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Association between salivary flow and dental caries in institutionalized adolescents: Cross-sectional study

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ABSTRACT

Background: Brazil has a larger number of adolescent offenders, but studies evaluating their oral health are still limited.

Objective: Assess the association between salivary flow and caries experience in youngsters deprived of liberty.

Methodology: Sixty-eight male adolescents in conflict with the law, aged between 15 and 19 years, from a Socio-Educational Assistance Center in Brazil participated in the present study. They answered a structured questionnaire, and oral examination was performed by the Decayed, Missing, and Filled Teeth (DMFT) index. The salivary flow rate was obtained using the mechanically stimulated total saliva method. Adjusted Poisson regression was used for the association with total DMFT and its decayed component, using the salivary flow (continuous fashion) or the hyposalivation (≤ 1 ml/min) as independent variables.

Results: Participants were divided into two groups, those who did not have any decayed teeth at the moment of the examination (n = 39) and those who had at least one decayed tooth (n = 29). Moreover, two groups were formed based on the DMFT: those who had DMFT = 0 (n = 20) and those who had DMFT$\geq$1 (n = 48). In the multivariate analysis, hyposalivation was associated with DMFT$\geq$1 (p = 0.048), but when the salivary flow was included, no significant association with DMFT index was identified (p = 0.178). Conversely, the presence of at least one decayed tooth was significantly associated with the salivary flow (p = 0.004), but not with hyposalivation (p = 0.091).

Conclusions: Institutionalized adolescents who present hyposalivation or low salivary flow are associated with DMFT$\geq$1 index or presence of at least one decayed tooth, respectively.

1. Introduction

Dental caries, one of the most prevalent oral diseases, manifest as the localized degradation of robust dental structures, rendering them susceptible to acidic by-products resulted from the bacterial fermentation of dietary carbohydrates.[1] If untreated, this invasive and destructive condition can culminate in tooth loss. It is a multifactorial disease, wherein certain risk factors encompass a reduction in the rate of salivary flow and decline buffering capacity.[2,3]

Saliva is known to perform an important role in maintaining oral health, acting in functions such as digestion, lubrication of oral tissues, neutralization, depuration of unwanted products[4,5] as well as having its characteristics associated with the onset and progression of dental caries.[6,7] The salivary flow and composition are extremely important for adequate buffering capacity.[8] It means that through calcium, phosphate, and fluoride ions, it neutralizes acids produced by cariogenic bacteria, reversing the pH of the oral cavity and reducing the solubility of tooth enamel.[9] Saliva also protects against bacterial, fungal and viral immune infections, maintaining the integrity of soft and hard tissues and acting as a cleansing agent.[9,10]

The assessment of caries prevalence by the World Health Organization (WHO) in several countries, including Brazil, is performed through the decayed, missing and filled teeth (DMFT) index.[11] According to the 2010 National Oral Health Survey (SB BRASIL 2010),[12] the mean DMFT

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found among Brazilians was 2.1. However, when analyzing only those aged between 15 and 19 years, this average increases to 4.25.

Many of these young people, not only in Brazil but in several countries around the world, may be involved in conflicts with the law, resulting in measures of restriction and deprivation of liberty.[13] Internment is the most severe and restrictive socio-educational measure provided for in the Child and Adolescent Statute, institutionalizing adolescents with peers, who are also perpetrators of infractions. The socio-educational units provide re-education and social reintegration for adolescents considered to be of greater danger.[14]

Based on data from the National Council of Justice[15] in 2018, approximately 22,000 adolescents were confined in one of the 461 socio-educational units operating in Brazil. Rio Grande do Sul ranked fifth among the states with the highest number of interns across the country. These adolescents lack adequate means to maintain their oral health, with oral diseases being the main problem identified.[16,17] Inadequate oral hygiene practices, combined with the limited availability of nutritious foods, with priority given to sugary foods, restricted access to dental care, financial restrictions,[18,19] and the absence of educational initiatives focused on oral health at the Institutes,[19,20] comprise factors potentially associated with the greater development of dental caries in this population.[21]

Thus, considering the DMFT index indicated by SB Brasil 2010 for individuals aged 15–19 years, the large number of adolescent offenders in the country, and the fundamental role of saliva in the preventing dental caries, this study aimed to evaluate the potential association between salivary flow and the experience of dental caries among incarcerated youths in a municipality in the state of Rio Grande do Sul, Brazil.

