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Original Article

Association between Periodontal Condition and Nutritional Status of Brazilian Adolescents: A Population-based Study

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Abstract

Background: Obesity is a serious problem of public health and affects all socio-economic groups, irrespective of age, sex or ethnicity. The aim of this study was to evaluate the association between periodontal condition and nutritional status of adolescents.

Methods: This was a cross-sectional study using a probability cluster sampling, and the sample was defined by statistical criterion, consisting of 559 students aged 15-19 yr enrolled in public schools of adolescents of Campina Grande, PB, Brazil in 2012. Socioeconomic characteristics were analyzed, as well as self-reported general and oral health, anthropometric data and periodontal condition (CPI and OHI-S). Descriptive and analytical analysis from bivariate and multivariate Poisson regression analysis with 5% significance level was performed.

Results: Of the 559 adolescents, 18.6% were overweight and 98.4% had some form of periodontal changes such as: bleeding (34.3%), calculus (38.8%), shallow pocket (22.9%) and deep pocket (2.3%). There was association between presence of periodontal changes with obesity ($P<0.05$; CI 95%: 0.99 [0.98 - 0.99]).

Conclusion: The association between presence of periodontal changes and obesity status in adolescents was indicated.

Keywords: Adolescents, Periodontal disease, Inflammation, Obesity, Risk factors

Introduction

Overweight and obesity can be defined as an abnormal and high accumulation fat and can be harmful to health (1). They have a multifactorial character, where genetic, environmental, socioeconomic and behavioral factors may be significantly involved (2).

This disease has become increasingly evident in young individuals (3), reaching epidemic proportions, becoming a serious public health problem. One in three children aged 5-9 yr old are above the weight recommended by WHO, and 23.2% of adolescents are overweight (4).

Overweight children and adolescents may present chronic diseases traditionally dependent on age increasingly earlier (5). In this sense, obesity was associated with risk factors for cardiovascular diseases (6), such as hypertension (7,8), type 2 diabetes mellitus (9,10) and hyperlipidemia (11). Furthermore, a systemic inflammatory condition and to high levels of C-reactive protein can be associated (12), being therefore a potential risk factor for periodontal disease, especially in young individuals (13).

Periodontal disease is a chronic inflammatory oral disease -infectious of high prevalence (13,14), which if left untreated can lead to the destruction of the supporting tissues of teeth (5). In overweight or obese individuals, the production of inflammatory cytokines by adipose tissue aggravates the systemic inflammatory condition predisposing to the establishment or worsening of inflammatory diseases, such as periodontitis (12).

Thus, the association between overweight / obesity and periodontal disease has been described in several studies of national and international literature (7,11,13,15-20). However, few studies have investigated this possible association in children and adolescents (2,3,5,21,22).

Due to the need to seek results that elucidate the association between the two diseases in adolescents, the aim of the study was to evaluate the periodontal condition and nutritional status of Brazilian schoolchildren aged 15-19 yr.

Materials and Methods

Study Location

This cross-sectional study was conducted with adolescents aged 15-19 yr living in the city of Campina Grande, Northeastern Brazil in 2012. The city has 28 public schools, 21 of these are located in the urban area and 7 in rural areas, totaling 6514 students enrolled.

Sample

To obtain a representative sample, sample calculation was performed with the following parameters: estimated prevalence of periodontal disease of 50%, permissible error of up to 5%, adjustment of calculation for finite population, drawing effect of 1.4 and additional 10% for losses or refusals, totaling a minimum sample required for the study of 559 schoolchildren. A probability cluster sampling in only a stratum (classes) was used, wherein the amount of randomly selected students was proportional to the school size (23). Thus, the sample consisted of students from aged 15-19 yr enrolled in day shift of state high schools.

The exclusion criteria were: a) Diabetics (24); b) hypertensive (16); c) smokers (24); d) pregnant women (20); e) edentulous (18); f) users of fixed orthodontic appliance (11); g) individuals used antibiotics or anti-inflammatory in the 3 months prior to the study (20); h) those submitted to scaling and root planning in the 3 months before the exams (20).

Data collection

Data collection was carried out at school premises. Data collection instrument consisted of a form, with socioeconomic information, general health, oral hygiene habits and oral clinical examination. Two previously trained and calibrated examiners performed clinical examinations and two assistants performed the completion of forms and provided guidance on oral hygiene and supervised brushing. The training and calibration process consisted of a theoretical stage and a practical stage consisting of an *in lux* calibration (using images) for the Simplified Oral Hygiene Index (OHI-S); and in vivo calibration for the Community Periodontal Index (CPI) held with 10 volunteers with characteristics similar to the study population, obtaining substantial inter-rater and intra-rater reliability values (kappa 0.60 to 0.79) and almost perfect (Kappa 0.80 to 1.0) for CPI and OHI-S, respectively.

