REVISTA ENFERMAGEM ATUAL IN DERME

INGESTION OF CARIOGENIC FOODS, ORAL HEALTH AND ORAL MICROBIOTA OF UNIVERSITY STUDENTS

HÁBITOS ALIMENTARIOS Y SU RELACIÓN CON LA SALUD BUCAL Y LA MICROBIOTA ORAL DE ESTUDIANTES UNIVERSITARIOS

HÁBITOS ALIMENTARES E SUA RELAÇÃO COM A SAÚDE BUCAL E MICROBIOTA ORAL DE ESTUDANTES UNIVERSITÁRIOS

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ABSTRACT
Objective: To evaluate the relation between the ingestion of cariogenic foods by university students from African countries, the presence of dental caries and Candida spp. and the value of salivary pH. **Methods:** Transversal and analytic study, carried out at a Brazilian university. The ingestion of cariogenic foods was evaluated through a questionnaire and the rate of decayed, missing and filled teeth was determined (DMFT Index). To quantify the pH, an indicator strip was immersed in collected saliva. Identification of *Candida* spp. was carried out through a culture of the sample in CHROMagar Candida™. To analyze the data, we applied Kruskal-Wallis, Mann-Whitney and Qui-Square tests, considering a value of p < 0.05. **Results:** Out of 133 participants, 57.89% were Guinean, 20.30% had *Candida* spp. in their oral cavity and the majority ingested cariogenic foods and had a salivary pH of 7. The highest average in DMFT Index was observed among those who ingested dessert, chocolate and juice boxes. As for the ingestion of cariogenic foods among students with *Candida* spp. in their oral cavity, 44.44% and 33.33% ingested sweetened cookies and dessert once a week, respectively. The majority of participants who ingested dessert, chocolate, juice boxes and chocolate milk, regardless of frequency of ingestion, showed a pH of 7. **Conclusion:** In general, students, despite ingesting cariogenic foods, even with a weekly frequency, had low DMFT Index, adequate salivary pH and *Candida* wasn't present.
Keywords: Universities; Africa; Dental Caries; *Candida*

RESUMEN
Objetivo: Evaluar la relación entre la ingesta de alimentos cariogénicos por estudiantes universitarios de países africanos, la presencia de caries dental y Candida spp. y el valor del pH salival. **Métodos:** Estudio transversal y analítico realizado en una universidad brasileña. Se evaluó la ingesta de alimentos cariogénicos mediante un cuestionario y se determinó el Índice de dientes cariados, perdidos y obturados (Índice CPOD). Para cuantificar el pH, se sumergió una tira indicadora en la saliva recolectada. La identificación de Candida spp. se realizó cultivando la muestra en CHROMagar Candida™. Para el análisis de los datos, se aplicaron las pruebas de Kruskal-Wallis, Mann-Whitney y Chi-Cuadrado, considerando un valor de p < 0,05. **Resultados:** De los 133 participantes, el 57,89% eran guineanos, el 20,30% tenían Candida spp. en la cavidad bucal y la mayoría ingirió alimentos cariogénicos y presentó pH salival igual a 7. El promedio más alto del Índice CPOD se observó entre los que ingirieron postre, chocolate y jugo industrializado. En cuanto a la ingesta de alimentos cariogénicos en escolares con Candida spp. en la cavidad oral, el 44,44% y el 33,33% comían galletas azucaradas y postre una vez por semana, respectivamente. La mayoría de los participantes que ingirieron postre, chocolate, jugo industrializado y leche chocolatada, independientemente de la frecuencia de ingestión, tuvieron un pH de 7. **Conclusión:** En general, los estudiantes, a pesar de ingerir alimentos cariogénicos, incluso con una frecuencia semanal, presentaron índice CPOD bajo, pH salival adecuado y Candida sp. no estaba presente.
Palabras clave: Universidades; África; Caries Dental; *Candida*.

