GINGIVAL DISEASE IN ADOLESCENTS RELATED TO PUBERAL STAGES AND NUTRITIONAL STATUS

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ABSTRACT

The relationship between gingival disease in adolescents and pubertal stages is not clear. The aim of this study is evaluate whether there is a relationship between the prevalence of gingival disease in adolescents and the different stages of pubertal development as well as nutritional status. The study group was comprised of 158 adolescents ages 10 – 19 years. Measures of pubertal stages were based on physical examinations. The World Health Organization (WHO) community periodontal index of treatment needs – (CPITN) was used to assess levels of periodontal condition and treatment needs. The Body Mass Index was assessed by nutritionists from our Division and then the subjects were classified according to nutritional status by the WHO classification. According to CPITN scores, 17.72% of the adolescents scored 0 (healthy), 48.73% of the adolescents scored 1 (bleeding after probing) and 33.55% scored 2 (presence of calculus). There was no statistically significant difference among Tanner stages in relation to CPITN scores (p=0.130). Although there is biological plausibility to the occurrence of these associations, there is a lack of epidemiological data to support them. The clarification of this issue is important in the clinical practice of pediatric dentists.

KEYWORDS: Adolescent, body mass index, gingival diseases, obesity, puberty.

1. INTRODUCTION

Although there are a large number of pathological conditions that affect the periodontal tissues, the two most prevalent forms of the disease are plaque-associated chronic gingivitis and periodontitis. Gingivitis affects more than 70% of children older than 7 years of age[1]. Chronic periodontitis affects a small proportion of children and adolescents, but the prevalence and severity increase significantly with age[2].

It has been reported that increased levels of sex hormones, estrogens and progestins during pregnancy, puberty or among women taking oral contraceptives may induce endothelial damage, increase vascular permeability and influence granulation tissue formation[3].

Saito *et al.* (2001) studied the relationship between obesity and visceral fat accumulation and periodontitis[4]. They found that both are risk factors for periodontitis. According to the study of Saito *et al.* (2005) there is biological plausibility that gives meaning to the association between obesity and periodontitis[5]. Petti *et al*. (2000) studied the association between nutritional variables and gingival health and did not find statistically significant differences between overweight/obesity and gingivitis[6].

Puberty is characterized by several physical and hormonal changes. A classification system was developed based on these pubertal changes[7]. Sexual maturity ratings include breast development in females, genital development in males and pubic hair development in both males and females. According to this classification the pubertal stages are B1 through B5 and P1 through P5 in girls; G1 through G5 and P1 through P5 in boys.

Rapkin *et al.* (2006) noted that a child's age may be less important than his/her pubertal stage in both clinical and research settings[8]. This study found a high correlation between pubertal stages and circulating levels of estradiol and follicle stimulating hormone (FSH) primarily on epidemiological studies and concluded that Tanner pubertal stages are as reliable as the evaluation of FSH levels when these are unavailable.

The aim of this study was to evaluate whether there is a relationship between the prevalence of gingival disease in adolescents and the different stages of pubertal development as well as in relation to nutritional status.

2. MATERIAL AND METHODS

This study was done at the Federal University of São Paulo, in São Paulo, Brazil, and was approved by the Institutional Ethics Review Board (protocol number 1048/09). Informed consent was obtained from all subjects and their parents or guardians prior to

participation in the study. The subjects of the study were 158 adolescents (ages 10 - 19 years) referred to our clinic of Adolescent Medicine of the Department of Pediatrics (School of Medicine, Federal University of São Paulo). The Adolescent Clinic is part of the Outpatient Pediatric Clinic and provides medical services for adolescents between the ages of 10 - 19 years. The sample consisted of adolescents undergoing routine check-ups in our clinic. The number of adolescents enrolled in our clinic determined our sampling size, characterizing the choice process of the sampling unit as a convenience criterion for the study[9].

The sample size calculation was performed. The calculation of sample size for the study of association of gum disease in adolescents and the different stages of pubertal development as well as in relation to nutritional status used a prevalence-based study of an Epidemiological Survey on Oral Health held in São Paulo in 2008-2009[10]. The study evaluated three age groups: (5, 12 and 15-19). Prevalence of gingivitis in two groups: 12-year-old and 15 to 19-year-old adolescents (60% and 63.5%, respectively) was used to calculate the sample size with a statistical power of 80%. The sample number of adolescents in this study was, respectively: 4249 (12 years) and 2858 (15-19 years) and the World Health Organization (WHO) community periodontal index of treatment needs – CPITN[11] was used to assess levels of periodontal condition and treatment needs. The formula for required sample size when testing proportions was used to analyze the data[12], taking into account a significance level of $p < 0.05$. The sample size (N) necessary for this study to have statistical power was determined to be 157.

