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FACTORS ASSOCIATED WITH TOOTH CARIES DEVELOPMENT IN FOREIGN ACADEMICS OF A BRAZILIAN UNIVERSITY

1Gabriela Silva Cruz, 1Francisco Cezanildo Silva Benedito, 1Davide Carlos Joaquim, 1Lívia Coelho de Assis, 1Edmara Chaves Costa, 2Cosmo Helder Ferreira da Silva, 2Andressa Aires Alencar, 3Raquel Oliveira dos Santos Fontenelle, 1Erika Helena Salles de Brito and 1Ana Caroline Rocha de Melo Leite

1Universidade da Integração Internacional da Lusofonia Afro-Brasileira
2Universidade Católica de Quixadá
3Universidade Estadual Vale do Acaraú

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ABSTRACT

The study aimed to identify the factors associated with caries development in foreign individuals recently admitted to a Brazilian university. This is a cross-sectional, analytical and quantitative study conducted between 2017 and 2018 at the University of International Integration of Afro-Brazilian Lusophony. A questionnaire was applied, addressing the themes: socioeconomic and demographic aspects; self-perception and oral hygiene habits; behaviors in oral health and cariogenic diet. Carious, lost and obturated teeth (DMFT index) and salivary pH were quantified. The oral microbiota was collected for isolation and identification of *Candida* spp. The Mann-Whitney and Kruskal-Wallis tests were used, assuming a value of p <0.05. The average CPOD index was higher among the students with a poor self-perception of oral hygiene and who used toothbrushes and dentifrices. This average was higher among the students who had *Candida* spp. isolated from their oral cavity and with salivary pH equal to 7. It is concluded that the use of dental floss, the search for dental care and the cariogenic feeding are associated to the development of the students' carious process. Also contributing to this process are the salivary pH and the presence of *Candida*.

INTRODUCTION

Considered as one of the main oral diseases and a worldwide public health problem, caries is an infectious, dynamic and multifactorial disease mediated by dental biofilm in the presence of fermentable carbohydrate, adequate environment and time. Its etiology includes, besides these determinants factors (including species of *Candida*), modulating factors such as knowledge and behavior in oral health, oral hygiene, income and social class. Its importance lies in the fact that it affects one-third of the world's population in any age group and is associated with pain, suffering and impairment of organic functions (Valero *et al*., 2018; Lunardelli *et al*., 2016). Although its prevalence has declined in industrialized countries, as a result of the use of fluoride products such as

water, salt and toothpaste, associated with improved diet and oral cavity hygiene, there is a rise in developing countries, especially in socially unfavorable groups (Valero *et al*., 2018; Trohell *et al*., 2016). In the epidemiological context, data show higher levels of caries in Latin American and European countries, while lower levels are observed in the Middle East, Western Pacific, Southeast Asia, North America and Africa (Lagerweijl and Curr, 2016). In Brazil, the national survey Smiling Brazil, conducted in 2010, elevated the country to the group of countries with low prevalence of caries. However, in the Brazilian adult population, this prevalence is still high due to the failure to perform adequate treatment (Brasil, 2012). Similar to this reality, some African countries have experienced an increase in tooth loss among the adult population, which has led to a considerable increase in edentulism among 65-year-olds (Abid *et al*., 2015). In this context, studies with young people that enter the University

*Corresponding author: Gabriela Silva Cruz,
Universidade da Integração Internacional da Lusofonia Afro-Brasileira

become relevant, because they are vulnerable to the development of oral pathologies, due to the susceptibility to lifestyle changes and challenges to which they are submitted by the university environment (Freitas *et al*., 2019; Short and Mollborn, 2015). The higher DMFT score among *Candida* students in the oral cavity corroborates the fact that this fungal species participates in the development of carious lesions. Thus, the objective of this study was to identify the factors associated with the development of caries in foreign individuals recently admitted to an international university of Brazil.