RESUMO
Objetivo: Avaliar a relação entre a ingestão de alimentos cariogênicos por universitários de países africanos, a presença de cárie dentária e Candida spp. e o valor do pH salivar. **Métodos:** Estudo transversal e analítico, realizado em uma universidade brasileira. A ingestão de alimentos cariogênicos foi avaliada por meio de questionário e foi determinada o Índice de Dentes Cariados, Perdidos e Obturados (Índice CPOD). Para quantificar o pH, uma tira indicadora foi imersa na saliva coletada. A identificação de *Candida* spp. foi realizada através da cultura da amostra em CHROMagar Candida ™. Para análise dos dados, foram aplicados os testes de Kruskal-Wallis, Mann-Whitney e Qui-Quadrado, considerando um valor de p <0,05. **Resultados:** Dos 133 participantes, 57,89% eram guineenses, 20,30% tinham *Candida* spp. na cavidade oral e a maioria ingeria alimentos cariogênicos e apresentava pH salivar igual a 7. A maior média do Índice CPOD foi observada entre aqueles que ingeriram sobremesa, chocolate e suco industrializado. Quanto à ingestão de alimentos cariogênicos entre escolares com Candida spp. na cavidade oral, 44,44% e 33,33% ingeriam biscoitos açucarados e sobremesa uma vez por semana, respectivamente. A maioria dos participantes que ingeriu sobremesa, chocolate, suco industrializado e leite com chocolate, independente da frequência de ingestão, apresentou pH 7. **Conclusão:** Em geral, os alunos, apesar de ingerirem alimentos cariogênicos, mesmo com frequência semanal, apresentaram Índice CPOD baixo, pH salivar adequado e *Candida* sp. não estava presente.
Palavras-chave: Universidades; Àfrica; Cárie Dentária; *Candida*.

INTRODUCTION

In the context of oral disease, dental caries stands out as the most prevalent chronic infectious disease of the oral cavity, characterized by the destruction of dental hard tissues. In an epidemiological context, data show higher levels of dental caries in Latin American and European countries, whereas lower levels are observed in Middle East, Western Pacific, Southeast Asia and North America[1]. In the African continent, although programs and strategies to combat multifactorial origin oral disease have been instituted, studies show a high experience of caries in countries such as South Africa[2].

Considering that susceptibility of the African population to the carious process, a study conducted with African students at a Brazilian university with international outreach showed an alteration in nutritional habits, with the introduction of cariogenic foods in their diet, such as cookies, after arriving in Brazil[3]. In addition, those students show reduced knowledge concerning oral disease, as well as the understanding by some of them that a professional should only be sought after the oral pathology is already established[4].

Regarding the several factors associated to the emergence of carious lesions, the ingestion of cariogenic foods, rich in carbohydrates, appears as a determining element in that process, especially due to alterations in salivary pH and oral microbiota. Particularly, salivary pH, when in low levels, favors the installation of microorganisms in the oral cavity, responsible for the development of caries[5].

Concerning the participation of microorganisms from the oral microbiota, in addition to the important actions by *Streptococcus mutans* and other bacteria, literature points to the involvement of the fungus species *Candida albicans* in the beginning and progression of the carious lesion[6].

Therefore, based on the above explanation and on the constant need to implement policies aiming at the promotion of oral health and prevention of oral disease, such as dental caries, it becomes relevant to conduct studies that aim to understand the state of health of an individual's oral cavity, especially African university students, and factors that directly influence it.

Thus, this study aimed to evaluate the relation between the ingestion of cariogenic foods by African university students, the presence of dental caries and *Candida* spp. and the value of salivary pH.

METHODS

This is a transversal and analytical study, with quantitative approach, carried out in 2018, with African students at a Brazilian federal university with international outreach, located in the municipalities of Redenção and Acarape, state of Ceará, Brazil.

The students who participated in the study came from African countries that are part of the Community of Portuguese Language Countries (CPLP, in Portuguese), specifically from

Guinea-Bissau, Angola, Cape Verde, Mozambique and São Tomé and Príncipe.

The researchers excluded students younger than 18 years of age and those who had eaten less than two hours before saliva collection. According to Serratine and Silva (2009)[7], food ingestion causes the accumulation of small organic particles in the oral cavity that may act as nutrient source for cariogenic bacteria, which are capable to metabolize them, producing lactic acid and decreasing salivary pH.