The periodontal status was assessed using CPI and OHI-S. The five scores used to measure CPI were: healthy (CPI 0), gingival bleeding (CPI 1), calculus (CPI 2), shallow periodontal pocket of 4-5 mm (3 CPI) and deep periodontal pocket of 6 mm or more. The survey was conducted using a CPI probe (Trinity Ind. Com. Ltda., São Paulo, SP, Brazil) at six sites for each of the six index teeth (disto-buccal, medium-buccal, mesio-buccal, disto-lingual, medium-lingual and mesio-lingual). After obtaining the scores, the periodontal condition was defined, considering the worst condition found in any sextant (25), as healthy (CPI 0), mild periodontal alteration (CPI 1-2), severe periodontal alteration (CPI 3-4) (26).

Participants had biofilm assessed in the six index teeth through a fucsina solution (Replak®, Dentsply Ind. Com. Ltda., Petrópolis, RJ, Brazil),

then removed by supervised brushing. The four scores used were: absence of biofilm (OHI-S 0), biofilm covering up to ⅓ of the tooth surface (OHI-S), biofilm in more than ⅓ and less than ⅔ (OHI-S 2), biofilm in more than ⅔ (OHI-S 3). Calculation was made by adding up the scores of each index tooth, dividing them by the number of teeth evaluated, so the possible OHI-S values ranged from 0 to 3. The oral hygiene level was classified as satisfactory (OHI-S between 0 and 1.1) and unsatisfactory (OHI-S greater than 1.2).

In Brazil, family income is often measured in units of monthly minimum salaries. Physical activity was measured by self-report. For the nutritional status classification, height and weight were measured, in duplicate, using the average value. Height was measured in centimeters (cm) using a stadiometer (Filizola, São Paulo, Brazil). Body mass was measured in kilograms (kg) using a portable scale with a resolution of up to 500 grams (Filizola, São Paulo, Brazil). A reference table recommended by the Center for Disease Control and Prevention for children and adolescents aged 2-20 yr was used, which indicates the relative body mass position among individuals of the same age and sex (27). Thus, the following cutoff points were used: underweight: BMI <5th percentile; normal weight: BMI≥ 5th percentile and BMI <85th percentile; overweight: BMI> 85th and <95th percentile; obese: BMI> 95th percentile.

Data analysis

Data were processed in the SPSS statistical program (SPSS for Windows, version 18.0, SPSS Inc, Chicago, IL, USA), double entered and submitted to bivariate and multivariate Poisson regression analysis with robust variance to determine the association between the variable dependent (periodontal alteration), after categorization and independent variables (socioeconomic status, self-reported overall health, oral hygiene habits and nutritional status) (P<0.05). A backward procedure was used to select the variables that have achieved P<0.20 in the bivariate analysis. Variables with P<0.05 in the adjusted analysis were included in the final regression model.

Ethics

This study was approved by the Ethics Committee for Research on Human Beings of the State University of Paraiba (CAEE: 03263612.4.0000.5187). Participation was voluntary and linked to the signing of the Informed Consent Form.

Results

Among adolescents evaluated, 59% were female and the most prevalent age was 16 yr (33.1%). Most adolescents reported not being white (78%) and low income (72.8%). 18.6% of adolescents had excess body fat, 98.4% had some sort of periodontal alteration, and of these, 73.1% had mild periodontal alteration and 25.2% severe periodontal alteration (Table 1).

In the bivariate analysis, independent variables such as age, flossing, tongue cleaner and other hygiene devices (toothpick) and nutritional status were associated with presence of periodontal alterations in adolescents (Table 2). Variables age, use of tongue cleaner, dental floss, mouthwash, other hygiene devices and nutritional status were included in the multivariate model (P<0.20); however, only tongue cleaner and nutritional status remained in the final model of the Poisson regression (Table 2).

Discussion

The present study aimed to assess associations between periodontal condition and nutritional status in schoolchildren aged 15-19 yr, in a multivariate logistic regression analysis, taking into account possible confounding variables.

A survey with Brazilian adolescents obtained prevalence of 16% and 7.2% for overweight and obesity, respectively (4). Similar trend was observed when compared to other studies conducted in Brazil (28-31), corroborating the findings of this study. This high prevalence of overweight / obesity in this age group is a strong indication of an epidemic health behavior (32).