METHODOLOGY

This is a cross-sectional, analytical and quantitative study. Data collection and analysis were carried out from February 2017 to September 2018, at the University of International Integration of Afro-Brazilian Lusophony (UNILAB), at the campuses of the State of Ceará (Brazil). The target population of the study was composed of foreign scholars recently coming from African countries (Angola, Cape Verde, Guinea Bissau, Mozambique and Sao Tome and Principe). Considering that the study population was composed of 210 academics, a census was chosen. However, after applying the inclusion and exclusion and refusal criteria of some students, the final sample consisted of 133 participants. Only foreign students newly admitted to UNILAB and those under 18 years of age and / or who were not fasted for at least 2 hours prior to sample collection of saliva were included in the study because of the possibility of interference in salivary pH after food consumption. Following the application of the Informed Consent Form (ICF), the students completed a questionnaire, addressing the following variables: socio-demographic and economic aspects (date of birth, country of origin, gender, marital status and family income); self-perception of oral hygiene / oral health; habits of oral hygiene (means used in brushing, knowledge and use of dental floss, time of toothbrushing and brushing of the tongue); oral health behaviors (going to the dental surgeon / looking for dental care and replacement of the toothbrush) and cariogenic feeding (frequency of consumption of sweet wafer, dessert, candies, chewing gum, chocolate, box juice and chocolate).

For quantification of the salivary pH, the saliva was collected in a disposable plastic cup and then the pH indicator strip was immersed. The pH value was recorded by the colorimetric method, using a scale provided by the manufacturer for reading (Montanuci *et al*., 2013). Then, a professional dentist performed the clinical examination of the oral cavity to identify and determine the number of decayed, missing and filled teeth, and these data were recorded by the DMFT index. This is the most widely used instrument in the world (Silva *et al*., 2005). For detection of *Candida* spp. in the oral cavity, a sample was collected using a sterile swab. In the microbiology laboratory, the samples were seeded in Petri dishes, containing Sabouraud agar. The morphology of the colonies suggestive of *Candida* sp. (glabrous colonies of white or beige coloration, with creamy texture and smooth surface). For presumptive identification of the species, the culture medium CHROMagar Candida®, being able to observe the pigmentation of the colonies: *Candida albicans*; blue coloration - *Candida tropicalis*; pink color and rough appearance - *Candida krusei*; Lilac coloration - *Candida glabrata*; pink color and smooth appearance - *Candida parapsilosis* and white coloration - *Candida* sp. In the data analysis, normality was assessed by

applying the Kolmogorov-Smirnov test in the GraphPad program, version 5.00. In view of the non-normality of the data, the non-parametric Mann-Whitney and Kruskal-Wallis tests were used for comparison between two or three or more groups, respectively. A value of p <0.05 was used. The research was approved by the Research Ethics Committee of UNILAB, according to protocol CAAE 59953716.5.0000.5576 and opinion number 1,937,092.

RESULTS

A total of 133 foreign students, with a mean age of 24.1 ± 3 years, of whom the majority were Guinean, about 60% were male, did not have a fixed partner, associated to low family income (Table 1). When asked about self-perception of oral hygiene, approximately 56% of the participants considered it as regular and a majority used toothbrush and toothpaste. Of the participants who answered about the knowledge of dental floss, more than half were unaware of it and about 89% did not use it.

Table 1. Socio-demographic and economic aspects of international academics. Acarape-CE, Brazil, 2018

Variables	N (%)
Country (n = 133)	
Angola	43 (32,33)
Cape Verde	5 (3,76)
Guinea Bissau	77 (57,89)
Mozambique	5 (3,76)
Sao Tome and Principe	3 (2,26)
Sex (n = 133)	
Female	48 (36,09)
Male	85 (63,91)
Marital status (n = 131)	
With a fixed partner	41 (31,30)
Without fixed partner	90 (68,70)
Family income (n = 130)	
≤ 1minimum salary	59 (45,38)
Between 1 and 3 minimum wages	30 (23,08)
Does not have income	33 (25,38)
Do not know	8 (6,15)

[a]Conversion to Brazilian currency (minimum wage - R $ 954.00)

Table 2. Self-perception of oral hygiene, means used in brushing and oral health behavior of international scholars. Acarape-CE, Brazil, 2018