Among a total of 210 students from African countries in the CPLP who arrived in Brazil to attend the first semester of an in-person undergraduate course at the university where the research was carried out, 133 were selected after applying inclusion and exclusion criteria.

After the application and signature of two copies of the Free and Informed Consent Form, students were invited to answer a questionnaire, created by the authors, concerning themes related to their socioeconomic and demographic aspects (nationality, course, gender, age, marital status and family income) and cariogenic diet, such as the ingestion of sweetened cookies, dessert, candy, chewing gum, chocolate, juice boxes (industrialized juice) and chocolate milk, and the frequency of that ingestion (daily, once a week, twice a week, once a month, three times per month and never).

To quantify the salivary pH, the saliva of each student was collected in a disposable plastic cup and then immersed the pH indicator strip (Merck®)[7]. After that, a professional

odontologist carried out a clinical exam of the oral cavity to identify and determine the number of decayed, missing and filled teeth, recording these data through the DMFT Index (Decayed, Missing and Filled Teeth). It is the most used tool, globally, to evaluate the prevalence of dental caries, reflecting past and current experience of that pathology in permanent teeth.

To evaluate the presence of *Candida* spp. in the oral cavity, biological material was collected from the dorsal part of the tongue of each student using a sterile swab containing Stuart (Olen®) culture medium. Then, plated in dextrose Sabouraud agar and incubated in a greenhouse at a temperature between 35 and 37°C for 48 hours.

After that time, colonies with morphological aspects suggestive of *Candida* were plated on chromogenic culture medium (CHROMagar Candida™) and identified according to macro and micro morphological characteristics, according to Brito et al.[8].

For the descriptive analysis and association involving quantitative and qualitative variables, the statistics software Epi Info™ for Windows, version 7.2., was used. For the descriptive analysis of quantitative variables, the mean, standard deviation and median were considered. For the comparison involving independent quantitative variables, the normality of data, through the *Kolmogorov-Smirnov* test, using the statistics software GraphPad, version 5.00, was analyzed. The value of $p < 0.05$ was adopted as significant. With the non-normality of data, the

non-parametric tests Kruskal-Wallis and Mann-Whitney were applied. For the qualitative variables, the Qui-Square Test was used.

This study was considered and approved by the Committee of Ethics in Research at the higher education institution where the study took place, under the protocol CAAE 59953716.5.0000.5576 and decision number 1.937.092.

RESULTS

Took part in this study 133 students, out of which 57.89% (n = 77) were from Guinea-Bissau and 23.66% (n = 31) were enrolled in a Baccalaureate course in Human Science. As for gender, 63.91% (n = 85) of participants were male and, as for age, it varied from 19.4 to 38.7 years, with an average of 24.1 ± 3 years. Regarding marital status, 68.70% (n = 90) of participants didn't have a permanent partner. Concerning family income, 45.38% (n = 59) of students stated that their family income was equal to or lower than Brazilian minimum wage, result obtained after converting the value into Brazilian currency (minimum wage – R$ 954.00).

When we analyzed the students' mean DMFT Index, according to gender, both genders presented value equal to 2. Regarding country of origin, students from São Tomé and Príncipe had a higher mean (6.3 ± 4) and, regarding marital status, that value was higher for students who had partners (2.2 ± 2.3). Regarding family income, the mean was higher among students

who had family income equal to or lower than minimum wage (2.1 ± 2.4) or who didn't have family income (2.1 ± 2.1).

Concerning the ingestion of cariogenic foods, among the 130 replies, 94.62% (n = 123) and 60.00% (n = 78) reported ingestion of sweetened cookies and chocolate milk, respectively. Out of 131 replies related to ingestion of dessert, 91.60% (n = 120) mentioned this consumption and, out of 133 replies associated to the ingestion of juice boxes, 63.91% (n = 85) reported consuming them. Out of 128 replies regarding chewing gum, 84.38% (n = 108) declared they consumed that type of food. Out of 125 replies associated to the ingestion of candy and 132 associated to chocolate, 43.20% (n = 54) and 90.15% (n = 119) mentioned consuming those foods, respectively.

