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Gingival health of adolescents and the utilization of dental services, state of São Paulo, Brazil

ABSTRACT

OBJECTIVE: To evaluate the association between gingival health conditions and dental service utilization.

METHODS: An epidemiological survey of the oral health of 1,799 adolescents was carried out in 35 cities of the state of São Paulo, in 2002. Gingival health was assessed through the prevalence of gingival bleeding on probing and dental calculus (community periodontal index), and dental occlusion was assessed through the dental aesthetic index. The utilization of dental services was measured by means of the dental care index (F/DMFT) for each city. Multilevel logistic regression analysis was used to adjust explanatory models to factors associated with the outcome variables of interest.

RESULTS: The prevalence of gingival bleeding on probing was 21.5%, whereas dental calculus was prevalent in 19.4%. Male participants, who were either black or dark-skinned, lived in crowded homes, in rural areas, and showed schooling delay, were at a significantly higher risk than their respective counterparts. The following dental occlusion characteristics were also associated with unhealthy gum: incisor segment crowding, vertical anterior open bite, and antero-posterior molar relationship. Cities with a higher utilization of dental services showed a smaller proportion of adolescents with gingival bleeding and dental calculus.

CONCLUSIONS: The utilization of dental services was significantly associated with better gingival health conditions (gingival bleeding and dental calculus). This association did not depend on contextual and individual sociodemographic characteristics or dental occlusion.

DESCRIPTORS: Adolescent. Gingivitis, epidemiology. Periodontal Index. Malocclusion. Socioeconomic Factors. Dental Health Surveys. School Dentistry.

INTRODUCTION

The possible contribution of dental care to prevent periodontal diseases is an issue of public health interest. A systematic literature review indicated that, in the majority of studies, improvements in gingival conditions were obtained in the short run by oral health promotion initiatives.[16] Even though the reviewed studies focused on educational practices performed in schools and in the community, their results raised the hypothesis that both public and private dental care may have incorporated elements of oral health promotion into the clinical practice. Such measures could have contributed to reduce adverse gingival

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conditions among adolescents, such as the presence of dental calculus or gingival bleeding on probing.

Gingival bleeding and the presence of dental calculus in children and adolescents have been associated with sociodemographic conditions; with worse status associated to the following categories: male, light- and dark-skinned blacks, and under poorer socioeconomic conditions.[4] In this sense, it is necessary to measure sociodemographic characteristics of the examined individuals, as well as the context they live in, to adequately assess the association between gingival health outcomes and the utilization of dental services.

Apart from sociodemographic aspects, gingival condition may be influenced by aspects related to dental occlusion. Geiger[7] summarized evidence and arguments about the etiologic role of malocclusion in gingival inflammation and periodontal disease. In the 1950's and 1960's, few studies assessed the anatomical and functional contribution of dento-facial anomalies to the maintenance of gingival health. However, their conclusions were limited by the small number of examined people and the difficulty to control the several variables involved in the assessment of both conditions. The subsequent proposition of new measurement tools, especially the Community Periodontal Index (CPI)[17] and the Dental Aesthetic Index (DAI),[17] motivated studies testing hypotheses of association between these variables.[13] These observations emphasize the importance of assessing the prevalence of dento-facial anomalies among examined individuals as regards the study of association between gingival condition and the utilization of dental services.

The objective of the present study was to analyze oral health conditions, such as the prevalence of gingival bleeding on probing and dental calculus among adolescents, as well as their association with an index of utilization of the local dental service.

METHODS

From May to June of 2002, the state of São Paulo's Health Department conducted a comprehensive epidemiological survey of oral health, according to diagnostic criteria established by the World Health Organization (WHO).[17] Even though the survey included different age groups, the present study focused on 15-to-19-year-old adolescents living in 35 cities of the state of São Paulo. The oral examinations were performed at home, following a sample design representative of the assessment of dental caries per state macro-region and population size of the cities involved. For the cities participating in the survey, the observation of adolescents' gingival conditions is merely indicative and represents relevant information for the oral health service planning.

In order to control the reproducibility of observations, the kappa statistics for inter- and intra-observer agreement was employed, according to internationally standardized guidelines that were described in the original survey report.[a] In a specific study on the assessment of this procedure, the indicators presented were considered to be high and satisfactory for the survey purposes.[5]

The oral examination files originating from the initial survey data and concerning white, light- and dark-skinned black adolescents (1,799 individuals) were reviewed; about 1% of the global sample was excluded (adolescents classified in the "Asian" and "Amerindian" categories). Other gingival and periodontal conditions were not included in the study either.

