Risk Indicators of Gingivitis in 5-year-old Brazilian Children

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Purpose: To identify the risk indicators of gingivitis among socioeconomic, clinical and gender variables in 5-year-old children attending preschools in Piracicaba, Brazil, in 2005.

Materials and Methods: The sample consisted of 728 subjects attending 22 public (n = 428) and 18 private (n = 300) preschools. A previously calibrated examiner performed the clinical examination in an outdoor setting, under natural light, using a dental mirror, Community Periodontal Index probe and air-drying. Gingival status was measured using the gingival alteration index for 5-year-olds according to the national survey carried out in 2002 in Brazil (Health Ministry of Brazil, 2004). Socioeconomic variables (monthly family income, number of people living in the household, parents' educational level, home ownership and car ownership) were collected by means of a parental semi-structured questionnaire.

Results: The prevalence of gingivitis was 16.6%. Monthly family income ($p < 0.0001$), father's education ($p < 0.0007$), mother's education ($p = 0.0004$), type of school ($p < 0.0001$), car ownership ($p = 0.0854$), gender ($p = 0.0087$), initial lesion ($p < 0.0001$), dental caries ($p = 0.0008$), crowding ($p = 0.0054$) and spacing ($p = 0.0019$) were associated with gingival bleeding at $p < 0.15$ and were selected for the regression analysis. By means of multiple logistic regression analyses, monthly family income of up to 4 Brazilian minimum wages, presence of initial lesion, presence of crowding and male gender were found to be risk indicators of gingivitis.

Conclusion: The prevalence of gingivitis in 5-year-old preschool children in Piracicaba was 16.6%. Also, family income of up to 4 minimum wages, male gender, the presence of initial caries lesion and crowding were risk indicators of gingivitis.

Key words: gingivitis, preschool, risk indicator

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Among periodontal diseases, gingivitis is considered the most prevalent (Löe and Morrison, 1986; Sjödin and Matsson, 1996; Garcia et al, 2002) and it has been detected in the majority of the child populations during the last years (Garcia et al, 2002). The prevalence of clinically detectable gingivitis has ranged from 34.33% to 100% in preschool children as shown in several studies (Jahn and Jahn, 1997; Abrams and Romberg, 1999).

However, since the disease presents mild symptoms and most patients believe it does not cause serious damage, gingivitis is almost always considered an irrelevant problem. Periodontal diseases are not limited to adults. On the contrary, periodontal diseases are prevalent among children and adolescents. For example, gingivitis affects more than 70% of children older than 7 years of age. Furthermore, in young children,

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Table 1 Sample distribution according to type of school and gender. Piracicaba, Brazil, 2005

Type of school	Gender				Total
	Male		Female		
	n	%	n	%	n
Private preschool	136	45.33	164	54.67	300
Public preschool	230	53.74	198	46.26	428
Total	366	50.27	362	49.73	728

the earlier stages of gingivitis present characteristics that are very subtle, making it difficult to diagnose. If the disease is not diagnosed and eliminated, it may remain present until adulthood and/or develop into periodontitis. Though gingivitis does not always progress to periodontitis, periodontitis is preceded by gingivitis (Jahn and Jahn, 1997; Oh et al, 2002).

For this reason, early diagnosis is one of the best measures for the prevention of periodontal diseases (Sarian et al, 1993), which can be done by the detection of gingival bleeding during the clinical procedure of probing.

In this context, it is very important to carry out epidemiological studies periodically in order to find the trends of periodontal diseases over time. This is especially important in 5-year-olds since it is the index age to obtain data on oral health levels of primary dentition (World Health Organization [WHO], 1997). Moreover, oral health surveys in this age group are ideal to monitor disease prevalence and health status, as well as to evaluate programmes targeted at preschool populations (Cypriano et al, 2003).

Another important aspect is the investigation of elements that could prevent or promote the development of gingivitis once the disease is widespread. However, published data are limited to epidemiological measurements of incidence and prevalence, and less attention has been devoted to evaluate sociodemographic conditions associated with the prevalence of gingivitis in the preschool age (Sayegh et al, 2005). Furthermore, no study concerning risk indicators of gingivitis in 5-year-old preschool children has been reported in dental literature.

Therefore, the present study aims to describe the prevalence of gingivitis and identifying risk indicators of the disease among socioeconomic, clinical and gender variables in 5-year-old children attending preschools in Piracicaba, Brazil, in 2005.

