direct and significant association with NNS consumption. On the logistics regression model, the variables significantly associated with NNS consumption were gender (OR 1.3), age (OR = 2.59), DM (OR = 3.32), difficulty controlling weight (OR = 2.29) and consumption of diet foods (OR = 3.87). These results revealed that women are 30% more likely to consume NNS than men and that being aged between 50 and 60 years increases the likelihood of consuming these products by 2.59 times. In addition, being diabetic, having difficulty controlling body weight, and consuming diet foods increase the likelihood of NNS consumption by 3.32; 2.29 and 3.97 times, respectively.

Conclusion: The majority of the population studied were consumers of NNSs. The variables gender, age, DM, difficulty controlling body weight, and consuming diet foods were all associated with the consumption of NNSs.

Keywords: nonnutritive sweeteners, obesity diabetes mellitus, body weight.