Variables	N (%)
Self-perception of oral hygiene (n = 133)	
Bad	13 (9,77)
Regular	75 (56,39)
Good	45 (33,85)
Means used in brushing (n = 130)	
Toothbrush and toothpaste	120 (92,31)
Toothbrush, toothpaste and dental floss	10 (7,69)
Knowledge about dental floss (n = 130)	
Yes	61 (46,92)
Not	69 (53,08)
Flossing (n = 106)	
Yes	11 (10,38)
Not	95 (89,62)
Brushing teeth on waking and after each meal (n = 132)	
Yes	14 (10,61)
Not	118 (89,39)
Replacement of the brush every three months or when there is need (n = 133)	
Yes	118 (88,72)
Not	15 (11,28)
Language brushing (n = 133)	
Yes	120 (90,23)
Not	13 (9,77)
Going to the dentist (n = 133)	
Yes	47 (35,34)
Not	86 (64,66)

A similar percentage was observed among academics who did not brush their teeth upon waking and after each meal. The brushing of the tongue was reported by more than 90% of the participants and 64.66% of the scholars never sought dental care. As for the replacement of the toothbrush, the great majority did it every three months or when necessary, when there was wear of the bristles before the three months of use (Table 2). Specifically, when the averages of the DMFT Index of the academics were analyzed according to sex, both presented similar values. For the country of origin, the average was higher among the students from São Tomé and Príncipe (6.3 ± 4) and, for the marital situation, this value was higher among the students with a partner (2.2 ± 2.3).

In relation to the family income, the average was higher among the students who had income less than or equal to a minimum wage (2.1 ± 2.4) or who had no income (2.1 ± 2.1). When comparing the DMFT index medians obtained, according to sociodemographic and economic aspects, no statistical difference was observed between these variables (Table 3). Regarding dental evaluation, the mean DMFT index observed among the 123 participants evaluated was 2.0 ± 2.4. For salivary pH, 1.77%, 70.80% and 27.43% of the students presented pH equal to 6, 7 or 8, respectively. Regarding the presence of *Candida* sp., Of the 133 samples collected, 20.3% presented this fungus. Of these, 22 contained *Candida albicans*, 1 had *Candida glabrata* and 4 had *Candida* sp.

Table 3. Comparison between the means and medians of the DMFT Index, according to the sociodemographic and economic aspects, of international scholars. Acarape - CE, Brazil, 2018

Variable	CPOD Index Mean (±DPM[a])	Median of the DMFT Index[b]	P value
Sex (n = 123)			
Male	2,0 (2,2)	1,0	0,71[2]
Female	2,0 (2,4)	1,5	
Country (n = 123)			
Angola	2,0 (2,5)	1,0	0,19[1]
Cape Verde	2,0 (4,4)	0	
Guinea Bissau	1,8 (1,8)	2,0	
Mozambique	1,8 (2,0)	1,0	
Sao Tome and Principe	6,3 (4,0)	7,0	
Marital status (n = 121)			
With partner	2,2 (2,3)	2,0	0,24[2]
Without partner	1,8 (2,3)	1,0	
Family income (n = 120)			
≤ 1minimum salary	2,1 (2,4)	2,0	0,43[1]
Between 1 and 3 minimum wages	1,9 (2,7)	1,0	
Does not have income	2,1 (2,1)	2,0	
Do not know	0,8 (0,9)	0,5	

[a]Mean Standard Deviation; [b]Teeth Carious, Lost and Sealed; [1]Kruskal-Wallis test; [2]Mann-Whitney Test.

Table 4. Comparison between averages and medians of the DMFT index, according to self-perception and oral hygiene habits, oral health behaviors, presence of *Candida* sp. and salivary pH, of international scholars. Acarape - CE, Brazil, 2018