MATERIALS AND METHODS

Ethical aspects

The study was approved by the Research Ethics Committee of the Dental School of Piracicaba, State University of Campinas (UNICAMP), protocol number 147/2003. An informed consent form was signed by parents before beginning the survey. In addition to receiving a toothbrush, toothpaste and dental floss, all volunteers participated in activities with oral health education. Those who presented treatment needs were referred to dental care offices.

Sample

The sample size was chosen based on the prevalence of gingivitis reported in previous studies (Cypriano et al, 2003), and in order to obtain proportional representation from both public and private preschools in Piracicaba, which explains the different number of children in each type of school. A cluster sampling method was used which had a sampling error of 3.4%, a confidence level of 95%, a loss of 20% and gingivitis prevalence of 68.6%. Approximately 38% of the 5-year-old children of Piracicaba attend preschools, with 952 in public and 1040 in private preschools. Thus, the target of the present study was the population of 5-year-old children attending preschool (n = 1992). In this case, the sample drawn from preschool children (n = 728) corresponded to approximately 36.5% of 5-year-old children attending preschool in Piracicaba. A list with public (n = 38) and private (n = 69) preschools was provided by the Department of Education, out of which 22 public and 18 private preschools were randomly selected. In each preschool, all 5-year-old children were invited to participate in the study, for a total of 814 subjects (481 from public preschools and 333

from private preschools). Among them, children who did not return the informed consent form (n = 31; 3.81%), those absent on the examination day (n = 55; 6.76%), or those with severe dental hypoplasia, serious systemic disease, or a fixed orthodontic appliance (n = 0) were excluded from the study. The final sample was composed of 728 5-year-old preschool girls and boys, out of which 428 were from public preschools and 300 from private preschools. Table 1 shows the distribution of 5-year-old preschool children according to the type of school and gender. A response rate of 89.5% was reached.

Examination methodology

Clinical examination was performed outdoors by a previously calibrated examiner, under natural light, using Community Periodontal Index (CPI) probes ('ball point'), mirrors #5 and air-drying. Before examination each child performed tooth brushing supervised by a dental hygienist and each tooth was dried using compressed air through a portable dental compressor (Proquest Delivery System, model 4010, Compressor Technologies LTD, Englewood, USA).

Calibration

A benchmark dental examiner ('Gold Standard'), skilled in epidemiological surveys, conducted the calibration process, which lasted 28 hours. Theoretical activities with discussions on diagnosis criteria of gingivitis, dental caries, initial lesion (IL) and orthodontic diagnosis were performed by the examiners. In the practical activities with clinical examinations and data analysis, the mean Kappa of inter-examiner reliability was 0.95 for gingivitis and 0.88 for both dental caries and IL. Approximately 10% of the sample was re-examined in order to verify intra-examiner reproducibility. Kappa values of 0.96 for gingivitis and 0.89 for dental caries and IL could be reached. For orthodontic diagnosis the inter- and intra-examiner reliability, assessed by percentage of agreement, were 82.0% and 95.5%, respectively.

Diagnostic criteria and codes

Gingivitis was evaluated by the use of the gingival alteration index for 5-year-olds according to the national survey carried out in 2002 in Brazil (Health Ministry of Brazil, 2004), in which any sign of bleeding that occurred in three or more teeth during clinical examination was regarded as a positive finding. The presence of gingival bleeding was examined by carefully passing a CPI probe with a 0.5 mm ball tip throughout the gingival sulcus margin, following the sequence: distal, buccal, mesial, lingual. Dental caries was registered using the dmft (total of decayed, missing and filled primary teeth) and dmfs (total of decayed, missing and filled primary surfaces) indexes, according to the World Health Organization (WHO) diagnostic criteria (WHO, 1997). ILs were also recorded on surfaces of teeth (Nyvad et al, 1999; Fyffe et al, 2000). An IL was defined as an active caries that, through visual assessment by a calibrated examiner, indicated intact surface, no clinically detectable loss of dental tissue, and a whitish/yellowish coloured area of increased opacity and roughness (when the probe was employed, its tip was moved gently across the surface). Active white spot lesions, micro cavities contiguous to sealants, restorations and cavitations were also recorded. The presence of crowding and spacing were also evaluated according to the Dental Aesthetic Index (Cons et al, 1986) and analysis for the presence of mouth breathing followed the national survey carried out in 2002 in Brazil (Health Ministry of Brazil, 2004).

Questionnaire

All children received a semi-structured questionnaire to be answered by their parents. This questionnaire collected information on the socioeconomic level of the children's families (monthly family income, number of people living in the household, parents' educational level, home ownership and car ownership).