Regarding frequency of ingestion of cariogenic foods by the students, 29.23% (n = 38) of them consumed sweetened cookies and dessert once a week. Regarding chewing gum, candy and chocolate, 26.56% (n = 34), 56.80% (n = 71) and 30.30% (n = 40) of participants consumed them with a frequency of once a week, never and once a month, respectively. Regarding the ingestion of juice boxes and chocolate milk, 36.09% (n = 48) and 40.00% (n = 52) of participants never consumed them, respectively.

Analyzing the students' mean DMFT Index, according to the ingestion of sweetened cookies, the highest mean was obtained among

those who didn't consume that type of food (2.8 ± 2.7), which also happened in the consumption of chewing gum (2.2 ± 1.9) and candy (2.2 ± 2.4). As for the ingestion of dessert, the highest mean was observed among those who consumed that type of food (2.0 ± 1.2), which also happened in the ingestion of chocolate (2.1 ± 2.4), juice boxes (2.1 ± 2.6) and chocolate milk (2.3 ± 2.4) (Table 1).

Comparing the medians of DMFT Indices obtained in the evaluation of cariogenic foods ingestion, we didn't observe statistical difference between the variables researched (ingestion of sweetened cookies, dessert, chewing gum, candy, chocolate, juice boxes and chocolate milk) ($p > 0.05$).

Table 1 – Comparison between DMFT Indices and the ingestion of cariogenic foods by students. Redenção and Acarape – CE, Brazil, 2018

Variable	Mean DMFT Index (± DPM[a])	Median of DMFT Index[b]	Value of p[1]
Sweetened cookie (n = 120)			
Yes	2.0 (2.4)	1.0	0.27
No	2.8 (2.7)	2.0	
Dessert (n = 121)			
Yes	2.0 (1.2)	1.0	0.77
No	1.9 (1.4)	1.0	
Chewing gum (n = 119)			
Yes	2.0 (2.4)	1.0	0.35
No	2.2 (1.9)	2.0	
Candy (n = 115)			
Yes	1.9 (2.4)	1.5	0.41
No	2.2 (2.4)	2.0	
Chocolate (n = 122)			
Yes	2.1 (2.4)	1.5	0.69
No	1.6 (1.7)	1.0	
Juice boxes (n = 123)			
Yes	2.1 (2.6)	1.5	0.70
No	1.9 (1.9)	1.0	
Chocolate milk			

(n = 120)

Yes	2.3 (2.4)	2.0	0.07
No	1.7 (2.3)	1.0	

aStandard Deviation of the Mean; bDecayed, Missing and Filled Teeth; [1]Mann-Whitney Test.
Source: The authors

Out of 133 samples collected from the dorsal tongue, the presence of *Candida* sp. was observed in 20.30% (n = 27). Among them, we identified 22 strains of *Candida albicans*, 1 *Candida glabrata* and 4 *Candida* sp.

Regarding the presence of *Candida* in the oral cavity among students who consumed cariogenic foods, in around 80% of those who consumed sweetened cookies, dessert, juice boxes, chocolate milk, chocolate and chewing gum, *Candida* spp wasn't identified. Regarding the ingestion of candy, around 80% of students who didn't consume that type of food, that fungus species wasn't identified (Table 2).

Analyzing the relation between the presence of *Candida* sp. and the ingestion of cariogenic foods, a significant association was observed between not consuming candy and not having *Candida* in the oral cavity (p = 0.01). As for chocolate milk, a significant relation was verified between consuming that type of food and not having *Candida* in the oral cavity (p = 0.00). There was a significant association between consuming chewing gum and not having *Candida* in the oral cavity (p = 0.02).