2. Methods

The study is reported according to the guidelines proposed in the STROBE statements.[22] This cross-sectional observational study involved male adolescents in conflict with the law, aged between 15 and 19 years, from the Socio-Educational Assistance Center (CASE in Portuguese), in the city of Passo Fundo, located in the north of the state of Rio Grande do Sul, Brazil. This CASE unit includes only male adolescents and belongs to the Socio-Educational Support Foundation (FASE in Portuguese), the institution responsible for implementing socio-educational measures of internment and semi-freedom, judicially applied to adolescents who commit an infraction.

The present study was approved by the local Ethical Committee (protocol #016/2014) after formal authorization by FASE. The inclusion criteria were: adolescent being incarcerated in the CASE unit of Passo Fundo, agreed to participate in the study, and signed the Informed Consent by a legal representative. No exclusion criterion was performed.

Data were collected in December 2014, the moment that the unit had 74 youngsters. All of them were invited to participate. Sixty-eight adolescents agreed to participate in the research, and then an Informed Consent was signed by the legal representative of CASE for each participant. All procedures were performed under supervision, guidance and safety measures provided by the unit coordinator. As this study is a census of one institution, no *a priori* sample size calculation was performed.

2.1. Clinical examination, interview and salivary flow collection

The study consisted of two teams, each one composed by one interviewer, and one oral health examiner. All of them were previously trained by the study coordinators to ensure uniformity of data. A structured questionnaire that included sociodemographic data, history and general health behavior, and oral health habits was applied.[23] For the diagnosis of dental caries, the DMFT index was used, based on the criteria of the WHO (1997).[24]

The examiners were trained and calibrated for the examination and

the application of the questionnaires, using a group of selected adolescents of the same age, from a public school. The initial training for the DMFT index was performed by theoretical lectures, using a series of images for the classification of caries. For the application of the questionnaire, discussion of each question was performed, and researchers were instructed how to apply the questionnaire. All students selected for training were examined by examiners on two occasions, with an interval of 15 days between measurements. All data were tabulated and used to verify intra- and inter-examiner reproducibility using DMFT index as a discrete variable. The inter-examiner (k = 0.74) and intra-examiner (k = 0.81) reproducibility were calculated with kappa test. Therefore, inter-examiner and intra-examiner reproducibility were, respectively, moderate and strong.

The salivary flow was obtained using the mechanically stimulated total saliva method.[25] At the moment of collection, adolescents were comfortably seated, with their heads erect and their eyes open. They were instructed to chew for 6 min a sterile and standardized piece of rubber. In the first minute, saliva was swallowed and then, participants were instructed to periodically spit it into a waste cup. Time was controlled by a CITIZEN® analog wristwatch (Tokyo, Japan). The liquid component of the salivary flow was then measured with a waste syringe, and the salivary flow was determined in milliliters per minute (ml/min).

2.2. Outcome definition and main exposure

Based on the DMFT index, two dependent variables were defined: the presence of at least one decayed tooth and DMFT$\geq$1. The main exposure variable was determined as the salivary flow. Antoniazzi et al., 2017[26] classified stimulated salivary flow as normal flow ($>$1 ml/min), low flow (0.7–1.0 ml/min) or very low flow ($<$0.7 ml/min). Hyposalivation was considered when there is low salivary flow ($\leq$1 ml/min). In the present study, for this variable, two definitions were used of which one dichotomized the adolescent with normal flow ($>$1 ml/min) or with hyposalivation/low salivary flow ($\leq$1 ml/min). The salivary flow in a continuous fashion was also used.