Measures of pubertal stages were assessed based on physical examinations by physicians from our Division. The adolescents were classified into three subgroups, according to Tanner stages[13,14] where G indicates the genital development in males and B, breast development in females:

Subgroup 1 (Stages G1 and G2 - B1): before the growth spurt

Subgroup 2 (Stages G3 and G4 - B2, B3, and B4): growth spurt period

Subgroup 3 (Stage G5 - B5): end of the growth spurt

The gonadal stage was chosen for the classification, since pubic hair growth, one of the characteristics of the Tanner stages is governed by androgenic hormones8 and not by sexual hormones.

The Body Mass Index (BMI=weight/height²) was assessed by nutritionists from our Division and the subjects were then classified according to nutritional status (eutrophic, overweight and obese) by the WHO classification[15]. None of the participants were underweight.

Exclusion criteria included systemic disorders that could predispose to gingival disease such as asthma and diabetes, hormonal replacement therapy, immune deficiency as well as smoking[16]. To be included in this study, the adolescents were required to have all of the six index teeth (maxillary right and left permanent molar, mandibular right and left permanent molar, maxillary right central incisor and mandibular left central incisor) present and with preserved structure. Adolescents that were undergoing any kind of orthodontic treatment were also excluded from our study.

Four outpatient dentists were trained to perform the examination.

The World Health Organization (WHO) community periodontal index of treatment needs (CPITN)[11] was used to assess levels of periodontal condition and treatment needs. A dental mirror and the WHO periodontal probe -No. 621, with ball end 0.5 mm[17] were used to determine the bleeding response, the probing depth and the presence of calculus.

Each sextant was assigned a code number and the condition of the most affected site in that sextant was recorded. This method establishes that for subjects under 20 years of age, only six index teeth (maxillary right and left permanent molar, mandibular right and left permanent molar, maxillary right central incisor and mandibular left central incisor) should be evaluated. This process prevents mistakenly scoring the deepened sulci associated with eruption in this age group as periodontal pockets. For the same reason, when children under 15 years of age were examined, only bleeding and calculus were recorded. In our sample 42 adolescents were older than 15-year-old and none of them presented periodontal pockets. Thus, we scored all the subjects using with the following criteria:

CPITN 0 = healthy periodontal tissue

CPITN 1 = bleeding after careful probing

CPITN 2 = supra or subgingival calculus

Note that CPITN 1 and CPITN 2 are considered signs of gingivitis.

O'Leary's method was used to access the biofilm or plaque index[18]. The biofilm disclosing agent used was 5% erythrosine on the buccal, mesial, distal, lingual or palatal and occlusal/incisal surface. O'Leary's Plaque Index is based on the visible continuous plaque along the gingival margin. After staining, the percentage of tooth surfaces exhibiting stained plaque was calculated (number of stained surface/number of dental face x 100).

The data were evaluated using Excel (Microsoft®). Statistical evaluation of the data collected was performed with the use of SAS version 8.2 software. The groups were compared using multivariate logistic regression analysis, controlling for plaque index. The Kruskal-Wallis test was used to compare the continuous variables. The agreement between the examiners was calculated and Kappa-values indicated good to excellent (0.579–1.000) reliability, with intraclass correlation coefficient values ranging from 0.757 (CI 95%:0.507; 0.922) to 0.899 (CI 95%: 0.763; 0.970), indicating strong agreement. The significance level used was 0.05[19,20].

3. RESULTS

In this study, 48.10% of the adolescents in the sample were male and 51.90% were female. There were 35 adolescents ages 10-12 years (22.15%), 81 adolescents ages 13-14 years (51.27%) and 42 adolescents ages 15-19 years (26.58%).

Table 1. Plaque index compared to CPITN (Community Periodontal Index of treatment Needs) in all adolescents of the sample.

CPITN	N	Mean	Std Deviation	Minimum	Median	Maximum	p-value
Healthy	28	26.49	16.76	10.00	24.64	100.00	0.002
Bleeding	77	31.32	21.41	0.71	25.00	100.00	
Calculus	53	38.57*†	17.89	5.00	35.71	100.00	

Kruskal-Wallis Test: p = *p < 0.05 Healthy to Calculus and p =† p<0.05 Bleeding to Calculus CPITN is the dependent variable and IP is the independent variable.

Table 2. Distribution of CPITN (Community Periodontal Index of Treatment Needs) by nutritional status in male and female adolescents controlling for plaque index.