Table 2 – Relation between the presence of *Candida* sp. in the oral cavity and the ingestion of cariogenic foods by students. Redenção and Acarape – CE, Brazil, 2018

Variable	Presence *Candida* sp. n (%)		Value of p[1]
	Yes	No	
Sweetened cookies			
(n = 130)			
Yes	24 (19.51)	99 (80.49)	0.24
No	3 (42.86)	4 (57.14)	
Dessert (n = 131)			
Yes	24 (20.00)	96 (80.00)	0.73
No	3 (27.27)	8 (72.73)	
Chewing gum (n = 128)			
Yes	18 (16.82)	89 (83.18)	0.02*

No	7 (35.00)	13 (65.00)	
Candy (n = 125)			
Yes	12 (22.22)	42 (77.78)	0.01*
No	14 (19.72)	57 (80.28)	
Chocolate (n = 132)			
Yes	25 (21.01)	94 (78.99)	0.43
No	1 (7.69)	12 (92.31)	
Juice boxes (n = 133)			
Yes	16 (18.82)	69 (81.18)	0.11
No	11 (22.92)	37 (77.08)	
Chocolate milk (n = 130)			
Yes	16 (20.51)	62 (79.49)	0.00*
No	10 (19.23)	42 (80.77)	

*P < 0.05; [1]Qui-square test.
Source: The authors

Analyzing the ingestion of cariogenic foods among students who had *Candida* sp. in their oral cavity, 44.44% (n = 12) consumed sweetened cookies once a week, the same frequency observed among the 33.33% (n = 9) who ingested dessert. As for the consumption of chewing gum, 26.92% (n = 7) of participants never consumed it, the same number as those who consumed it once a month. About the ingestion of candy and chocolate, 53.85% (n = 14) and 34.62% (n = 9) of students never consumed candy and ingested chocolate once a month, respectively. Concerning juice boxes and chocolate milk, 40.74% (n = 11) and 38.46% (n = 10) of participants never consumed them, respectively (Table 3).

Table 3 – Presence of *Candida* sp. in the oral cavity and frequency of ingestion of cariogenic foods by the students. Redenção and Acarape – CE, Brazil, 2018

Variable	Presence of *Candida* sp. n (%)	
	Yes	**No**
Sweetened cookies (n = 130)		
Daily	6 (22.22)	24 (23.30)
1x per week	12 (44.44)	26 (25.24)
2x per week	1 (3.70)	22 (21.36)
3x per month	1 (3.70)	17 (16.50)

1x per month	4 (14.81)	10 (9.71)
Never	3 (11.11)	4 (3.88)
Dessert (n = 131)		
Daily	6 (22.22)	20 (19.23)
1x per week	9 (33.33)	29 (27.88)
2x per week	3 (11.11)	16 (15.38)
3x per month	2 (7.41)	12 (11.54)
1x per month	4 (14.81)	19 (18.27)
Never	3 (11.11)	8 (7.69)
Chewing gum (n = 128)		
Daily	3 (11.54)	8 (7.84)
1x per week	5 (19.23)	29 (28.43)
2x per week	3 (11.54)	16 (15.69)
3x per month	1 (3.85)	12 (11.76)
1x per month	7 (26.92)	24 (23.53)
Never	7 (26.92)	13 (12.75)
Candy (n = 125)		
Daily	1 (3.85)	3 (3.03)
1x per week	3 (11.54)	11 (11.11)
2x per week	2 (7.69)	6 (6.06)
3x per month	1 (3.85)	6 (6.06)
1x per month	5 (19.23)	16 (16.16)
Never	14 (53.85)	57 (57.58)
Chocolate (n = 132)		
Daily	0 (0.00)	8 (7.55)
1x per week	7 (26.92)	25 (23.58)
2x per week	8 (30.77)	17 (16.04)
3x per month	1 (3.85)	13 (12.26)
1x per month	9 (34.62)	31 (29.25)
Never	1 (3.85)	12 (11.32)
Juice boxes (n = 133)		
Daily	3 (11.11)	2 (1.89)
1x per week	6 (22.22)	18 (16.98)

2x per week	1 (3.70)	13 (12.26)
3x per month	3 (11.11)	16 (15.09)
1x per month	3 (11.11)	20 (18.87)
Never	11 (40.74)	37 (34.91)
Chocolate milk (n = 130)		
Daily	3 (11.54)	5 (4.81)
1x per week	7 (26.92)	13 (12.50)
2x per week	0 (0.00)	14 (13.46)
3x per month	3 (11.54)	3 (2.88)
1x per month	3 (11.54)	27 (25.96)
Never	10 (38.46)	42 (40.38)

Source: The authors

Analyzing the salivary pH, 1.77% (n = 2), 70.80% (n = 80) and 27.43% (n = 31) of students had pH 6, 7 and 8, respectively. Among participants who declared they consumed cariogenic foods, most had salivary pH equal to 7 (Table 4).