Variable	CPOD Index Mean (±DPM[a])	Median of the DMFT Index[b]	P value
Self-perception of oral hygiene			
(n = 123)	3,9 (2,6)	4,0	0,00[1#]
Bad	1,9 (2,4)	1,0	
Regular	1,5 (1,7)	1,0	
Good			
Means, used for brushing	2,05 (2,46)	1,00	0,83[1]
(n = 129)	1,80 (1,54)	2,00	
Toothbrush and toothpaste			
Toothbrush, toothpaste and dental floss	1,8 (2,4)	1,0	0,36[2]
Knowledge about dental floss	2,1 (2,3)	2,0	
(n = 120)			
Yes	0,7 (1,0)	0	0,02[2#]
Not	2,3 (2,5)	2,0	
Flossing (n = 96)			
Yes	1,3 (0,9)	1,0	0,62[2]
Not	2,0 (2,4)	1,0	
Brushing teeth upon waking and after each meal (n = 122)			
Yes	1,9 (2,2)	2,0	0,86[2]
Not	2,2 (3,1)	1,0	
Replacing the brush every three months or when there is a need			
(n = 123)	2,0 (2,3)	1,0	0,78[2]
Yes	1,8 (2,2)	1,5	
Not			
Tongue brushing (n = 123)	3,5 (2,8)	3,0	0,00[2#]
Yes	1,1 (1,3)	1,0	
Not			
Going to the dentist (n = 123)	2,96 (3,1)	2,2	0,095[1]
Yes	1,79 (2,1)	1,0	
Not			
Presence of Candida sp. (n = 123)	2,0 (2,8)	2,0	0,27[1]
Yes	2,2 (2,4)	1,5	
Not	1,2 (1,3)	1,0	

[a]Mean Standard Deviation; [b]Teeth Carious, Lost and Sealed; [1]Kruskal-Wallis test; [2]Mann-Whitney Test; [#]P<0,05

Table 5. Comparison between averages and medians of the DMFT index, according to the consumption of cariogenic foods, of international scholars. Acarape - CE, Brazil, 2018

Variable	CPOD Index Mean (±DPMa)	Median of the DMFT Indexb	P value
Sweet biscuit (n = 120)			
Daily	2,6 (3,0)	2,0	0,53
Once a week	1,93 (2,1)	1,0	
Twice a week	1,56 (2,3)	0,0	
Three times a month	1,5 (1,5)	1,0	
Once a month	2,0 (2,2)	2,0	
Never	2,8 (2,7)	2,0	
Dessert (n = 121)			
Daily	1,9 (2,0)	2,0	0,91
Once a week	2,0 (2,6)	1,0	
Twice a week	1,8 (2,6)	2,0	
Three times a month	2,8 (3,1)	1,0	
Once a month	1,5 (1,5)	1,5	
Never	2,0 (2,1)	1,0	
Chewing gum (n = 119)			
Daily	0,7 (0,8)	0,5	0,34
Once a week	1,6 (1,5)	2,0	
Twice a week	2,4 (3,1)	1,5	
Three times a month	2,1 (3,3)	0,0	
Once a month	2,3 (2,5)	2,0	
Never	2,1 (1,9)	2,0	
Bullets (n = 115)			
Daily	0,6 (1,1)	0,0	0,39
Once a week	1,6 (2,9)	0,0	
Twice a week	1,1 (1,2)	1,0	
Three times a month	2,8 (2,8)	4,0	
Once a month	2,2 (2,3)	2,0	
Never	2,2 (2,4)	2,0	
Chocolate (n = 122)			
Daily	1,7 (2,4)	1,0	0,94
Once a week	2,4 (2,8)	2,0	
Twice a week	1,7 (2,2)	1,0	
Three times a month	1,9 (2,4)	1,0	
Once a month	2,0 (2,2)	1,0	
Never	1,5 (1,7)	1,0	
Box juice (n = 123)			
Daily	2,7 (3,4)	2,0	0,91
Once a week	2,1 (2,8)	1,0	
Twice a week	2,3 (2,1)	2,0	
Three times a month	2,2 (3,2)	1,0	
Once a month	1,6 (1,7)	2,0	
Never	1,9 (1,9)	1,0	
Chocolate milk (n = 120)			
Daily	3,3 (3,0)	2,5	0,29
Once a week	2,3 (2,9)	2,0	
Twice a week	2,0 (2,1)	2,0	
Three times a month	3,6 (3,2)	2,5	
Once a month	1,9 (1,8)	2,0	
Never	1,6 (2,2)	1,0	

aMean Standard Deviation; bTeeth Carious, Lost and Sealed; lMann-Whitney Test.

