Impact of gingivitis on Oral Health-Related Quality of Life in 12-years-old schoolchildren of Quito-Ecuador

Abstract

Purpose: Evaluate the impact of gingivitis on Oral health-related quality of life (OHRQoL) among 12-year-old schoolchildren from Quito, Ecuador. **Methods:** We evaluated 998 schoolchildren using the Community Periodontal Index for gingival bleeding and calculus. OHRQoL was assessed with the Child Perceptions Questionnaire 11-14 (CPQ_{11-14}) questionnaire. **Results:** Of the 998 schoolchildren, 93% had gingival bleeding and 73% had dental calculus. Schoolchildren with more than one sextant with gingival bleeding had 1.18 times higher mean CPQ_{11-14} (RR = 1.18, 95% CI = 1.11 to 1.27) than those with none or just one affected sextant. Male schoolchildren presented a 15% lower mean Child Perceptions Questionnaire (CPQ) (RT = 0.85; 95% CI = 0.76 to 0.96). Children whose parents had incomplete secondary education had a 15% lower mean CPQ (RT = 0.85; 95% CI = 0.77 to 0.94). Bleeding in more than one sextant was significantly associated with worse quality of life in the emotional well-being (RT = 1.40, 95% CI = 1.03 to 1.90) and social well-being domains (RT = 1.76, 95% CI = 1.32 to 2.34). **Conclusion:** <mark>Gingival bleeding negatively impacted</mark> the OHRQoL of 12-year-old Ecuadorian schoolchildren living in Quito.

Keywords: Gingivitis, periodontal diseases, quality of life, paedriatic

INTRODUCTION

Gingivitis is the most common form of periodontal diseases and is highly prevalent in children and adolescents (Du et al., 2019; Chen et al. 2020, Ortiz et al. 2022,Singh et al. 2022). Most investigations reveal that parental educational level, family size and toothbrushing frequency are associated with gingivitis in children and adolescents (Du et al., 2019; Chen et al. 2020, Ortiz et al., 2022,Singh et al., 2022).

There is evidence that gingivitis may have a negative impact on children´s oral health-related quality of life (OHRQoL) (Botero et al. 2015; Krisdapong et al. 2012; Krisdapong et al. 2012; Nanayakkara et al. 2013; De Stefani et al. 2019). OHRQoL is a multidimensional construct that reflects people's comfort when eating, sleeping, and engaging in social interaction; their self-esteem; and their satisfaction concerning their oral health (U.S. Department of Health and Human Services, 2000). The impact of gingivitis on OHRQoL may be explained by the children's perception of the clinical signs of gingivitis. In other words, the perception of gingival edema and bleeding could impact the emotional

well-being domain of OHRQoL instruments by making them feel worried, dissatisfied, and frustrated (Tomazoni et al. 2014). Further, the clinical signs of gingivitis could be perceived by children´s friends or colleagues, which could impact the social well-being domain of instruments by affecting their social interactions in the school environment (Krisdapong et al. 2012; Maroneze et al. 2018). Importantly, 12-year-old children undergo social and psychological changes, which makes esthetics important to them (Maroneze et al. 2018; Ortiz et al. 20210

Some studies conducted in Latin America have observed that gingivitis may impact on children and adolescents' OHRQoL (Tomazoni et al. 2018; da Silva et al. 105; Ortiz et al. 2020), mainly on their emotional well-being (Tomazoni et al. 2014). However, these studies were conducted in Brazil; findings about this topic in other Latin American countries are scarce. Understanding the impact of gingivitis and other oral conditions on OHRQoL can justify the acquisition of public resources for oral health care, and the development of public health programs by promoting preventive measures (Ortiz et al. 2020). Moreover, population-based surveys must identify the associated individual and contextual factors whose modification can reduce the prevalence of gingival bleeding, which could result in public policies on controlling such factors for maintaining a good quality of life   (Kandelman et al. 2012). Therefore, the present study aimed to investigate the impact of gingivitis on the OHRQoL of 12-years-old scholars of public schools from the Metropolitan District of Quito.