Male adolescents				
	Eutrophic	**Overweight**	**Obese**	**Total**
Healthy	3 (10.00)	3 (20.00)	3 (9.68)	9
Bleeding	16 (53.33)	8 (53.33)	16 (51.61)	40
Calculus	11 (36.67)	4 (26.67)	12 (38.71)	27
Total	30	15	31	76
Female adolescents				
Healthy	7 (25.00)	6 (33.33)	6 (16.67)	19
Bleeding	14 (50.00)	4 (22.22)	19 (52.78)	37
Calculus	7 (25.00)	8 (44.44)	11 (30.56)	26
Total	28	18	36	82

Logistic Regression Analysis (male adolescents): p= 0.530; † logistic regression analysis (female adolescents): p= 0.623; ‡ CPITN is the dependent variable and the nutritional status and IP are independent variables.

Table 3. Distribution of CPITN (Community Periodontal Index of Treatment Needs) by Tanner stages subgroups in male and female adolescents controlling for plaque index.

Tanner	Subgroup 1	Subgroup 2	Subgroup 3	Total
Male adolescents				
Healthy	5 (17.24)	4 (12.90)	0 (0.0)	9
Bleeding	17 (58.62)	16 (51.61)	7 (43.75)	40
Calculus	7 (24.14)	11 (35.48)	9 (56.25)	27
Total	29	31	16	76
Female adolescents				
Healthy	1 (20.00)	11(22.92)	7 (24.14)	19
Bleeding	2 (40.0)	25 (52.08)	10 (34.48)	37
Calculus	2 (40.0)	12 (25.00)	12 (41.38)	26
Total	5	48	29	82

* Logistic Regression Analysis (male adolescents): p= 0.053; † Logistic Regression Analysis (female adolescents): p= 0.714; ‡ CPITN is the dependent variable and Tanner stages subgroups and IP are independent variables.

According to the Tanner subgroups, 50.00% of the adolescents were in the growth spurt period.

There were no statistically significant differences in the CPITN scores of either male or female adolescents, when evaluating nutritional status (Table 2) or Tanner stages (Table 3).

Regarding nutritional status distribution, 36.71% of subjects were eutrophic, 20.89% were overweight and 42.40% were obese; 48.73% of the adolescents had a CPITN score of 1 (bleeding after probing) and 33.55% had a CPITN score of 2 (presence of supra or subgingival calculus).

Evaluating all adolescents in the sample, without separating by gender, there was no statistically significant difference among Tanner stages in relation to CPITN scores (p=0.130) and no statistically significant differences were found between the CPITN scores in relation to nutritional status (p=0.724).

The Table 1 demonstrates that there was a statistically significant difference among the scores of CPITN in relation to plaque index, when comparing the calculus group to both the healthy and the bleeding groups.

4. DISCUSSION

The relationship between puberty and gingivitis has been discussed in several studies[21-23]. To our knowledge, the only two published studies that have established a relationship between Tanner stages and gingivitis are the study of Delaney *et al.* (1986)[24] and the study of Mombeli *et al.* (1989)[21], Hugoson *et al.* (1981)[22] reported a low prevalence of gingivitis in pre-schoolers, followed by a gradual increase in prevalence reaching a peak around puberty[22]. Mombeli *et al.* (1989)[21] followed pubertal development by evaluating Tanner stages, bone age and clinical gingival conditions in 42 adolescents ages 11-15 years in a 4-year longitudinal study and found highly significant trends of increase in bleeding scores in both boys and girls with the start of pubertal phase[21]. In 35% of cases, bleeding scores reached a peak value 1-5 years after the onset of pubertal development. Delaney *et al.* (1986)[24], found that significant changes in components of the microbiotic of the gingival crevice were associated with skeletal, sexual, dental and chronologic age of subjects[24]. According to a review by Bimstein & Matsson (1999)[23], hormonal influence on the gingival tissues and the composition of the dental plaque are of particular relevance during puberty[23].

Our study revealed a statistically significant difference between plaque Index and CPITN scores in adolescents when comparing the calculus group to the healthy group and to the bleeding group. This demonstrates that there is a positive and significant association between plaque index and the presence of dental calculus.

According to Genco (1996)[25], although the importance of specific bacteria in the plaque has been highlighted, several investigators have reported that the quantity of plaque accumulation has weak, none, or negative association with periodontitis[25]. However, several investigations have shown a close relationship

between the incidence of gingivitis and oral hygiene[26-28].