2.3. Independent variables

Age was used continuously. Ethnicity/skin color was categorized as white or non-white. The non-white group included adolescents who reported themselves as being black, yellow, brown, or indigenous. The level of education of the adolescent was dichotomized into those with incomplete elementary education, including the illiterate, and those with at least complete elementary education.

Smoking exposure was categorized as current smokers, former smokers, and never smokers. Self-reported history of other licit and illicit drugs was also collected, such as crack, cocaine, marijuana, and alcohol. For each drug, the sample was divided into yes or no. The use of daily medication was dichotomized into yes or no. Those adolescents that reported the use of at least one daily medication were categorized as "yes."

Access to the dentist in the last 12 months was also classified as yes or no. Toothbrushing frequency was categorized into two groups, those who reported toothbrushing more than three times a day and those who reported at least three times a day.

2.4. Statistical analysis

Data analysis was performed using the SPSS 21.0 statistical package (IBM Corp., Armonk, NY, EUA). Univariate analysis for the association between dependent and independent variables was performed with Mann Whitney test. To both age and salivary flow variables, the Shapiro-Wilk test was used and an asymmetric distribution was detected. Associations between dependent variables and independent variables were assessed using the chi-square or Fisher's exact tests. Bi- and multivariate analyses were performed using Poisson regression with robust variance.

Four independent multivariate models were constructed, considering both outcomes (presence of decayed teeth and DMFT index) and both forms of salivation assessment (continuously or in the presence or absence of hyposalivation).

The literature reports that the frequency of toothbrushing and visits to the dentist are associated with the history of dental caries.[27] Therefore, both variables were included in the multivariate models regardless of the p-value detected. Moreover, all variables that presented a p-value <0.25 in the bivariate analysis were included in the initial multivariate analyses. The combination of p < 0.05 and changes in the models were used to determine the final multivariate model. A backwards strategy was used in all models.

3. Results

All incarcerated adolescents were invited to participate. Among them, only six adolescents did not consent to participate, obtaining a response rate of 91.89 %. Study participants (n = 68) were divided into the following groups: those who did not have any decayed teeth (n = 39, mean age: 17.03 ± 1.01) and those who had at least one tooth decayed (n = 29, mean age: 17.31 ± 1.05); those who had DMFT = 0 (n = 20, mean age: 16.95 ± 0.95) and those who had DMFT≥1 (n = 48, mean age: 17.23 ± 1.10). Table 1 presents a univariate analysis for the association between dependent and independent variables. In this analysis, age was not significantly associated with any of the reported outcomes (p > 0.05). However, a higher level of education was significantly associated with no decayed teeth (p = 0.045). The lower mean of salivary flow was significantly associated with both outcomes: the presence of at least one decayed tooth (p = 0.029) and DMFT≥1 (p = 0.034). In addition, the presence of hyposalivation was significantly associated only with DMFT≥1 (p = 0.017) (Table 1).

The bivariate analyses are demonstrated in Table 2. Similar variables were included in all initial multivariate models, which were adolescent's level of education, use of marijuana, use of alcohol, access to the dentist in the last 12 months, and toothbrushing frequency (per day).

In the final multivariate analysis, the variable hyposalivation was

significantly associated with DMFT≥1 (p = 0.048), with a prevalence ratio (PR) of 0.647 (95 % confidence interval [95%CI]: 0.420–0.997). It means that adolescents who did not present hyposalivation had 35.3 % lower PR for having at least one decayed, missing or filled tooth (Table 3). However, when the salivary flow was included as a continuous variable, no significant association with DMFT index was identified (p = 0.178) (Table 4).