Table 1: Distribution of socioeconomic, nutritional and periodontal characteristics of adolescents, Campina Grande, Brazil

Variable	n	%
Sex (n= 559)		
Female	330	59
Male	229	41
Age (n=559)		
15	144	25.7
16	185	33.1
17	152	27.2
18	62	11.1
19	16	2.9
Skin color (n=559)		
White	123	22
Non white	436	78
Family income (n=559) (Brazilian Reals R$)		
Up to 1500	407	72.8
From 1500 to 9500	152	27.2
Nutritional status (n=559)		
Underweight	35	6.3
Normal weight	420	75.1
Overweight	66	11.8
Obese	38	6.8
Periodontal status (n=559)		
Healthy	9	1.6
Periodontal alteration	550	98.4
CPI (Maximum score) (n=559)		
Healthy	9	1.6
Bleeding	192	34.3
Calculus	217	38.8
Pocket 4-5mm	128	22.9
Pocket 6mm or +	13	2.3
OHI-S (n=558)		
Satisfactory	335	59.9
Unsatisfactory	223	39.9

In relation to periodontal status, the prevalence of bleeding and calculus was similar to data obtained in the Brazilian survey of oral health (33). In contrast, there was a considerable increase over the shallow periodontal pocket. This increase has occurred due to the lack of adequate oral health behavior, poor living conditions, poor oral hygiene practice and low utilization of oral health services (34, 35).

Previous studies indicate higher incidence of association between obesity and periodontal disease status in younger individuals (7, 36). A plausible explanation for this fact would be that early obesity may be more harmful, given that its development is related to poor dietary habits (31) and not to weight gain in adulthood due to the aging process (13).

Several studies conducted with cChildren and adolescents have evaluated the association between periodontal disease and overweight / obesity through obesity indicators such as BMI (2,3,5,12,21,22), waist circumference (5,22) , skinfold thickness (5) and visceral adipose tissue (22). Despite the variety of indicators, BMI is widely used because it correlates to direct fat measures such as hydrostatic weighing and dual energy ab-

sorptiometry X-rays, being a reliable indicator and an easy and inexpensive method to perform screening of weight categories that may lead to health problems (27).

Table 2: Distribution of adolescents in bivariate and multivariate Poisson regression models for periodontal condition and independent variables

Variable	CPI		Bivariate#		Multivariate†	
	Healthy n (%)	Periodontal alteration (%)	Non adjusted RP		Adjusted RP	
			P value	(CI 95%)	*P* value	(CI 95%)
Sex						
Female	4 (1.2)	326 (98.8)	0.394	0.99 (0.98 – 1.00)	-	-
Male	5 (2.2)	224 (97.8)		1.00	-	-
Age*						
15	3 (2.1)	141 (97.9)	0.317	0.99 (0.99 – 1.00)	-	-
16	5 (2.7)	180 (97.3)		1.00	-	-
17	1 (0.6)	151 (99.3)	0.082	0.99 (0.97 – 1.00)	-	-
18	0 (0.0)	62 (100.0)	0.024	0.98 (0.97 – 0.99)	-	-
19	0 (0.0)	16 (100.0)	0.028	0.98 (0.97 – 0.99)	-	-
Health problem						
Yes	3 (2.6)	112 (97.4)		1.00	-	-
No	6 (1.3)	438 (98.7)	0.428	0.99 (0.97 – 1.00)	-	-
Use of medication						
Yes	3 (2.1)	138 (97.9)		1.00	-	-
No	6 (1.4)	412 (98.5)	0.608	0.99 (0.98 – 1.01)	-	-
Physical activity						
Yes	4 (1.5)	269 (98.5)	0.790	1.00 (0.99 – 1.01)	-	-
No	5 (1.7)	281 (98.2)		1.00	-	-
Dental floss*						
Yes	7 (3.0)	228 (97.0)		1.00	-	-
No	2 (0.6)	322 (99.3)	0.048	0.98 (0.97 – 1.00)	-	-
Mouthwash*						
Yes	1 (0.6)	159 (99.4)	0.142	1.00 (0.99 – 1.01)	-	-
No	8 (2.0)	391 (97.9)		1.00	-	-
Other devices*						
Yes	0 (0.0)	12 (100.0)	0.003	1.00 (1.00 – 1.01)	-	-
No	9 (1.6)	538 (98.4)		1.00	-	-
Nutritional status*						
Underweight	0 (0.0)	35 (100.0)	0.003	1.00 (1.00 – 1.02)	0.415	0.99 (0.97 – 1.01)
Normal weight	8 (1.9)	412 (98.1)		1.00		
Overweight	1 (1.5)	65 (98.5)	0.315	0.99 (0.97 – 1.01)	0.521	0.99 (0.99 – 1.00)
Obese	0 (0.0)	38 (100.0)	0.004	0.99 (0.98 – 0.99)	0.011	0.99 (0.98 – 0.99)
OHI-S						
Satisfactory	7 (2.1)	328 (97.9)		1.00	-	-
Unsatisfactory	2 (0.9)	221 (99.1)	0.235	0.99 (0.98 – 1.00)	-	-