MATERIALS AND METHODS

This was a population-based cross-sectional study with a representative sample of 12-year old children studying in public schools from the urban area of Quito, Ecuador. This publication is part of the "QUITO Oral Health Survey" (QUITO-OH Survey), a survey that assessed dental caries, traumatic dental injuries, malocclusion, gingival bleeding, presence of calculus, fluorosis and oral health-related quality of life (OHRQoL) (Michel-Crosato et al. 2019). The protocol was approved by the Institutional Review Board of the University of São Paulo and the Central University of Ecuador. Parents or legal guardians of the children were contacted and signed an informed consent. Further, children signed an assent form before their inclusion.

This manuscript was written following the recommendations of the guideline 'Strengthening the Reporting of Observational Studies in Epidemiology (STROBE)' (von Elm et al. 2014).

Setting, sample, participants

We examined 1,100 12-year-old children, randomly selected from public schools of the urban area of Quito, Ecuador. Details of the sampling method and sample size calculation can be found on the published protocol (Michel-Crosato et al. 2019). Only children that were born between April 2004 and March 2005 were included in the study. We excluded children whose parents or guardians did not sign

the consent form, children who did not agree to participate, children presenting or reporting systemic diseases and children who did not attend the days of the examinations.

Explanatory and Outcomes Variables

Six trained and calibrated examiners examined the children from March to May, 2017. We organized three teams consisting of two examiners, two note-takers, one interviewer and one assistant. Groups were organized according to the schools' geographic localization (Southern, Central and Northern Quito). To prevent selection bias, children were randomly selected before the clinical examination. Dentists who were not involved in the clinical examination applied the questionnaire; hence, they were not aware of the oral health conditions of the children. Likewise, the examiners who performed the clinical evaluations were unaware of the children's responses to the questionnaires.

Children were examined in their school environment, under artificial light, using sterilized dental mirrors and gauze pads to dry the teeth surfaces. We used the Community Periodontal Index (World Health Organization 1997) to assess the prevalence and extent of the periodontal condition. The examiners gently inserted (less than 20g of force) a ball-point periodontal probe in the sulcus of six sites per tooth (mesio-buccal, buccal, disto-buccal, disto-lingual, lingual and mesio-lingual) of teeth 2, 8, 14, 19, 24, and 30. They evaluated the sites for gingival bleeding (yes or no) and calculus (yes or no). We did not examine the presence of periodontal pocket, since this condition is not expected at this age. Participants with no gingival bleeding or with only one sextant with gingivitis were classified as children with no gingival bleeding. Children were classified as having gingival bleeding when 2 or more sextants presented this condition. Participant presenting any sextant with calculus were classified as having this condition.

Dental caries was evaluated calculating the number of decayed, missed and filled permanent teeth (DMFT) index and malocclusion was assessed by the Dental Aesthetics Index (DAI). Details about the other collected oral health variables, such as tooth loss, DMF-T, and DAI were previously described, as well as the description about the training and calibration of the examiners (Michel-Crosato et al. 2019).

In addition to the previously described oral health conditions, we gathered information about access to dental services, socioeconomic variables, school performance and OHRQoL.

We evaluated the children's OHRQoL with the short-version of Child Perceptions Questionnaire 11-14 (CPQ_{11-14}) (Jokovic et al. 2006). One examiner, not involved in the clinical examination, interviewed the children and applied the Latin-American Spanish version of CPQ_{11-14} (Abanto et al. 2013; Salinas-Martínez et al. 2014). This questionnaire evaluates four dimensions of quality of life: oral symptoms, functional limitations, emotional well-being and social well-being. Each domain contains four questions. The children reported the events' frequency in the last three months, with scores that varied between "never" to "every day or almost every day". The sum of the scores, which can range from 0 to 64, was calculated. The higher the total scores values, the worse the OHRQoL. The scores obtained in each domain were also analyzed as outcome variables.