On the other hand, the salivary flow was significantly associated with the presence of at least one decayed tooth (p = 0.004), with a PR of 0.842 (95%CI: 0.749–0.947). In this case, for each increase of 1 ml/min in the salivary flow, there is a decrease of 15.8 % in PR of having a decayed tooth (Table 4). No statistically significant association was identified between the presence of hyposalivation (≤1 ml/min) and at least one decayed tooth in these adolescents (p = 0.091) (Table 3). In all four models performed, toothbrush frequency and access to the dentist in the last 12 months were not significantly associated with both outcomes.

4. Discussion

The present study evaluated whether salivary flow could be associated with the experience of dental caries in adolescents deprived of liberty. In Brazil, few studies are investigating oral health conditions in this population,[14] which highlights the importance of the present findings, understanding the reality of the oral health conditions of these individuals, in an attempt to adapt the dental care provided to them. In this study, among the twenty-nine young people who had at least one decayed tooth at the moment of the exam, twenty-six (89.7 %) had incomplete an elementary school. A low level of education can generate numerous impacts on the lives of young people, from the weakening of their oral health, due to limited access to information, to the decrease in income.[28,29] In addition, there is a marked degree of fragility in the families of these adolescents, leading to worse health conditions.[30]

Previous studies have demonstrated that dental caries is a multifactorial disease affected by both salivary flow and its composition, encompassing fluidic components, which include ions, and protein

Table 1
Description of characteristics of adolescents in conflict with the law as they relate to caries components.

Variables	Mean ± SD n – (%)	No decayed teeth (n = 39; 57.4 %)	At least one decayed tooth (n = 29; 42.6 %)	p-value	DMFT = 0 (n = 20; 29.4 %)	DMFT≥1 (n = 48; 70.6 %)	p-value
Age		17.03 ± 1.01	17.31 ± 1.05	0.258&	16.95 ± 0.95	17.23 ± 1.10	0.400&
Ethnicity/skin color	**White**	12 (30.8)	10 (34.5)	0.746*	4 (20.0)	18 (37.5)	0.160*
	Non-white	27 (69.2)	19 (65.5)		16 (80.0)	30 (62.5)	
Adolescent's level of education	**Incomplete elementary school**	27 (69.2)	26 (89.7)	0.045*	15 (75.0)	38 (79.2)	0.706*
	At least complete elementary school	12 (30.8)	3 (10.3)		5 (25.0)	10 (20.8)	
Smoking exposure	**Smokers Former smokers/Never smokers**	9 (23.1)	8 (27.6)	0.671*	6 (30.0)	11 (22.9)	0.539*
		30 (76.9)	21 (72.4)		14 (70.0)	37 (77.1)	
Use of medication	**Yes**	23 (59.0)	15 (51.7)	0.552*	13 (65.0)	25 (52.1)	0.328*
	No	16 (41.0)	14 (48.3)		7 (35.0)	23 (47.9)	
Use of cocaine	**Yes**	13 (33.3)	13 (44.8)	0.335*	7 (35.0)	19 (39.6)	0.723*
	No	26 (66.7)	16 (55.2)		13 (65.0)	29 (60.4)	
Use of crack cocaine	**Yes**	10 (25.6)	7 (24.1)	0.887*	7 (35.0)	10 (20.8)	0.219*
	No	29 (74.4)	22 (75.9)		13 (65.0)	38 (79.2)	
Use of marijuana	**Yes**	30 (76.9)	26 (89.7)	0.173*	17 (85.0)	39 (81.3)	1,000#
	No	9 (23.1)	3 (10.3)		3 (15.0)	9 (18.8)	
Use of alcohol	**Yes**	26 (66.7)	25 (86.2)	0.066*	15 (75.0)	36 (75.0)	1,000*
	No	13 (33.3)	4 (13.8)		5 (25.0)	12 (25.0)	
Access to the dentist in the last 12 months	**Yes**	24 (61.5)	16 (55.2)	0.598*	10 (50.0)	30 (62.5)	0.340*
	No	15 (38.5)	13 (44.8)		10 (50.0)	18 (37.5)	
Toothbrushing frequency (per day)	**≤3 times**	2 (5.1)	4 (13.8)	0.390#	16 (80.0)	43 (89.6)	0.288*
	>3 times	37 (94.9)	25 (86.2)		4 (20.0)	5 (10.4)	
Hyposalivation	**Yes**	23 (59.0)	22 (75.9)	0.145*	9 (45.0)	36 (75.0)	0.017*
	No	16 (41.0)	7 (24.1)		11 (55.0)	12 (25.0)	
Salivary flow (in ml/min)		5.51 ± 3.12	3.91 ± 1.82	0.029&	5.68 ± 2.59	4.47 ± 2.76	0.034&

