

Impact of a high-sugar diet and socioeconomic conditions on caries experience in children and young adults

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ABSTRACT

Objective: to evaluate the association between the prevalence of dental caries, sugary food intake and socioeconomic conditions of children and young adults.

Material and methods: socioeconomic questionnaires were applied to parents and/or guardians of 36 children and adolescents attending a soccer club in the city of Alegre – ES, Brazil, aged between 7 and 20 years. To assess food intake, a Food Frequency Questionnaire (FFQ) was applied. Tooth decay was assessed using the Decayed, Missing, Filled Teeth Index (DMFT) and plaque through the Simplified Oral Hygiene Index (OHI-S). Subsequently, lectures and oral hygiene and nutritional education activities were held. The plaque index was then reevaluated two weeks after the intervention. The presence of caries was expressed using relative frequency. In order to evaluate the factors associated with dental caries, a logistic regression model was used ($p < 0.05$), and to evaluate the effect of the intervention, the paired t-test was used to compare the plaque index. **Results:** 67% out of the assessed children had past and current history of decay, with a median DMFT of 2. Among the variables assessed 'family income', 'parents' educational level' and 'consumption of high-sugar foods' no statistically significant association ($p < 0.05$) with the presence of dental caries was observed. To evaluate the bacterial plaque index, it was observed that the intervention was effective ($p < 0.05$) with an initial OHI-S of 1.98 and final of 1.43.

Conclusion: a high prevalence of polarized DMFT was found in the sample. The health education actions were effective in reducing plaque. Almost all of the sample was found to have the habit of consuming sugary food four or more times a week. No significant associations were found between dental caries and the variables analyzed.

Keywords: Dental cavity; Nutritional education; Socioeconomic profile; Children; Adolescents.

Introduction

Dental caries is a worldwide public health problem that commonly affects children and adults.¹ Due to its high prevalence and severity, caries can impact the quality of life of affected individuals,² resulting in pain, tooth loss, chewing problems and psychosocial problems.^{3,4} According to the 2010 National Research on Oral Health, the prevalence of dental caries among Brazilian adolescents aged 12 years is 56%. Even though it still affects more than half of the adolescent population, there was a 13% reduction compared to the 2003 National Research on Oral Health due to increased access to health services.⁵ However, this prevalence is still worrying, since caries is one of the main causes of tooth loss, negatively impacting the quality of life of affected individuals.⁶

Dental caries is considered a multifactorial disease,⁷ which has various etiologies, including psychosocial,⁸ socioeconomic,⁹ demographic,¹⁰ and eating factors. The relationship between food and oral hygiene practices and the development of caries is of great relevance, since individual susceptibility, oral hygiene habits and the consumption of foods rich in sucrose can contribute to an imbalance in the dental biofilm and consequently for the onset and progression

of caries disease.¹¹

The process of developing carious lesions can be aggravated by the individual's eating habits. In dental biofilm there are several bacteria that perform the metabolism of fermentable carbohydrates, especially sucrose, releasing acids as a product of fermentation. When there is excess of acid production combined with inefficient oral hygiene practices, it can lead to progressive tooth demineralization, causing caries cavities.¹²

Among the inadequate eating habits among children and adolescents, the consumption of sugary drinks and foods stands out, which may result in high-sugar diet patterns and the consequent increase in the frequency of tooth decay.¹³

In addition to dietary risk factors, the family's socioeconomic status, parental education level, and the social class in which the individual is inserted also play an important role in the etiology of caries, since these factors interfere with access to dental services.^{14,15} It is important to emphasize that oral hygiene habits should be stimulated, since they contribute to the reduction of the incidence of this disease,¹⁶ regardless of the individual's social class.

Considering the above, this study aimed to investigate the frequency of caries and its relationship with

the consumption of sugary foods and the socioeconomic factors of families of children and adolescent athletes who attend a football club in the city of Alegre – ES, Brazil. Furthermore, we aim to show how to promote the reduction of the incidence of bacterial plaque, and consequently, of caries, using health promotion activities (lectures on oral hygiene and nutrition education).

Material and Methods

This study is characterized as a cross-sectional study, conducted between September and December 2018. This is a convenience sample composed of 36 adolescents and young adults, aged between 7 and 20 years old, soccer players at the Rio Branco club in the city of Alegre – ES, Brazil, who expressed interest in participating in the study.