Statistical analysis

Descriptive analysis was conducted to present the prevalence of gingivitis and presence of calculus, values obtained with the CPQ_{11-14} and the explanatory variables. The explanatory variables were: gingival bleeding, calculus, dental loss, DMFT, Dental Aesthetics Index, sex, family income, mother´s and father´s schooling, and person per room. Qualitative variables were summarized using the number and percentage, and quantitative variables were summarized with the mean and standard deviation.

We used multilevel Poisson regression to evaluate the impact of gingival bleeding and other explanatory variables on the main outcome variable, CPQ_{11-14}. Rate ratio (RR) values and respective 95% confidence intervals (95% CI) were calculated. The analysis was performed using robust variance to correct for possible overdispersion. Although no contextual variables were tested in this study, we used the multilevel approach to adjust for the cluster effect since the sampling was primarily based on schools. With this approach, we could also evaluate the effect of the cluster on the outcome by evaluating the random effects of the multilevel models.

First, we conducted univariate analyses, in which each variable was analyzed separately. For the multiple analysis, the association between gingival bleeding and quality of life was adjusted to demographic and socioeconomic variables of each child and other oral conditions (dental caries, traumatic dental injuries and malocclusion). We built different multiple models. The first model included only variables related to the gingival conditions. The second analysis included other variables related to oral health (dental caries, tooth loss and malocclusion). Finally, a third multiple model was built, which included socioeconomic variables. The analyses were performed with the total scores and with specific domains of the CPQ_{11-14} questionnaire.

All analyses were conducted using the statistical package Stata 13.0 (Stata Corporation, College Station, TX, USA), and the significance level was set at 5%.

RESULTS

At first, 33 schools from the urban zone of Quito were randomly selected. Two school coordinators claimed that the research could disrupt the school´s routine. Thus, 1,100 children were randomly selected from the remaining 31 schools. Among these students, 998 children were examined between March and May 2017. The reasons for non-participation were not returning the consent form (96 children), absence on the day of examination (4 subjects) and refusal to be examined (2 children). One scholar did not respond to the CPQ_{11-14}. Thus, 997 scholars were included in this study, with a positive response rate of 90.6%. The overall agreement among the examiners for gingival bleeding was 92.2% (Kappa 0.733, 95% CI 0.65 to 0.82), and for presence of calculus was 92.5%, with a kappa value of 0.85 (95%CI = 0.79 to 0.89).

From 997 participants, 55.5% were female. Around 54% of families had a family income higher than 1 Ecuadorian minimum wage (EMW). Moreover, the majority of children's mothers and fathers had at least more than 8 years of formal education. The prevalence of children with more than 1 sextant with

gingival bleeding was 89.1%, and children with calculus represented 73.6% of the sample included. Details of the distribution for each independent variable can be observed in the Table 1.

Table 1 also displays the descriptive statistics of the CPQ_{11-14} total scores for each variable, as well as, univariate regression analyses among these variables and the outcome. Scholars who had more than one sextant with gingival bleeding presented an 18% higher mean CPQ_{11-14} (RR = 1.18; 95% CI= 1.11 - 1.27), compared to those who had none or just one sextant involved. Similarly, children who presented tooth loss, DMF-T > 4 and severe / handicapping malocclusion presented significantly higher CPQ_{11-14} total scores. Moreover, a greater impact in oral health related quality of life was associated with the mother´s and father´s educational level and the number of persons living per room. Male scholars exhibited a 15% lower CPQ mean.

In the regression model adjusted for only periodontal conditions (gingival bleeding and presence of calculus), we observed that presence of gingival bleeding in more than one sextant is significantly associated with a greater impact in OHRQoL. On the other hand, presence of calculus was not associated with the OHRQoL (model 1, Table 2). These tendencies were maintained when the model was adjusted by other oral health conditions (model 2, Table 2). In this model, children with DMFT higher than 4, children with tooth loss and with malocclusion also presented significant association with a more negative impact on OHRQoL (Table 2).

In the final model, including socioeconomic variables, children presenting gingival bleeding in two sextants or more, the CPQ_{11-14} total scores were around 15% higher than in children with no gingival bleeding (model 3, Table 2). Other variables were also significantly associated with higher total scores (Table 2). Considering the random effects of the model, we observed that the variance partition coefficient is significant, denoting that part of variance is attributable to between-school differences. However, the contextual variance values did not present significant differences comparing all regression models (Table 2).