#Poisson regression not adjusted for independent variables and presence of periodontal changes; *Variables incorporated in the multivariate model ($P<0.20$); Age, dental floss, mouthwash, other devices and nutritional status; † Poisson multivariate regression adjusted for the presence of periodontal changes and socioeconomic characteristics, oral hygiene and nutritional status (variables independent), by the backward procedure.

The present study showed a positive association between obesity and presence of periodontal changes, since a high body mass index may be a potential risk factor for periodontal disease at a

young healthy population (15). In young Americans aged 17- 21, for each 1 kg, there was a 6% increase in the risk of periodontitis (5). Gingivitis has also been linked to obesity in adolescents aged 10-18 yr (2,3). In contrast, association was found only between the number of episodes of obesity and presence of dental calculus (12), this could play a significant role in the development and worsening of periodontal disease for predisposing to the formation and maintenance of biofilms over the gingival margin.

Sex can influence a number of individual characteristics such as genetics, size, hormonal status, nutrition and general oral health habits, promoting different exposure and susceptibility responses (21,22). In children aged 8-12 yr, gingivitis was significantly associated with overweight / obesity only in boys (21). Despite these differences between sexes, there were no statistically significant differences in this research proving this association in adolescents.

In addition, other socioeconomic factors such as number of residents of a residence and maternal education also have influenced the occurrence of periodontal disease in obese subjects (21). Although, data on income have been collected, it was not included in the bivariate and multivariate model, since reported income involves different aspects hampering the reliability of data (32).

Literature describes numerous mechanisms that may explain the association between obesity and periodontal changes. Periodontal disease is characterized by inflammatory and immune response due to biofilm formation (37). In turn, obese individuals tend to be hypersensitive to inflammation and, consequently, more susceptible to develop periodontal disease in the presence of pathogens (38), in addition to influencing biofilm amount and composition (20).

The biological mechanisms involving adipocytokines, proinflammatory cytokines derived from adipose tissue acting on periodontal tissues by initiating an immune response of the host, as well as the balance between pro- and anti-inflammatory cytokines may determine the extent of the periodontal tissue damage (16). Thus, in obesity, there is an increased concentration of free acids derived from the increase in size of adipocytes, which recruit macrophages from the adipose tissue, resulting in the secretion of tumor necrosis factor-α (TNF-α), increased interleukin - 6 (IL-6), inducing the increase of C-reactive protein (CRP), resulting in acute systemic inflammation (18). The presence of systemic inflammation may cause an increase in the local inflammatory response of external stimuli such as dental biofilm (12).

Oral hygiene was measured by OHI-S, indicating the amount of biofilm present on tooth surfaces, unlike other studies that evaluated this data using the plaque index (PI) (2,21) and observed a clear significance between biofilm deposition and gingivitis / obesity association. Although there was no association with OHI-S, there is an indication in literature that obese young individuals tend to have worse attitude towards oral hygiene compared to normal weight ones (2). Therefore, it becomes difficult to affirm whether the association between obesity and periodontal disease is due to systemic changes arising from obesity (3) or to correlations between oral self-care and general lifestyle (2).

As for lifestyle, the lack of physical activity possibly influences periodontal disease, but this association was not observed in the analysis of this study. The practice of physical activity was established as a healthy behavior and a protective factor against periodontitis (39,40). Thus, people engaged in physical activity programs improve blood flow and oxygen exchange efficiency, reducing inflammation, which plays a significant role in the pathogenesis of the periodontal disease (41).

This study presents a cross-sectional design and therefore cannot establish causal relationships. In this sense, longitudinal studies should be carried out to determine the causal direction of the relationship between periodontal disease and obesity. Furthermore, periodontal change was measured in accordance with CPI criteria, which evaluate the presence of bleeding, calculus and periodontal pocket only in index teeth and may even underestimate or overestimate the prevalence of periodontal diseases (42). Additionally, the lack of

standardization in the criteria defining the periodontal status makes it difficult to compare results with other studies in literature.

Conclusion

There is an association between presence of periodontal changes and obesity status in adolescents aged 15-19 yr. This observation underlies the need to develop public policies of general and oral health for the prevention of injuries still at early ages.

Ethical considerations

Ethical issues (Including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc.) have been completely observed by the authors.

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