Legend: *Chi-square; #Fisher exact test; &Mann-Whitney test. To all continuous variables, Shapiro-Wilk test showed a p-value <0.001. Therefore, it was used a non-parametric test.

Table 2
Bivariate analysis for the association of different independent variables with presence of decayed teeth and total DMFT.

Variables		Prevalence ratio (95%CI) for at least one decayed tooth	p-value	Prevalence ratio (95%CI) for DMFT≥1	p-value
Age		1.158 (0.894–1.499)	0.266	1.077 (0.943–1.230)	0.274
Ethnicity/skin color	**White**	Ref.	0.743	Ref.	0.743
	Non-white	0.909 (0.512–1.611)		0.909 (0.512–1.611)	
Adolescent's level of education	**Incomplete elementary school**	Ref.	0.094	Ref.	0.719
	At least complete elementary school	0.408 (0.143–1.163)		0.930 (0.626–1.381)	
Smoking exposure	**Smokers**	Ref.	0.663	Ref.	0.565
	Former smokers/Never smokers	0.875 (0.479–1.597)		1.121 (0.759–1.655)	
Use of medication	**Yes**	Ref.	0.550	Ref.	0.550
	No	1.182 (0.683–2.047)		1.182 (0.683–2.047)	
Use of cocaine	**Yes**	Ref.	0.328	Ref.	0.719
	No	0.762 (0.442–1.313)		0.945 (0.694–1.287)	
Use of crack	**Yes**	Ref.	0.888	Ref.	0.280
	No	1.048 (0.547–2.006)		1.267 (0.825–1.945)	
Use of marijuana	**Yes**	Ref.	0.234	Ref.	0.694
	No	0.538 (0.194–1.493)		1.077 (0.744–1.558)	
Use of alcohol	**Yes**	Ref.	0.111	Ref.	1.000
	No	0.480 (1.95–1.182)		1.000 (0.702–1.425)	
Access to the dentist in the last 12 months	**Yes**	Ref.	0.595	Ref.	0.358
	No	1.161 (0.670–2.012)		0.857 (0.617–1.191)	
Toothbrushing frequency (per day)	**≤3 times**	Ref.	0.125	Ref.	0.379
	>3 times	0.605 (0.318–1.149)		0.762 (0.416–1.396)	
Hyposalivation	**Yes**	Ref.	0.176	Ref.	0.045
	No	0.623 (0.313–1.237)		0.652 (0.430–0.990)	
Saliva flow		0.850 (0.750–0.964)	0.011	0.949 (0.878–1.026)	0.192

Table 3
Multivariate analysis for the association of different independent variables with presence of decayed teeth and total DMFT, considering the individuals with hyposalivation.