Analyzing the relation between salivary pH and ingestion of cariogenic foods, a significant association between the researched variables (ingestion of sweetened cookies, dessert, chewing gum, candy, chocolate, chocolate milk and juice boxes) wasn't observed (p > 0.05).

Table 4 – Relation between salivary pH and ingestion of cariogenic foods by students. Redenção and Acarape – CE, Brazil, 2018

Variable	Salivary pH n (%)			Value of p[1]
	pH 6	pH 7	pH 8	
Sweetened cookies (n = 111)				
Yes	2 (1.90)	75 (71.43)	28 (26.67)	0.44
No	0	3 (50.00)	3 (50.00)	
Dessert (n = 111)				
Yes	2 (1.96)	73 (71.57)	27 (26.47)	0.49
No	0	5 (55.56)	4 (44.44)	
Chewing gum (n = 109)				
Yes	2 (2.15)	64 (68.82)	27 (29.03)	0.72
No	0	13 (81.25)	3 (18.75)	
Candy (n = 105)				

Yes	1 (2.13)	34 (72.34)	12 (25.53)	0.93
No	1 (1.72)	42 (72.41)	15 (25.86)	
Chocolate (n = 113)				
Yes	2 (1.94)	73 (70.87)	28 (27.18)	0.84
No	0	7 (70.00)	3 (30.00)	
Juice boxes (n = 113)				
Yes	2 (2.63)	54 (71.05)	20 (26.32)	0.45
No	0	26 (70.27)	11 (29.73)	
Chocolate milk (n = 110)				
Yes	2 (2.94)	45 (66.18)	21 (30.88)	0.52
No	0	33 (78.57)	9 (21.43)	

[1]Qui-square test
Source: The authors

Analyzing salivary pH and the frequency of ingestion of cariogenic foods, most participants who stated they consumed dessert, chocolate, juice boxes and chocolate milk, regardless of frequency of consumption, had pH 7. For sweetened cookies, it was observed that 50.00% (n = 3) of students who never consumed this type of food showed a pH value of 7 and, for other consumption frequencies reported, the verified pH was 8. The pH value of 7 was also registered in the consumption of chewing gum twice a week. For candy, 66.66% (n = 2) of participants who ingested them daily had pH 8, which was also observed among the 57.14% (n = 4) of students who consumed it twice a week.

DISCUSSION

This study was the first to determine and relate/compare the ingestion of cariogenic foods with the occurrence of dental caries, salivary pH and presence of *Candida* in the oral cavity of African students at a Brazilian federal university with international outreach.

Concerning the mean DMFT Index of students, according to gender, both genders showed low means for that index, according to the WHO classification[9]. This mean was similar to that obtained among Odontology students at a college in Lisbon (Portugal)[10]. However, lower means have been recorded among African populations, such as Nigerian[11].

Analyzing the mean DMFT Index of students, according to nationality, the higher value recorded among San Tomean students may have happened because of the reduced number of participants of that nationality compared to others. It is also possible that this finding results from the high sugar intake among that population, according to Coimbra et al.[12]. Concerning marital status, the higher mean DMFT Index observed among participants with

partners may stem from the experience of other realities and adversities able to compromise attention to oral health.

About family income, the higher mean DMFT Index observed among students who had no family income or had family income equal to or lower than minimum wage highlights the influence that economic conditions have over the development of dental caries[13]. Actually, the financial conditions of an individual or family can interfere, among other circumstances, in the access and use of health services.

Regarding the ingestion of cariogenic foods, the high number of participants who consumed different types of these foods, especially sweetened cookies, dessert, juice boxes, chewing gum and chocolate, corroborates study by Akaji et al.[14]. Although those studies had African children and teenagers as participants, their habit of consuming sugar-rich carbohydrates may be present in youth and adults, especially if we acknowledge that the institution of nutritional habits begins early[15].