Gingival condition was assessed by the community periodontal index (CPI), thus classifying: each mouth sextant as healthy (CPI=0); presence of gingival bleeding on probing (CPI=1); or dental calculus (CPI=2). Based on this index, the prevalence of gingival bleeding was calculated, taking into consideration the adolescents who showed at least one sextant with CPI=1. Correspondingly, the prevalence of dental calculus refers to the presence of at least one sextant with CPI=2.

Dental occlusion of adolescents was assessed by the dental aesthetic index, which comprises the following conditions: missing anterior teeth, crowding and spacing in the incisal segments, diastema, largest anterior maxillary and mandibular irregularity, maxillary and mandibular overjet, vertical anterior openbite, and antero-posterior molar relation.[17]

The adolescents' dental chart was associated with a questionnaire (home interview) answered by the adolescents, about their sociodemographic characteristics. In addition to sex, age and skin color, other conditions of interest were compared. Urban and rural residents were compared. Household crowding was calculated as the ratio between the number of residents and the number of rooms in the household; this measurement has been used in epidemiological studies as a socioeconomic condition index. Schooling delay (number of years of education in relation to age) is one of the variables incorporated into the calculation basis of the human development index in Brazil. For the purpose of comparative analysis, "schooling delay" distinguished adolescents with at least one year of delay, whereas "household crowding" distinguished those who lived in homes whose resident/room ratio was higher or equal to one.

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For the contextual characterization of social condition, the human development index was employed, a measure that gathers information on longevity, income and level of education. In the case of Brazilian cities, this index is assessed by the United Nations Development Program's local regional office in Brazil.

The dental care index[2] was employed to measure the utilization of dental services in participating cities. Traditionally used in assessments and comparative analyses of dental care program effectiveness, this index is calculated as the proportion of the number of filled teeth in relation to the total number of decayed teeth (decayed, missing and filled), based on data provided by the status of dental crown assessed in the same survey. This index is exclusively applied to the study of aggregate data, i.e., it is not defined for the assessment of individuals.

The statistical analysis used the SPSS 8.0-1997 software. The assessment of factors associated with the prevalence of gingival bleeding and dental calculus used the odds ratio (OR) and corresponding 95% confidence intervals, as estimated by non-conditional logistic regression analysis[9] and without adjustment for the other study variables.

The subsequent adjustment of association fitted multivariate models of non-conditional logistic regression analysis: the empty model (without associated factors); model 1 (including the individuals' sociodemographic characteristics); model 2 (including the individuals' sociodemographic characteristics and dento-facial anomalies); and the full model, comprising the multilevel assessment of individual characteristics (first level), the dental care index and the human development index of participating cities (second level). The selection of covariates for the multivariate models observed criteria of biological plausibility and statistical fitting. For the goodness-of-fit assessment of the different models, the -2loglikelihood test was used.[10]

Corresponding to the fourth multivariate model, the multilevel analysis employed the scheme of fixed effects/random intercept, as described by Sniders & Bosker,[15] and following the computer-assisted routine developed by the authors and described in another study.[3]

The oral health survey that provided data for this study was approved by the *Conselho Nacional de Ética em Pesquisa* (CONEP – National Research Ethics Committee, process n. 581/2000).

RESULTS

Few more than a third (34.3%) of the adolescents had unhealthy gingival status in one or more of their mouth sextants; 21.5% of them had gingival bleeding on probing in at least one sextant, a similar proportion showed dental calculus (19.4%) in at least one sextant (Table 1). There was no presence of deep periodontal pockets (6mm or more); less than 1% presented with shallow periodontal pockets (4-5mm). Despite this record, periodontal pockets were not assessed.

The unadjusted statistical analysis identified individual sociodemographic characteristics associated with gingival bleeding and dental calculus (Table 2). Male adolescents, light- and dark-skinned blacks, and those living in rural areas were under higher risk for both outcomes. The same was verified among adolescents showing schooling delay and living in crowded households. Several dento-facial anomalies were also associated with unhealthy gingival condition: crowding in the incisal segments; anterior maxillary and mandibular irregularity; mandibular and maxillary overjet; vertical anterior openbite; and half or one whole cuspid of antero-posterior molar relation. Adolescents with gingival bleeding on probing and dental calculus had a poorer profile of dental treatment needs, as indicated by lower values of the dental care index than those shown by adolescents with healthy gingival status.