When controlling for plaque index, there was no statistically significant difference between Tanner stages in adolescents and CPITN scores. A Brazilian epidemiologic study found that the prevalence of gingivitis in adolescents varies from 53.3% to 78.5%[29]. In our study, the prevalence of gingivitis (CPITN scores 1 and 2) is 82.83%. The lack of statistical difference among subgroups of Tanner stages and CPITN scores can be explained by the fact that the increase in bleeding scores and gingivitis is a continuous process during puberty and peaks 1-5 years after the onset of pubertal development[21] 73.42% of the adolescents in our study were between 10-14 years of age and 50.00% of the adolescents were in the growth spurt period. This makes it very difficult in a continuous process with wide individual variations to find differences between subgroups of Tanner stages, as they can reach a peak in gingivitis in a period around the growth spurt and this period can be superimposed among the subgroups. The clinical meaning of this finding is that the pediatric dentist should be aware of the age-dependent reactivity and hormonal influences on gingival tissues, particularly after the onset of puberty, in order to diagnose gingival inflammation that is out of proportion to age. Such a situation can be indicative of a high susceptibility to periodontal diseases. The importance of prevention, early diagnosis and treatment of periodontal diseases disease is high.

Obesity is increasing worldwide at an alarming rate and it has become a major public health problem in both developed and developing societies[30]. A number of epidemiological studies have examined the association between obesity and periodontitis[4,5,31-35]. Although some of the studies showed a strong positive association[4,5,31], others only observed moderate positive associations[32,35]. It should be noted that obesity and other risk factors are rarely isolated causes of periodontitis[35] .

Based on current knowledge, the adverse effects of obesity on the periodontium may be mediated through impaired glucose tolerance, dyslipidemia or increased levels of various bioactive substances secreted by adipose tissue[36].

Some studies have evaluated the relationship between body mass index (BMI) and periodontitis in young adults[37,38]. Ekuni *et al*. (2008)[37] evaluated 618 Japanese students ages 18-24 years and found that BMI could be a potential risk factor for periodontitis among healthy young individuals[37]. Sarlati *et al.* (2008)[38] examined the possible relationship between body weight and periodontal disease in a sample of young Iraniansages 18 to 34 years and found that overall and abdominal obesity were associated with the extent of periodontal disease[38]. Al-Zahrani *et al.* (2003)[32] showed a significant association between obesity and the prevalence of periodontal disease among individuals ages 18-34 years and not in the middle-aged and older age groups[32]. One possible explanation is that the effect of obesity is diluted in the older age groups in the presence of stronger risk factors such as age. The influence of obesity on the periodontal status of older participants may be masked, since non-obese subjects would also develop periodontal disease as they age. It is important to point out that the prevalence of periodontitis reported in the World Health Organization Global Oral Health Data Bank for 15–19-year-old individuals is approximately 10%[39].

In our study, no significant difference was found in the CPITN scores in relation to nutritional status when controlling for plaque index. In our sample, the prevalence of obese (42.40%) or overweight adolescents (20.89%) was higher than that in the general population. The explanation for this may be that there is a specific outpatient center in our Division for obese adolescents. In addition, only 42 adolescents were older than 15 years of age and none of them had periodontal pockets. We, therefore, scored all the subjects as CPITN 0-2, which characterizes gingivitis, not periodontitis. The studies described in the literature[37,38] do not relate obesity with gingivitis, but relate to periodontitis. As the prevalence of gingivitis in our study was very high, even though no significant difference between CPITN scores and the nutritional status of the adolescents was found; it is very important to remember that a change in periodontal tissue status that is due to metabolic changes associated with obesity might increase the extent and progression of periodontal disease later in life[40]. Therefore, establishment of preventive programs for management of obesity might be an adjunctive approach to improving periodontal health[38] and since the prevalence of gingivitis in adolescents is very high, it is imperative to monitor these patients closely.

Although CPITN is not an index that discriminates degrees of gingival inflammation, since the gingival bleeding may be present with minor and severe inflammation, it is an objective index and less subject to Intra-observer variations, and is therefore widely used. In addition, CPITN is an index of choice for population surveys[17].

There were no statistically significant differences in the prevalence of gingival disease in adolescents and the different stages of pubertal development or nutritional status. However, as the prevalence of gingivitis in adolescents is very high, pediatric dentists should be very closely involved in the prevention, early diagnosis and treatment of gingival diseases. If gingivitis is left untreated, it can advance to periodontitis. In addition, the management of obesity is important to prevent periodontal disease.

5. CONCLUSION

Considering that there is only very limited information on such associations, these findings are

important. Although there is biological plausibility to the occurrence of these associations, there is a lack of epidemiological data to support them. The clarification of this issue is important in the clinical practice of pediatric dentists.

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