When we analyzed the averages of the DMFT index of the students, it was observed that these indices remained higher among those who demonstrated self-perception of bad oral hygiene and those who used toothbrush and toothpaste, as well as those who did not know and did not use dental floss. Regarding dental brushing on waking and after each meal, the highest average occurred among those who did not practice it at these times and who replaced the brush every three months or when necessary. Higher averages were also recorded among the academics who performed brushing the tongue and those who kept going to the dentist. For the presence of *Candida* sp. and salivary pH, the mean was higher among the academics who had species of this genus isolated and pH equal to 7. When comparing the medians of the DMFT index obtained, according to self-perception of oral hygiene, the data showed a higher median among those who considered it as poor (p = 0.00). Regarding dental flossing, the highest median occurred among those who did not use it (p = 0.02) and the median was higher among those who did not (p = 0.00).) (Table 4).

Regarding the frequency of consumption of cariogenic foods, 29.23% of the students ate sweet biscuits and dessert once a week. Regarding the consumption of sweets, 26.56% of the participants consumed chewing once a week, 56,80% had never consumed candy and 30,30% consumed chocolate once a month. Regarding the ingestion of box juice and chocolate, 36.09% and 40.00% of the students had never consumed them, respectively. When the averages of the DMFT index of the academics were analyzed, according to the sweet wafer consumption, the highest average was obtained among those who never consumed it. Regarding the dessert intake, the highest average was observed among those who ate three times at month, the same occurring for the consumption of candies and chocolates. For chocolate, chewing gum and box juice, the average was increasing among those who consumed once a week, twice a week, and daily. When comparing the medians of the DMFT index, according to the consumption of cariogenic foods, no statistical difference was observed between the studied variables (p> 0.05) (Table 5).

DISCUSSION

This study was the first to determine and relate / compare the experience of caries and its determinants and modifiers of newly enrolled scholars in an international university of Brazil, located in municipalities of Ceará. The average of the DMFT index of the academics, according to the sex, presented a low average for this index, according to classification of the World Health Organization (WHO, 1997). However, lower means were registered among nursing students and the African population, such as Nigerian (Rwakatema *et al.*, 2015; Lawal and Alade, 2017). Although considered low, the DMFT index registered among the participants, according to sex, when compared to other studies, was shown to be higher. This phenomenon may justify regular self-perception of oral hygiene / oral health, use of toothbrush and toothpaste only in the hygiene of the oral cavity, non-use of dental floss, non-brushing upon waking and after each meal and lack of dental care search presented by participants of both sexes. Regarding family income, the highest DMFT index average was observed among students who had income less than or equal to a minimum wage. This finding highlights the influence of economic conditions on the development of caries, especially reflecting the access and use of health services (Valero *et al.*, 2018). When evaluating the self-perception of oral hygiene of the foreign students of this research, a relatively more positive evaluation was noticed than the scholars evaluated in other studies (Iwuala *et al.*, 2015; Silva *et al.*, 2018). Different from that observed here, work developed with students entering the Dental School found that 68.42% of the respondents rated their oral health as good (Cruz *et al.*, 2015).

For the self-perception of oral hygiene / oral health, the highest average of the DMFT index presented among the participants who considered it as poor reveals that this self-assessment can exceed the limit of subjectivity and occur in inadequate oral health conditions, corroborating with a study that evidenced a negative evaluation of oral health by individuals with decayed and missing teeth and requiring dental prosthesis (Moura *et al.*, 2014). The use of toothbrushes and toothpaste, regardless of nationality, sex and income, was corroborated by a study involving university students of different nationalities[14]. However, it was unexpected that there were no other means used by the African population, such as the chewing gum ("chewing sticks" ou *miswake*) (WHO, 2016). Among the means used for oral hygiene, low adherence to dental use by academics can be justified by the lack of knowledge on the part of the participants, of both sexes, lower income and especially coming from Guinea-Bissau and Mozambique. In addition to these factors, its high cost, low awareness of its role in the oral hygiene process (Silva *et al.*, 2018), its reduced access and time spent in its use can contribute to reducing the use of dental floss among participants (Cruz *et al.*, 2015; Silva *et al.*, 2018). In fact, the use of toothbrushes, toothpaste and dental floss is recommended for the mechanical control of dental biofilm (Kubo and Mialhe, 2011). Failure to comply with this recommendation, especially in relation to dental floss, can explain the higher average DMFT index found among participants who did not know the thong and the highest average and median among those who did not use. Regarding the time of toothbrushing / brushing frequency, some authors consider that the practice of brushing after each meal represents an important attitude towards the reduction of biofilm and dental calculus (Kim *et al.*, 2018). A similar result was evidenced among medical and engineering scholars, as