The multilevel study showed comparable results for both gingival health outcomes. Sociodemographic characteristics (sex, age and household crowding) and dental occlusion characteristics (crowding, openbite and molar relation) were included as control of the association between gingival condition measures and the dental service utilization index in the cities. Moreover, the model related to gingival bleeding included significant associations with rural residence, schooling delay and skin color. Aiming to control the hypothesis of association between gingival health and dental service utilization by means of contextual socioeconomic conditions, both models included the human development index, despite their lack of significant association with the outcomes.

For both bleeding (Table 3) and the presence of calculus

Table 1. Prevalence of periodontal conditions, according to the Community Periodontal Index for adolescents. State of São Paulo, Southeastern Brazil, 2002. (N=1,799)

Index value	Periodontal condition	N	%	95% confidence interval
CPI = 0	All sextants healthy	1.182	65.7	63.5; 67.9
CPI = 1	Gingival bleeding in at least one sextant	388	21.6	19.7; 23.6
CPI = 2	Dental calculus in at least one sextant	349	19.4	17.6; 21.3

CPI: Community Periodontal Index

Table 2. Non-adjusted assessment of factors associated with gingival bleeding and dental calculus among adolescents. State of São Paulo, Southeastern Brazil, 2002. (N=1,799)

Condition	Gingival bleeding			Dental calculus		
	CPI=1	CPI≠1	Non-adjusted OR (95%CI)	CPI=2	CPI≠2	Non-adjusted OR (95%CI)
Sociodemographic						
Sex						
Female	208	856		186	878	
Male	180	555	1.33 (1.06; 1.67)	163	572	1.35 (1.06; 1.70)
Skin color						
White	242	1,032		225	1,049	
Light- and dark-skinned black	146	379	1.64 (1.30; 2.08)	124	401	1.44 (1.13; 1.85)
Residence area						
Urban	351	1,359		323	1,387	
Rural	37	52	2.75 (1.78 ; 4.27)	26	63	1.77 (1.10; 2.84)
Household crowding						
No	301	1,213		272	1,242	
Yes	87	198	1.77 (1.34; 2.35)	77	208	1.69 (1.26; 2.26)
Schooling delay						
No	197	950		208	939	
Yes	191	461	2.00 (1.59; 2.51)	141	511	2.00 (1.59; 2.51)
Dento-facial anomalies						
Crowding (incisal segments)						
Absent	220	930		182	968	
Present	168	481	1.48 (1.17; 1.86)	167	482	1.84 (1.45; 2.33)
Anterior maxillary irregularity						
Absent	224	922		197	949	
Present	164	489	1.38 (1.10; 1.74)	152	501	1.46 (1.15; 1.85)
Anterior mandibular irregularity						
Absent	224	898		180	942	
Present	164	513	1.28 (1.02; 1.61)	169	508	1.74 (1.37; 2.20)
Anterior maxillary overjet						
≤ 3 mm	305	1,163		251	1,217	
≥ 4 mm	83	248	1.28 (0.98; 1.69)	98	233	2.04 (1.55; 2.68)
Anterior mandibular overjet						
Absent	379	1,401		342	1,438	
≥ 1 mm	9	10	3.33 (1.34; 8.25)	7	12	2.45 (0.96; 6.28)
Anterior vertical openbite						
Absent	346	1,343		313	1,376	
≥ 1 mm	42	68	2.40 (1.60; 3.59)	36	74	2.14 (1.41; 3.24)
Antero-posterior molar relation						
Normal	213	912		175	950	
Half or one whole cuspid	175	499	1.50 (1.20; 1.89)	174	500	1.89 (1.49; 2.39)
Dental treatment			p			p
Care Index	57.0%	76.4%	< 0.001	56.8%	75.5%	< 0.001

Table 3. Logistic regression multivariate models and multilevel assessment of factors associated with gingival bleeding among adolescents. State of São Paulo, Southeastern Brazil 2002. (N=1,799)