Data analysis

The prevalence of gingivitis was analysed according to children and not by surfaces. The dependent variable gingivitis was dichotomised according to presence or absence of bleeding. Univariate analyses using the chi-square test (χ^2) at 5% significance level were performed to test the influence of independent variables (gender, monthly family income, number of people living in the household, parents' educational level, home ownership, public or private school, car ownership, dental caries, presence of IL, mouth breathing, crowding and spacing) on dependent variables. Then, multiple logistic regression analyses using the stepwise procedure were performed in order to identify the risk indicators of gingivitis. Only the independent variables

Table 2 Association of gingival bleeding (dichotomisation by bleeding or no bleeding) with socio-economic, clinical, and gender variables related to oral health. Piracicaba, Brazil, 2005

Variables	Gingival bleeding					
	No bleeding		Bleeding			
	n	%	n	%	χ^2	p
Gender					6.87	0.0087
Female	315	87.02	47	12.98		
Male	292	79.78	74	20.22		
Monthly family income					15.82	< 0.0001
≤ 4 Minimum wages*	335	79.20	88	20.80		
> 4 Minimum wages	230	90.91	23	9.09		
Number of people living in the household					28.60	< 0.0001
≤ 4 people	401	88.91	50	11.09		
> 4 people	176	73.03	65	26.97		
Father's education					11.62	0.0007
≤ 8 years of schooling	182	78.79	49	21.21		
> 8 years of schooling	265	89.53	31	10.47		
Mother's education					12.55	0.0004
≤ 8 years of schooling	225	77.59	65	22.41		
> 8 years of schooling	339	87.82	47	12.18		
Home ownership					0.37	0.5399
Yes	293	84.20	55	15.80		
No	282	82.46	60	17.54		
Type of school					19.55	< 0.0001
Public preschool	335	78.27	93	21.73		
Private preschool	272	90.67	28	9.33		
Dental caries					11.19	0.0008
0 (no)	394	64.91	59	48.76		
> 0 (yes)	213	35.09	62	51.24		
Initial lesion					16.90	< 0.0001
0 (no)	449	87.02	67	12.98		
> 0 (yes)	158	74.53	54	25.47		
Crowding					7.72	0.0054
0 (no)	447	85.80	74	14.20		
1 (yes)	160	77.29	47	22.71		
Spacing					9.64	0.0019
0 (no)	24	64.86	13	35.14		
1 (yes)	583	84.37	108	15.63		
Mouth breathing					0.99	0.3196
0 (no)	311	84.74	56	15.26		
1 (yes)	296	81.99	65	18.01		

* Minimum wage at the time of the data collection ≡ US $101.02.

with significant association at $p < 0.15$ were selected for the regression analysis, thus, eliminating the ones that would make little contribution to the model. The logistic regression models were used to estimate the adjusted Odds Ratios (OR), their 95% confidence intervals (CI) and significance levels. All statistical tests were performed by the use of the SAS software (SAS, 2001) at 5% significance level.

RESULTS

The prevalence of gingivitis in the present study was 16.6%. Only the children whose parents completed the questionnaire were included in the univariate analysis in Table 2, which shows bivariate associations of independent variables with gingival bleeding under the chi-square test. Monthly family income ($p <$

0.0001), father's educational level ($p < 0.0007$), mother's educational level ($p = 0.0004$), type of school ($p < 0.0001$), car ownership ($p = 0.0854$), gender ($p = 0.0087$), IL ($p < 0.0001$), dental caries ($p = 0.0008$), crowding ($p = 0.0054$) and spacing ($p = 0.0019$) were significantly associated with gingival bleeding ($p < 0.15$) and, therefore, selected for the multiple regression analysis. Among them, monthly family income of up to 4 Brazilian minimum wages, presence of IL, presence of crowding and male gender were risk indicators of gingivitis in primary teeth as shown by the logistic model (Table 3). Children whose parents had a low monthly family income were 2.27 times more prone to have gingival bleeding than those whose parents presented a higher income ($p = 0.0008$). Children with one or more IL were 2.05 times more likely to have gingivitis in comparison with those free of IL ($p < 0.0001$).

DISCUSSION

The present study evaluated the prevalence of gingivitis and its risk indicators in a random sample of 728 five-year-old preschool children. The response rate of 89.5% was considered high.