A clinical examination was performed to assess the presence of dental caries and plaque. To assess the frequency of dental caries was used the Decayed, Missed and Filled Teeth Index (DMFT) and to evaluate the dental plaque was used the Simplified Oral Hygiene Index (OHI-S). For the DMFT index, we considered the component “D” corresponding to decayed teeth, “M”, missed teeth (extracted or with indication of extraction), “F”, filled teeth (restored). In this context, “D” and “M” refer to the current history of teeth and “F” highlights the past history of caries.¹⁷ For biofilm, the Simplified Oral Hygiene Index (OHI-S) was used with tablets of dye composed of basic fuchsin (2%), sodium saccharin, lactose, sodium cyclamate and excipients. At the time of the examination, the dentist applied the previously pigmented tablets to the buccal surfaces of teeth #16, #11, #26, #31 and lingual surface of teeth #36 and #46. The clinical examination was performed by only one examiner (dental surgeon). The clinical examination was performed during the day, with the individual sitting and under natural light using disposable tongue depressors. To ensure the reliability of the data, the examiner was previously calibrated with intra-examiner training that prepared him for clinical evaluation in regard of presence/absence of caries; presence/absence of biofilm.

Consumption of high-sugar foods was based on the frequency of consumption of source foods, with consumption characterized as ‘never’, ‘one to three times a week’, or ‘4 or more times’, and dichotomized for analysis of factors associated with caries according to the following categories: consume and not consume. The foods analyzed were sweets, sweetened coffees, teas and juices (including honey, molasses and sugar) and sweetened soft drinks or industrialized beverages. In the socioeconomic evaluation, the following variables were investigated: age, family income per capita, education level of the household. A questionnaire on dental habits was also applied, containing the following information: frequency of daily brushing,

flossing, dental appointment and in which sector (public or private) and reason for consultation. After the survey of oral hygiene conditions through the OHI-S were held the lectures, with athletes being separated according to age (7 to 10 years, 11 to 15 years, 16 to 20 years), and a lecture given for each age group, with educational activities on eating habits and oral hygiene, with proper guidance. Two weeks after the intervention, a new appointment was made for reevaluation of the OHI-S. At the end of the activities, the athletes who needed dental treatment received referral to health units in their regions.

For the DMFT index classification we obtained an average and considered the degrees of severity: very low (0.0 to 1.1), low (1.2 to 2.6), moderate (2.7 to 4.4), high (4.5 to 6.5), and very high (6.6 and more).¹⁸ Exfoliated teeth of the deciduous dentition were excluded from the analysis.

For the OHI-S classification, scores from 0 to 3 were assigned based on the amount of biofilm present in each tooth, in which: 0 (surface without biofilm); 1 (one third of the surface covered by biofilm); 2 (two thirds of the surface covered by biofilm); 3 (all surface covered by biofilm).¹⁹ Subsequently, the arithmetic mean of the results was calculated, which allowed the evaluation of the oral hygiene index of each child and adolescent. It was classified between 0.0 and 0.6, oral hygiene considered good; from 0.7 to 1.8, regular; between 1.9 to 3, poor hygiene.²⁰ In the income categorization, we used the classification proposed by Neri (2008),²¹ in which families whose monthly per capita income was between 0 and 135 Reais were categorized in Class E, between 135 and 214 Reais are in Remediated - D, between 214 and 923 Reais were classified as Middle Class - C and above 923 Reais are part of Elite A and B. The monthly per capita income data were regrouped, so those who received more than 214 Reais fit in class A, B and C, which was categorized as high income, people who received less than 214 Reais were in class D and E, being categorized as low income.

For the classification of education, parents/guardians without education or with incomplete elementary school were classified as low education, when they had completed elementary school, complete high school or incomplete high school were classified as average education, and those who had completed or incomplete graduation, or higher degree was considered high education.²²

For socioeconomic characterization of food intake and the presence of caries, the frequency distribution was used. The DMFT index and the OHI-S were expressed as measures of central tendency and dispersion. The DMFT index was categorized as follows: ≥ 1 (presence) and $= 0$ (absence). For OHI-S, averages were performed before and after the intervention. In order to evaluate possible associations between DMFT and the variables from

the study, the logistic regression model was used. Initially, bivariate regression analyzes were performed and variables whose significance level was ($p < 0.05$) were included in the multiple analyzes. For all analyzes, we considered a significance level less than 0.05 with a confidence interval of 95%. All analyzes were performed with the aid of the Software STATA 15[®]. OHI-S data before and after the intervention were entered into a database with the aid of the Microsoft Excel 2016, and statistical analysis was performed using a paired t-test with two samples ($p < 0.05$), 5% significance level, and 95% confidence intervals.