Level	Empty model		Model 1					Model 2				
	Coef.	SE	Coef.	SE	OR	95% CI	p	Coef.	SE	OR	95% CI	p
First level: individuals	-1.29	0.06	-1.34	0.67			0.047	-1.52	0.68			0.026
Sociodemographic												
Age			-0.03	0.04			0.405	-0.04	0.04			0.343
Male			0.30	0.12	1.36	1,08; 1,71	0.010	0.32	0.12	1.38	1.09; 1.74	0.007
Light- and dark-skinned black			0.34	0.13	1.40	1,10; 1,79	0.007	0.31	0.13	1.36	1.06; 1.74	0.015
Rural area			0.93	0.23	2.53	1,62; 3,96	< 0.001	0.87	0.23	2.40	1.52; 3.78	< 0.001
Household crowding			0.40	0.15	1.49	1,11; 2,00	0.008	0.39	0.15	1.48	1.10; 1.99	0.010
Schooling delay			0.60	0.12	1.82	1,43; 2,32	< 0.001	0.58	0.12	1.78	1.39; 2.28	< 0.001
Dento-facial anomalies												
Crowding								0.32	0.12	1.38	1.08; 1.75	0.009
Anterior openbiter								0.76	0.21	2.13	1.40; 3.24	< 0.001
Molar relation								0.25	0.13	1.28	1.01; 1.63	0.043
-2loglikelihood	1,875.92		1,801.58					1,775.00				
Second level: cities								Coef.	SE	β	95% CI	p
Constant								+0.50	0.53	-	-0.58; +1.59	0.353
Dental care index								-0.63	0.19	-0.51	-1.02; -0.24	0.002
Human development index								-0.04	0.68	-0.01	-1.43; +1.35	0.951
–2loglikelihood (full model)								1,736.14				

SE: standard error of regression coefficient

(Table 4), the complete model presented better goodness of fit (significantly lower -2loglikelihood) when compared to the preceding partial models. The same factors associated with gingival bleeding on probing were associated with the variation of dental calculus prevalence.

DISCUSSION

Unhealthy gingival conditions affected a relatively high proportion of adolescents. Over a third of participants in this study had gingival bleeding or dental calculus in at least one sextant of the mouth. This number is even higher than the proportion related to 12-year-old children in the same geographical context.[3]

The present indication of worse gingival conditions among male adolescents is confirmed by extensive literature review.[11] Gender differences have also been reported for oral health knowledge and behavior, with female adolescents and children showing advantages as regards tooth-brushing and use of dental floss, diet, self-esteem and regular dental service utilization.[14] In the Brazilian context, the profile of dental service utilization has also been reported to be less favorable among light- and dark-skinned black students[1] and rural residents.[12] These differences are consistent with the associations indicated by the present study. Furthermore, they emphasize the need to include individual sociodemographic characteristics as control factors of the association between gingival condition and dental service utilization.

The present study pointed to the prevalence of gingival bleeding and dental calculus being associated with the examined adolescents' socioeconomic conditions. This

Table 4. Logistic regression multivariate models and multilevel assessment of factors associated with dental calculus among adolescents. State of São Paulo, Southeastern Brazil, 2002. (N=1,799)

	Empty model		Model 1					Model 2				
First level: individuals	Coef.	SE	Coef.	SE	OR	95% CI	p	Coef.	SE	OR	95% CI	p
Constant	-1.42	0.06	-4.07	0.68			< 0.001	-4.44	0.70			< 0.001
Sociodemographic												
Age			0.14	0.04			< 0.001	0.14	0.04			< 0.001
Male			0.33	0.12	1.39	1.10; 1.77	0.007	0.34	0.12	1.40	1.10; 1.78	0.006
Light- and dark-skinned blacks			0.25	0.13	1.29	1.00; 1.66	0.050					
Rural area			0.50	0.25	1.65	1.02; 2.66	0.042					
Household crowding			0.48	0.15	1.62	1.20; 2.18	0.001	0.49	0.15	1.64	1.21; 2.21	0.001
Dento-facial anomaly												
Crowding								0.53	0.12	1.70	1.34; 2.17	< 0.001
Anterior openbite								0.68	0.22	1.97	1.28; 3.04	0.002
Molar relation								0.48	0.12	1.61	1.26; 2.06	< 0.001
-2loglikelihood	1,770.10		1,729.91					1,687.50				
Second level: cities								Coef.	EP	β	95% CI	p
Constant (fixed part)								+0.27	0.35	-	-0.44; +0.99	0.445
Dental care index								-0.49	0.13	-0.57	-0.74; -0.23	0.001
Human development index								+0.12	0.45	+0.04	-0.80; +1.04	0.792
–2loglikelihood (full model)								1,659.48				

observation is also consistent with previous studies applied to the Brazilian context. The oral examination of young men drafted for military service[8] indicated that gingival bleeding and dental calculus were significantly associated with household income and level of education of both the adolescents and their parents.