Based on the marked presence of ingestion of fermentable carbohydrates by students, the lack of significant comparison between the DMFT Index and that ingestion was surprising, since a diet rich in carbohydrates is a relevant risk factor for the development of carious lesion. However, this result emphasizes that dental caries is a condition originated from the action of multiple causes, such as the presence of bacteria and their products, saliva components, frequency of sugar intake, oral hygiene habits and general state of health[16]. Cultural, social and political aspects also contribute to that disease[17].

Concerning the frequency of ingestion of cariogenic foods, the data obtained revealed a considerable regularity in the intake of those foods, specifically sweetened cookies, dessert and chewing gum, among participants. In this context, the frequency and ingestion of fermentable carbohydrates by these students must be accompanied throughout their stay in Brazil, especially if we analyze the study by Luebke and Driskell[18]. These authors showed that 82.0% of university students consumed sugary foods (including food and drink, such as candy, soda pop, juice, doughnuts, jam etc.) and 89.3% ingested powder juice, which could be associated to the difficulties in managing academic activities or the reduced knowledge of the effects these foods have on oral health.

Regarding the higher mean DMFT Index recorded among students who reported ingesting dessert, chocolate, juice boxes and chocolate milk, this finding highlights the contributions by these foods in the development of the carious process. The intake of cariogenic foods among university students was also reported by Freire and Calábria[19].

When we question the ingestion of sweetened cookies, chewing gum and candy, the results obtained were interesting for indicating a higher mean DMFT Index among participants who didn't consume these types of food. This finding suggests the presence of other risk factors for the emergence and development of

the carious lesion among those students[6]. In addition to that possibility, it is important to know that the cariogenic potential of food depends on conditions such as form, composition, ingestion in the presence of other foods and liquids, exposure time to the tooth and frequency of ingestion.

The above assumptions may justify the results identified here that, even in the presence of a high regularity in the ingestion of sweetened cookies and chewing gum by some participants, this regularity didn't induce a higher mean DMFT Index among those students. It can be also suggested that this lower mean DMFT Index shown by these students happened because there was a small number of them.

When we evaluated the presence of *Candida* in the oral cavity of participants, the percentage obtained was lower than the one mentioned by Paz et al.[20]. According to these authors, approximately 50% of healthy individuals have *Candida* yeast species in their oral cavity. However, other studies pointed to a different prevalence than Paz et al.[20], which varied around 20% to 75% and 30% to 70%[21].

It is important to emphasize that, although *Candida* species are part of the oral microbiota, several local factors, such as the bacterial microbiota itself, nutrition, presence of salivary antibodies, age and parasite-host interaction, can influence the higher or lower incidence of isolation of these microorganisms in the oral cavity. Thus, it is possible that the low percentage of students from which *Candida* was

isolated resulted from one or more of these factors[21].

Regarding the species identified, corroborating what was observed here, where, out of the positive samples for *Candida* sp., the majority were identified as *C. albicans*, Barbieri et al.[22] mentioned that, among the species isolated from the oral cavity, approximately 80% are *C. albicans*, followed by *C. parapsilosis*, *C. krusei*, *C. kefyr*, *C. famata* and *C. tropicalis*.

Concerning the ingestion of sweetened cookies and chewing gum, the absence of *Candida* among students who consumed those types of food (especially chewing gum), including those who did so more frequently, befits the fact that they didn't present a higher DMFT Index. These findings consolidate the relation between *Candida* and the development of dental caries[23], as well as the participation of other factors in the emergence and progression of the carious lesion, such as the ingestion of food in the presence of liquids and time of contact with dental surface and behaviors aimed at oral health.

About the absence of *Candida* in samples of participants who ingested dessert, encompassing also those who consumed it more regularly and those with higher DMFT Index, this finding may be associated to the fact that *S. mutans*, the main etiologic agent of dental caries, can inhibit the formation of *C. albicans* germ tubes, through competence stimulating peptides[24]. As a consequence, there can be a

decrease in the virulence of *Candida* and secondary attachment[1].

Regarding the absence of *Candida* among participants who ingested juice boxes, chocolate milk and chocolate, particularly chocolate milk, we can suppose that *S. mutans*, probably present due to the high DMFT Index shown by these students, interferes in this fungus's colonization of the oral cavity[24]. About the absence of *Candida* among students who didn't consume candy, despite the higher DMFT Index, this phenomenon may have happened due to the presence of another carbohydrate source for *S. mutans* and its inhibition over the fungus.