Variables		Prevalence ratio (95%CI) for at least one decayed tooth[a]	p-value	Prevalence ratio (95%CI) for DMFT≥1[b]	p-value
Access to the dentist in the last 12 months	**Yes**	Ref.	0.237	Ref.	0.808
	No	0.452 (0.121–1.686)		1.042 (0.750–1.447)	
Toothbrushing frequency (per day)	**≤3 times**	Ref.	0.260	Ref.	0.295
	>3 times	1.349 (0.802–2.270)		1.382 (0.755–2.531)	
Hyposalivation	**Yes**	Ref.	0.091	Ref.	0.048
	No	0.550 (0.275–1.101)		0.647 (0.420–0.997)	

The initial model included the following variables:
[a] Adolescent's level of education, use of marijuana, use of alcohol, access to the dentist in the last 12 months, toothbrushing frequency (per day) and hyposalivation.
[b] Access to the dentist in the last 12 months, toothbrushing frequency (per day) and hyposalivation.

Table 4
Multivariate analysis for the association of different independent variables with presence of decayed teeth and total DMFT, considering the salivary flow.

Variables		Prevalence ratio (95%CI) for at least one decayed tooth[a]	p-value	Prevalence ratio (95%CI) for DMF≥1[b]	p-value
Access to the dentist in the last 12 months	**Yes**	Ref.	0.354	Ref.	0.482
	No	1.271 (0.766–2.110)		0.889 (0.642–1.233)	
Toothbrushing frequency (per day)	**≤3 times**	Ref.	0.203	Ref.	0.317
	>3 times	0.435 (0.121–1.566)		0.738 (0.406–1.339)	
Saliva flow		0.842 (0.749–0.947)	0.004	0.949 (0.878–1.024)	0.178

The initial model included the following variables:
[a] Adolescent's level of education, use of marijuana, use of alcohol, access to the dentist in the last 12 months, toothbrushing frequency (per day) and hyposalivation.
[b] Access to the dentist in the last 12 months, toothbrushing frequency (per day) and hyposalivation.

constituents.[31,32] When these are inadequate, they become important risk factors for the development of oral diseases, due to the deleterious effects on immunological responses. In this context, the current study demonstrated that increased salivary flow are associated with lower PR of dental caries occurrence, while hyposalivation is significantly associated with presence of decayed teeth. It is important to consider that the exposure of this population to various unhealthy habits, such as use of licit/illicit drugs and alcohol consumption, may contribute to decreased salivary flow. Furthermore, constant use of these illicit drugs may lead to structural changes in the salivary glands, such as a reduction in serous acini. In an animal model study, it was showed that these structures undergo atrophy, significantly affecting the functions of the glands, which may lead to hyposalivation.[33] However, it is essential to highlight

that due to the nature of the present study, saliva collection was performed only once, which does not allow temporality between both variables.

Different results were detected from the continuous and dichotomous evaluation of salivary flow. Hyposalivation is defined as the quantifiable reduction in the rate of salivary flow. The gold standard to determine the limit between the flow considered normal and low is still not well clear in the literature.[26] There are divergent perspectives among authors, where some consider hyposalivation when the stimulated salivary flow rate is below 0.5 ml/min,[34] while others designate this at a threshold of less than 0.7 ml/min,[35] and some still consider 1 ml/min as a cutoff point.[26] The present study used the current threshold for hyposalivation, as the prevalence of salivary flow <0.7 ml/min was very low. In addition, the use of salivary flow ≤1.0 ml/min was proposed by another study[26] with similar characteristics (adolescents

institutionalized in facilities for the treatment of chemical dependency) of the current sample.

Saliva can generally be classified as unstimulated, when at rest, or stimulated. The salivary stimulation, in the present study, was made through the chewing of a sterile rubber, but alternative methods for stimulating salivary secretion are recognized, including chewing gum and pieces of paraffin.[36] Optimally stimulated saliva has been reported for values between 1 and 2 ml/min.[37] Therefore, it is recommended that both continuous and dichotomous modes of salivary flow assessment be included in clinical protocols and population surveys, to assess the risk factors for oral diseases.