Dental occlusion characteristics among adolescents were also associated with the prevalence of bleeding and calculus. Poorer gingival conditions have been observed among children and adolescents with dento-facial anomalies.[3] Moreover, longitudinal studies point to orthodontic correction as collaborating to make tooth brushing more effective.[9]

The identification of sociodemographic characteristics and dento-facial anomalies associated with modifications of gingival status requires that these factors be controlled in the assessment of dental service utilization effectiveness. The outlined multilevel models indicated that the cities with higher dental care index tended to show a more favorable profile of gingival bleeding and dental calculus prevalence. This association is ecological and concerns the prevalence of gingival conditions and the level of dental service utilization in the cities participating in the survey. Thus, the individual risk of adolescents cannot be inferred. As the multilevel models consisted of multivariate adjustment to contextual and individual sociodemographic covariates, as well as dental occlusion, it is estimated that this association is not due to confusion or absence of control for these factors.

Other aspects that may interfere with the risk of gingival bleeding and dental calculus are relevant for this assessment, such as: the presence of dental plaque, which can be measured by the plaque index; the quality and frequency of oral hygiene; the type of dental care performed; the availability of oral hygiene products; the dentists' preparation as regards preventive and educational practices; and the availability of specific oral health promotion initiatives. However, these factors are not usually assessed in epidemiological surveys planned in accordance with WHO guidelines.

Furthermore, this information is not available for the study population. The absence of assessment of these aspects is thus acknowledged to be a limitation of the present study.

Another limitation refers to the measurement tool of gingival status. The Community Periodontal Index has been criticized for being an old-fashioned paradigm to assess disease.[11] Especially among adolescents, the validity of the hierarchical record of conditions of interest (bleeding, calculus and periodontal pocket) is questioned. It is estimated that the hierarchical records of conditions assessed by means of the CPI, when applied to populations with low prevalence of periodontal pockets, would not lead to the underestimation of dental calculus prevalence. However, the same is not true for bleeding, as the dental calculus record (CPI=2) does not enable the identification of the concomitant bleeding (CPI=1) in the same sextant. This observation is consistent with the reporting of higher prevalence of gingival bleeding in another survey among Brazilian adolescents, which modified the diagnostic criteria established by the WHO.[8]

In spite of these limitations, the epidemiological survey carried out in the state of São Paulo, in 2002, constitutes the most recent and far-reaching, best quality database available for the population-based diagnosis of these conditions. Aiming to attenuate the limitation represented by the hierarchical recording of gingival conditions, the present study opted for the study of factors associated with the prevalence of gingival bleeding and dental calculus, avoiding the less accurate alternative of the joint assessment of these conditions. In this sense, the reference category for the comparative analysis of dental calculus prevalence (absence of calculus) includes the presence of bleeding, which could also be questioned as a limitation to this study.

An extensive reform of the national health system occurred in Brazil during the 1990's, when public services extended the provision of dental care. Beginning with this reform, the availability of preventive treatments (application of fluoride varnish and sealants), dental restoration and oral health promotion (oral health education, fluoride mouthwash, evidencing dental plaque, supervised tooth brushing, distribution of toothbrushes and other dental hygiene products, and epidemiological surveys) has been increased.

The allocation of public resources for these purposes has substantially increased dental care availability, especially for children, and public dental services have been assessed and found to have contributed to reduce oral health inequalities in the state of São Paulo.[1] However, the association between gingival health indicators and dental service utilization had not been evaluated among adolescents.

Therefore, the present study is compatible with the hypothesis that the current oral health care system in Brazil may have enabled potentially effective practice of oral health promotion. This hypothesis has also been indicated by recent studies aimed at other age groups,[3] or employing different analytical schemes.[5] An alternative hypothesis consists in considering the dental care index to be higher in the cities where the examined group was more concerned about general oral health care. This hypothesis suggests the possibility of reverse cause, inherent in cross-sectional studies.

In the cities studied, the higher utilization of dental services by adolescents was associated with a lower prevalence of gingival bleeding and dental calculus, as controlled by sociodemographic characteristics and dental occlusion. This observation justifies the hypothesis that better preparation of the cities to meet the treatment needs of dental fillings may have been followed by efforts to promote oral health, by means of either collective initiatives performed in non-clinical environments, or favorable modifications in the clinical setting. It is suggested that subsequent studies investigate this hypothesis, assessing the contemporary nature of the dentist-patient interaction in the public and private services, thus contributing to the clarification of the relationship between dental treatment and oral health promotion.

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