The results demonstrated a prevalence of gingivitis of 16.6% in 5-year-olds in Piracicaba. A previous oral health survey conducted in Piracicaba in 1999 had shown that 68.6% of the 5-year-olds from public preschools presented the disease (Cypriano et al, 2003). As described by some researchers, the disease has been affecting from 75.5% to 98.1% of the children (Jahn and Jahn, 1997; Moraes and Valença, 2003). International data demonstrate that gingivitis has been detected in 66.2% of the preschool children in Jordan (Sayegh et al, 2005). The prevalence of gingivitis identified in this study is much lower than that observed in the literature. However, the criteria used in this study (Health Ministry of Brazil, 2004) to classify a child with gingivitis was the presence of bleeding in three or more teeth. Therefore, it is important to mention that comparison between different studies may be difficult due to the application of different criteria for recording the disease, which would probably lead to conflicting results (Moraes and Valença, 2003), and also to the diversity of samples from different geographic and socioeconomic conditions.

In relation to the present data, the results demonstrated an improvement in the gingival condition of 5-year-old preschool children in 2005 compared with the data from the epidemiological surveys in 1999. A reduction in the prevalence of gingivitis could be observed over time, which could be attributed mainly to the implementation of preventive oral health education measures that have been targeted to children in public preschools since the year 2000. Other possible explanations for the improvement in oral health are the widespread use of fluoride, in particular fluoride toothpaste, the changes in sugar consumption, the gradual improvement of oral hygiene level as well as life conditions and the easy access to oral health services.

The present study was also aimed at identifying the risk indicators of gingivitis among gender, socioeconomic and clinical variables. Gender was significantly associated with gingival bleeding and boys were more prone to have the disease than girls (Table 3). Studies on young children and adolescents have demonstrated that there is no general consensus about whether gender is a risk factor for periodontitis or not (Albandar and Rams, 2002). However, it has been reported that periodontal diseases are more prevalent in men than in women (Albandar, 2002). In fact, other researchers suggest that the greater disease prevalence in men can be associated to predisposing genetic factors (Reichert et al, 2002). Also, the prevalence of gingivitis in children has not been directly associated with the amount of plaque but with the bacterial content of the plaque and tissue factors of the host (Bimstein et al, 1985). Therefore, future studies should be carried out in order to add data to this field of enquiry.

In Table 2, gender, monthly family income, number of people living in the household, father's education, mother's education, type of school, spacing, crowding, dental caries and IL were significantly associated with gingival bleeding ($p < 0.15$) and were selected for the multiple regression analysis. Among them, male gender, presence of IL, presence of crowding and low monthly family income were risk indicators of gingivitis as shown by the logistic model (Table 3). Evidence from the literature has shown that children whose fathers present a low income have a high prevalence of gingivitis (Gesser et al, 2001; Maltz and Silva, 2001).

Among clinical variables, gingivitis was significantly associated with caries, which corroborated other reports (Grindefjord et al, 1993; Campus et al, 2001). However, this variable was not a risk indicator of gingivitis. In contrast, dental crowding was a risk indicator of the disease, and several studies have shown that dental crowding is negatively correlated with gingival bleeding (Glans et al, 2003; Staufer and Landmesser, 2004).

The presence of one or more IL was associated with gingivitis and could be considered a risk indicator (Table 3). The children who presented initial caries lesion were more prone to have gingival bleeding. In fact, the development of an IL occurs in areas with biofilm

Table 3 Stepwise logistic regression with gingivitis as dependent variable. Piracicaba, Brazil, 2005

Variables	Presence of gingival bleeding n	%	OR	95% CI	p
Gender					
Female	47	12.98	reference	1.04–2.45	0.0298
Male	74	20.22	1.60		
Initial lesion					
0 (no)	67	12.98	reference	1.33–3.16	< 0.0001
> 0 (yes)	54	25.47	2.05		
Monthly family income					
> 4 Minimum wages*	23	9.09	reference	1.37–3.75	0.0008
≤ 4 Minimum wages	88	20.80	2.27		
Crowding					
0 (no)	74	14.20	reference	1.11–2.68	0.0124
1 (yes)	47	22.71	1.72		

* Minimum wage at the time of the data collection = US $101.02.

accumulation, especially in cervical regions near marginal gum. Thus, the presence of biofilm in such areas can favour the development of gingival inflammation as well as caries lesions. Although this study cannot assess whether IL is a risk factor for gingivitis, or the opposite, because it is a cross-sectional study, some investigations have shown gingivitis as a strong predictor of caries (Ogaard et al, 1994; Ekstrand et al, 1998; Matilla et al, 2002). Furthermore, the detection of initial caries lesion in epidemiological surveys is very important in order to demonstrate the need for preventive measures in the population studied, and could potentially reduce the prevalence of caries and gingivitis in the future (Assaf et al, 2004).

In conclusion, gingivitis prevalence in 5-year-old children attending preschools in Piracicaba was 16.6%, and family income up to 4 Brazilian minimum wages, presence of IL, presence of crowding and male gender were risk indicators of gingivitis in primary teeth.

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