The study was conducted in the city of Alegre-ES, Brazil, in 2018, after approval by the Research Ethics Committee of the Federal University of Espírito Santo (UFES), under the protocol 2.627.087.

Results

The study included 36 children and young adults practicing soccer. The adolescents were all male and the average age was 12 years (± 3.6).

Based on the clinical examination, it was found that about 66% of the participants had a current or previous history of caries, and the median DMFT identified in this group was 2 decayed, missed or filled teeth, ranging from 0 to 8. Regarding the OHI-S, of the 36 athletes initially present in the sample, 18 did not show up to the reevaluation stage.

Evaluating the 18 participants who attended the two stages, in the first stage a value of 1.98 (± 0.55) was obtained and in the reevaluation after the intervention a value of 1.43 (± 0.42) was obtained, which showed a

statistically significant reduction ($p < 0.05$) (Figure 1).

In characterization of food consumption it was observed that 97% of participants consumed sweets 4 or more times a week, 78% consumed coffee, teas and sweetened juices (including honey, molasses and sugar) 4 or more times a week and 67% reported consumption soft drinks and industrialized drinks 1 to 3 times a week (Table 1).

In the socioeconomic characterization of families, 89% of the athletes' families were in the upper class, with income between R\$ 214 and R\$ 293 per month per capita. Regarding education of the household, 75% of the evaluated individuals have medium to high education (Table 2).

In the studied sample, 89% of participants reported having gone to the dentist, with 70% attending the Public Health System. Regarding the reason for the consultation, 17% reported having gone only in case of pain, while 83% reported having sought care for prevention. The questions related to oral hygiene habits allowed us to identify that 69% of individuals brush their teeth 4 or more times a day and 64% floss (Table 3). In addition, 67% of participants had $DMFT > 0$, which highlights for previous and/or current experience of dental caries in most individuals.

Regarding the associated factors, there was no statistically significant correlation ($p < 0.05$) between the presence of caries and the following parameters: 'parental education level', 'consumption of sweetened coffees, teas and juices (including honey, molasses and sugar)', 'soft drink and sweetened industrialized drinks consumption', and 'family income' (Table 4).