well as those of Dentistry (Agarwal *et al.*, 2017; Cebeci *et al.*, 2018). In this research, the behavior accepted by most participants, in replacing the brush every 3 months or when necessary, followed the recommended in the literature. When comparing the data presented here, the number of students who followed this recommendation was higher than that found in a recent study (Cebeci *et al.*, 2018). This behavior is particularly important if it is considered that the wear of their bristles increases the adhesion surface of microorganisms, such as *Estreptococcus* sp., *Lactobacillus* sp. e *Candida albicans*, increasing the risk of developing oral and systemic infections, particularly in immunocompromised individuals (Marins and Michels, 2017). The high percentage of academics who reported brushing the tongue revealed similarity with other studies. The relevance of this habit as a daily practice to avoid or decrease the accumulation of microorganisms on the lingual surface and consequent pathologies such as halitosis (Cruz *et al.*, 2015).

When evaluating the search for dental care, the finding of a high number of academics who had never been attended by a dental surgeon can be attributed to an unequal distribution of dental services and lack of resources for oral disorders (WHO, 2016). Consolidating the above, the highest average of the DMFT Index occurred among academics who did not brush their teeth upon waking and after each meal and did not replace the brush every three months or when necessary. Differently than expected, the highest mean of the DMFT Index was found among the academics who brushed the language and sought dental care. Although the tongue brushing habit does not match a higher mean of the DMFT Index, this finding may suggest inadequate oral cavity hygiene. Regarding the mean and median highest of the DMFT index among those who sought care with the dental surgeon, this occurred may result from a larger quantity of treated teeth or previous history of decayed, missing or filled teeth or deficiency of educational actions in health conducted by the professional dentist. Regarding the Candida species identified, the fact that most isolates present Candida albicans was not surprising, since it is the fungal species most found in the oral cavity and associated with candidemia (Telles *et al.*, 2017; Naicker *et al.*, 2016). The higher DMFT index among Candida students in the oral cavity corroborates the fact that this fungal species participates in the development of carious lesions (Valero *et al.*, 2018). Considering that salivary pH should vary from 7 to 7.4, the value recorded among the students was within normal limits. This fact suggests that the oral environment of these participants is healthy from a dental and periodontal point of view (Montanuci *et al.*, 2013). The higher mean CPOD score found among participants with pH equal to 7 may suggest that, despite the effect of adequate buffering of saliva, there are other factors that contribute to the greater number of decayed, lost or obturated teeth among these students. In relation to the average DMFT of the academics, according to the consumption of sweet biscuit, the highest value found among those who never consumed it, may suggest that the sugar source necessary for the emergence and development of the carious process is related to other fermentable carbohydrates (Anil and Anand, 2017). Considering also the determinants and modulators, the lack of sweet wafer consumption by the students, against a higher average DMFT index, is not an impediment to the development of carious processes, since other risk factors may be involved (Anil and Anand, 2017; Ramadan *et al.*, 2014). For the consumption of chocolate, chewing gum and box juice, the higher frequency of

consumption of these foods may have contributed to a higher average of the DMFT index registered among the students, emphasizing the influence of the frequency of intake of sugary foods in the onset of caries (Lima *et al.*, 2016). In view of the above, it can be verified that different factors may be associated with high DMFT rates in this population, with greater susceptibility due to the stress of the university environment and changes in habits.

Conclusion

It is concluded that the sociodemographic and economic aspects, the use of dental floss, the search for dental care and cariogenic feeding are associated with the development of the carious process in foreign individuals recently admitted to the University. Also contributing to this process are the salivary pH and the presence of *Candida*.

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