It is noteworthy that missing and filled teeth may be the result of other oral issues, such as trauma, fractures, or periodontal diseases. Additionally, due to economic constraints, access to dental healthcare services among these adolescents could be precarious, resulting in inadequate treatment for each condition. Although the DMFT index only assesses missing teeth and fills because of dental caries, it is not uncommon for young people to be uncertain or do not know the reason for the extraction or filling. Consequently, potential misclassifications for the DMFT index should not be ruled out. While tooth loss due to periodontal diseases is improbable within this age bracket, readers should acknowledge this as a constraint of the present study. Importantly, while the DMFT index is widely used by dental researchers, its efficacy in assessing disease activity may not be presumed.

Another crucial aspect to take in account is that the frequent use of illicit drugs is a factor that can directly impact an individual's oral health, leading to inadequate hygiene habits and infrequent dental appointments.[38] A substantial proportion of adolescents included in this study reported history of use of drugs, a parameter included as an independent variable. In congruence with the Brazilian context, in this study, marijuana was the most frequently drug used, with its consumption reported by fifty-six (82.35 %) youngsters. Some studies link the use of this drug with reduced salivary flow[39–41] and some demonstrate elevated DMFT rates when compared to non-users.[42–44] This latter observation is consistent with the current study, wherein among the fifty-six individuals who confirmed marijuana consumption, thirty-nine exhibited DMFT≥1. In Brazil, the most common mean age for starting drug use is 16.5 years.[45] Given that this age range aligns with the population under investigation (15–19 years), it can be assumed that a considerable portion of the adolescents within this sample might still be actively involved in illicit drug use, thereby influencing their responses. Moreover, a potential memory bias might have influenced data acquisition, as the self-reported information from adolescents predominantly pertains to experiences predating their institutionalization period. It must be emphasized that, during data collection, adolescents were consuming illicit drugs, as this was not allowed the institution. Unfortunately, the timeframe since last use of these substances was not collected, which may be faced as a limitation. However, temporality between normal salivary flow and quitting the use of illicit drugs is not established in the literature.

It is important to note that 75 % of the adolescents in this study reported alcohol consumption. While there is no definitive proof of a direct cause-and-effect link between alcohol consumption and dental caries,[46] it is worth mentioning that alcoholics have previously shown lower salivary flow and a lower salivary pH, which could potentially contribute to a higher incidence of caries.[47] Additionally, it is important to consider the sugar content in most alcoholic beverages, as this could also play a role in this process. Moreover, the same 91.2 % of the sample reported brushing their teeth more than three times daily. This highlights that a high brushing frequency does not necessarily indicate optimal oral health conditions. It is possible that these teenagers may not be aware of the correct brushing techniques, emphasizing the importance of providing oral hygiene instruction to this demographic. Another possibility is that young people may feel embarrassed to admit to infrequent hygiene practices, leading them to provide inaccurate information about their habits.

The cross-sectional design of this study also brings certain limitations. It is not possible to infer causality, demonstrating only the presence or absence of the associations. Further longitudinal studies would be necessary in this field. Although there is evidence in the literature about the harmful effects of illicit drugs and alcohol consumption on oral health, the results of this study are not significantly in line with these findings, as shown in Table 2. This was most likely due to the small sample size, and a study with a larger sample is warranted. However, based on the convenience sample used, data interpretation must be performed cautiously, since they cannot be extrapolated to all young people deprived of freedom in the country. It is understood that the timeframe could provide a different external validity when considering the current situation of this population, given that the data collection occurred nine years ago. Nonetheless, the present study does exhibit higher internal validity as it utilized previously trained and calibrated examiners who conducted validated oral health examinations. Also, based on the census conducted, the high response rate increases the validity of the study's findings. In this sense, the findings point to an additional concern regarding the oral health of adolescents in conflict with the law: factors that potentially affect salivary flow.

Dental caries experience among adolescents deprived from liberty is high. Presence of hyposalivation or low salivary flow are associated with DMFT≥1 or at least one decayed tooth, respectively, in institutionalized adolescents.

Acknowledgements

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