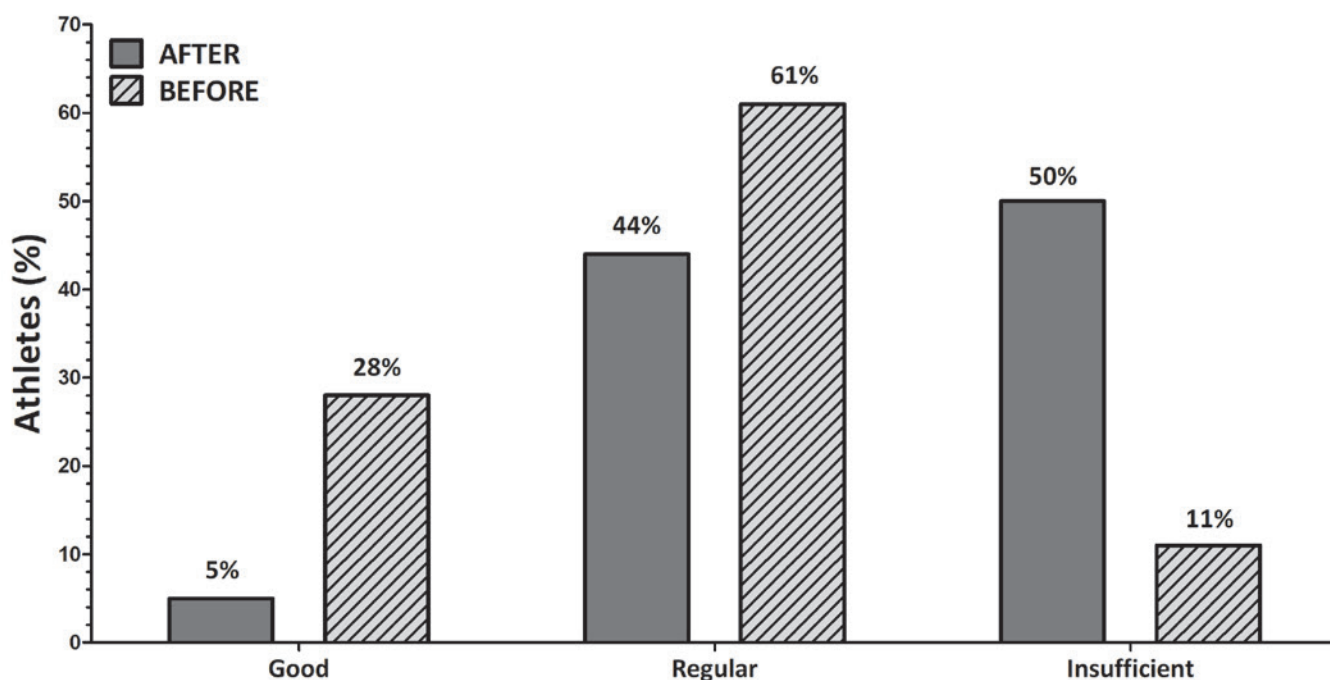


Figure 1. Simplified Oral Hygiene Index of athletes before and after intervention.

Table 1. Frequency of consumption of high-sugar foods by children and young adults attending the Rio Branco soccer club in the city of Alegre, Espírito Santo, Brazil, 2018.

High-sugar food	Frequency of consumption					
	Never		1 to 3 times a week		4 or more times	
	N	%	N	%	N	%
Sweet	1	3	-	-	35	97
Sweetened coffee, tea and juice	4	11	4	11	28	78
Sweetened beverages and soft drinks	1	3	24	67	11	30

Table 2. Socioeconomic classification of families of children and young adults attending the Rio Branco soccer club in the city of Alegre, Espírito Santo, Brazil, 2018.

Feature	Frequency	
	N	%
Parents education		
Low	9	25
Average and High	27	75
Social classification		
High	32	89
Low	4	11

Table 3. Dental habits of children and young adults attending the Rio Branco soccer club in the city of Alegre, Espírito Santo, Brazil, 2018.

Frequency of diary brushing	N	%
1 to 2 times	8	23
3 times	3	8
4 ou more	25	69
Flossing		
Yes	23	64
No	13	36
Have been to the dentist appointment		
Yes	32	89
No	4	11
Reason for aproitment		
Only in case of pain	6	17
Orientation and prevention	26	83
Health service		
Public	22	70
Private	10	30

Discussion

Caries is related to socioeconomic factors, characteristics of the host and microorganisms, as well as diet and hygiene habits of the individual, which characterize a multifactorial disease, considered a worldwide endemic.²³ The indices used in the diagnosis of dental conditions are cumulative: once the individual acquires caries, the tooth will be restored or missed, and due to the multiplicity of factors related to this disease, the proportion individuals presenting caries-free and consequently DMFT= 0 decreases according to age.²⁴

Oral health is influenced by the population's access to public policies, especially in the group of people with the greatest social vulnerability.²⁵ Evidence of this is that the percentages of DMFT = 0 are lower in the Midwest, North and Northeast regions when compared to the South and Southeast regions, which are more developed regions with greater access to public services and better quality of life.⁵ In our studies, the overall median value of DMFT found was 2, classified as low severity,¹⁸ characterizing this result as above the average found in the Southeast region of Brazil, obtained in the 2010 National Research on Oral Health.⁵ Athletes aged 15-19 had an average DMFT of 3.08, lower than that found in the Southeast region, which was 5.94 according to the 2003 National Research on Oral Health,²⁴ and 3.83 according to the data published in 2010.⁵ The decline in these DMFT values can be explained by the start of water fluoridation practice, use of fluoride toothpastes, decreased sugar consumption, and improvements in socioeconomic conditions.²⁶

In the studied sample, 100% of the athletes presented biofilm. Seabra *et al.*,²⁷ in a study conducted with 272 children from two public schools in Belo Horizonte - Brazil with different Social Vulnerability Index of August 2006, concluded that the presence of biofilm is a great risk for the development of dental caries, so biofilm removal is essential for the control of periodontal and caries disease. In the same study, associations were found between socioeconomic factors and the development of carious lesions in children, showing that the most vulnerable group was more susceptible to caries infection.