About the presence of *Candida* among participants who ingested sweetened cookies and dessert once a week, this finding may reflect the connection between *Candida* and cariogenic foods. In this sense, literature shows the *C. albicans* can mediate early childhood caries, through physical and metabolic interaction with *S. mutans*, in which the lactic acid produced by the streptococcus provides carbon for fungal growth[25].

Still in that context, fungi show great capacity for colonization and exploration of living and decomposing substrate, needing minimal necessary conditions to their growth. They get their nutrition mainly from carbon sources absorbed from the environment. Therefore, a diet rich in carbohydrates, decomposing in the mouth environment, may favor the survival and growth of *Candida* spp. in that environment[26].

Regarding the ingestion of chewing gum, candy, chocolate, juice boxes and chocolate milk, although species of *Candida* were observed among participants who ingested those foods, it is possible that their low frequency of ingestion doesn't interfere in the process of growth and evolution of that fungus in the oral cavity[27]. This hypothesis allows us to suppose that other carbohydrate sources may be present among the participants.

Concerning salivary pH, it had, in general, neutral value among the majority of participants, including those who consumed fermentable carbohydrates. Considering that salivary pH should vary between 7 and 7.4[28], the value recorded among most students, regardless of the presence of cariogenic diet, proved within normal parameters.

This result was particularly unexpected, acknowledging both the normal levels of salivary pH among students who ingested cariogenic foods and the inexistence of a significant relation between the pH value and that type of diet. Actually, food rich in sugar represents substrate for microorganisms from the dental biofilm, boosting the production of acids capable of raising saliva acidity and decreasing salivary pH. However, that finding may be understood based on the properties of saliva, such as composition, viscosity and flow, and characteristics related to the food, such as consistence, composition, time of permanence in the oral cavity and frequency of intake, as well as on the students' oral health behavior.

About the relation between salivary pH and the ingestion of dessert, chocolate, juice boxes and chocolate milk, the permanence of neutral pH, regardless of frequency of ingestion and presence of a higher DMFT Index, highlights the contributions of other factors in pH maintenance and development of the carious process.

For the sweetened cookies, the pH level of 7 among those who never ingested this food can suggest that, for these students, this value corresponded to normal pH. Regarding pH 8 recorded among the other frequencies of ingestion of that food, it can be inferred that these participants may present alterations in salivary composition, especially in compounds with basic character, such as bicarbonate, naturally increasing pH. This assumption can be related to the low DMFT Index identified among participants who ingested sweetened cookies. The same can be attributed when the frequency of ingestion of candy, salivary pH and DMFT Index were evaluated.

Regarding chewing gum consumption, the neutral pH verified among participants who chewed that snack twice a week can result from the fact that the chewing gum itself, despite usually containing sugar, removes food residues from the dental surface, in addition to increasing salivary flow[29]. This hypothesis can justify the lower DMFT Index found among students who consumed that type of food.

In this sense, it is important to mention that saliva, in addition to buffering and neutralizing acids produced by cariogenic microorganisms or directly originated from the diet, functions, in an important role in caries prevention, as a mechanical cleaning agent, decreasing the accumulation of dental biofilm and decreasing the solubility of dental enamel[30].

CONCLUSION

Based on this study, it can be concluded that, generally, students, despite ingesting cariogenic foods, even in a weekly frequency, showed low DMFT Index, adequate salivary pH and absence of *Candida*. Regarding the DMFT Index and the ingestion of cariogenic foods, the highest mean Index level was identified among students who consumed dessert, chocolate, juice boxes and chocolate milk.

Concerning the relation between the ingestion of food rich in sugar and the presence of *Candida*, that association varied according to the type of food ingested and the frequency, particularly evidenced through the isolation of that fungus among students who ingested sweetened cookies and dessert with a weekly frequency. For salivary pH, the association between its ingestion and the acidity or basicity of saliva happened in different types of cariogenic food ingested and their consumption frequency, predominating the neutral or basic pH among the recorded values.

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