The initial OHI-S of our sample was 1.85, and at the

Table 4. Analysis of the factors associated with dental caries in children and young adults attending the Rio Branco soccer club in the city of Alegre, Espírito Santo, Brazil, 2018.

Variable		DMFT				IC95% ⁺	p*
		Absence		Presence			
		N	%	N	%		
Consumption of sweetened drinks	No	4	11	32	89	0.11-2.48	0.42
	Yes	8	22	28	78	0.40-8.98	
Consumption of soft drinks and industrialized sweetened drinks	No	4	11	32	89	0.22-4.34	1.0
	Yes	8	22	28	78	0.23-4,35	
Income (social class)	High	15	42	21	58	0.06-6.86	0.7
	Low	11	69	25	31	0,14-16.94	
Household education level	Average and High	9	25	27	75	0.20-4.95	1.0
	Low	9	25	27	75	0.20-4.95	

*p<0.05, significance level of 5%. + 95% confidence interval

end, after the intervention, it was 0.92, being significantly lower (p <0.05). Likewise, a study with a similar methodology, conducted in the same city as the present study by Santos *et al.*,²⁸ found a significant reduction (p <0.05) from 1.85 to 0.92 after interventions with nutrition education and oral hygiene guidelines.

In our study the reduction was smaller, since the methodology did not include supervised brushing. However, it should be also considered that the sample of the present study is relatively small, thus the association may have occurred at random.

Confirming these findings, Rodrigues *et al.*²⁹ when implemented supervised tooth brushing through a daily health education project in preschool children (3-6 years) for an average of 106 days in 5 schools in Portugal found a significant reduction in biofilm, initially having a Biofilm Index of 2.83 contrasting with 0.40 in the end of the study.

Although the analyzes made in our study did not reach statistically significant results, the consumption of sugar, sweets, honey and molasses was reported by 97% of the sample, which is almost equivalent to the total of the athletes, so it was not possible to determine statistical correlations, since the response rate for the 'not consuming' variable was too low frequency. Borges *et al.*,³⁰ when evaluating the factors associated with caries in students from southern Brazil, in a sample of 623 students aged 10 to 17 years, correlating the frequency of caries consumption and soft drinks also found no significant results, as also seen in our findings. Silva *et al.*,³¹ when correlated the frequency of consumption of 'standard obesogenic diet', which included sweet, sugars, soft drinks and other sugary foods in a sample of 1,439 students aged 6 to 13 years in the city of São Francisco do Conde - BA, Brazil, found associations with dental caries.

Our studies did not find a significant association between

family income and the presence of dental caries, which confirms the findings of Almeida *et al.*³² with similar results, who conducted their research in the state of Pernambuco, with 50 mothers accompanied by one of their children aged 3 to 12 years, finding the occurrence of caries in a large part of the sample, therefore, lower family income or equal to one minimum salary had no correlation with the presence of this disease. Thus, in larger samples the correlation between the experience of carious lesions and socioeconomic factors can be observed when compared with relatively smaller samples.

Regarding the variable 'parental education level', we found no statistically significant relationship with dental caries in our study. This is in agreement with the studies by Scapinello *et al.*,³³ who evaluated 120 children aged 7 to 10 years registered in a school from the city of Nova Roma do Sul-RS, Brazil, where DMFT had no relationship with mother's education, assessed throughout years of study. In contrast, studies conducted by Engelmann *et al.*³⁴ with a sample of 1,134 children from Santa Maria-RS, Brazil, the chances of having caries were higher in children whose parents had no primary education.

Although significant associations between dental caries and risk factors such as socioeconomic pattern and diet consumption have not been identified in the studied population, other studies^{35,36,37} has shown the positive contribution of these factors to the presence of dental caries in children and adolescents, since the consumption of high-sugar foods contributes to the formation of carious lesions, in view of the fact that acids produced by cariogenic bacteria in the fermentation of sugars promote tooth demineralization, and that family's socioeconomic conditions interfere with access to health services and information about oral hygiene care through public policies.

Conclusion

The variables 'family socioeconomic class', 'household education level' and 'consumption of sweets, sugary foods and drinks' did not show a significant relationship with caries in the multivariate model. However, almost all (97%)

of children and young adults consumed sugary foods and drinks 4 or more times a week. It was also found that after educational interventions, the bacterial plaque index showed a statistically significant reduction.

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