The impact of gingival bleeding on the CPQ_{11-14} domains is presented in Table 03. Scholars who presented one or more sextants with gingival bleeding exhibited a 40% higher mean score of the emotional well-being domain than those with up to one sextant. Likewise, gingival bleeding in more than one sextant was associated with 76% higher social well-being score. Scholars with dental calculus presented CPQ11-14 total scores 14% lower, when compared with the ones without dental calculus, in the functional limitation domain (Table 3).

DISCUSSION

We observed that gingival bleeding exerted a negative impact on the children's quality of life, even in the adjusted models. The negative impact of gingivitis on the children´s OHRQoL can be explained by their self-perception of the clinical signs of gingivitis, such as edema, redness and bleeding

of the gums, which can affect their self-esteem, self-confidence and social interactions (Nanayakkara et al. 2013).

Our results agree with other studies that observed the impact of gingivitis on the quality of life of scholars (Tomazoni et al. 2014; Castro et al. 2011; Paula et al. 2012). A Thailand epidemiological survey with 12 and 15 years-old adolescents used Child-Oral Impacts on Daily Performances (Child-OIDP) [Gherunpong et al., 2004] and Oral Impacts on Daily Performances (OIDP) (Adalyanon and Sheiham, 1997) questionnaires and demonstrated that gingivitis and the presence of calculus influenced psychosocial aspects of 12 years-old children (Krisdapong et al. 2012; Krisdapong et al. 2012). The authors observed that gingivitis was the most common oral disease (80%) in 12 years-old children and it was associated with psychosocial daily life performances, such as smiling, study and social contact. Likewise, our results showed that gingivitis had a negative impact in the CPQ_{11-14} scores in social and emotional well-being domains, which means that it can negatively affect the adolescent's self-esteem and social interaction. Moreover, gingival bleeding can worsen daily hygiene practices, such as tooth brushing, and modify children's perception of oral health (Tomazoni et al. 2014). Furthermore, in agreement with our results, Krisdapong et al. (2012) found that gingivitis presented greater impact on the quality of life than the presence of calculus.

We also evaluated aspects such as socioeconomic and demographic data. We observed that lower family income and level of parents' education were associated with a greater impact in oral health related quality of life. These findings agree with a previous study with 12 years-old Brazilian schoolchildren, which showed that low socioeconomic background worsened OHRQoL [Sfreddo et al., 2019]. Two explanations can support this finding (Moor et al. 2017). First, lower socioeconomic status can lead to limited access to material resources, such as health services (Fernandes et al. 2010), resulting in worse oral clinical conditions. The second possible reason is that socioeconomic status influences health behavior (Lee et al. 2020). People with lower socioeconomic status experience more stress and lower social support, which can result in worse oral outcomes. Like other published studies that have demonstrated an association between socioeconomic factors, such as mother's education (Paula et al. 2012; Piovesan et al. 2010), family income (Sfreddo et al. 2019) and household overcrowding (Paula et al. 2012), our results pointed out the importance of evaluating socioeconomic characteristics and demonstrated the importance of addressing these factors in oral health interventions.

Male scholars presented a 14% lower CPQ mean than females. This finding agrees with the literature and can be explained by the fact that girls are more conscious and concerned about oral health (Sfreddo et al. 2019; Gururatana et al. 2014; Anthony et al. 2018). Besides, gingival redness and swelling can alter its appearance and women are usually more worried about aesthetic-related health than men (Anthony et al. 2018; Stucliffe, 1972). This result can also be explained by hormonal differences. Some studies demonstrated that girls frequently present a peak of gingivitis earlier than boys (approximately 11 years old for girls and 13 years old for boys) (Stucliffe, 1972; Mombelli et al. 1990). Considering that our study included 12 years-old adolescents, the higher impact of gingivitis in female scholars could be explained by the fact that girls presented a higher prevalence and extension of gingival bleeding.

Gingivitis was diagnosed by the presence of bleeding on probing, as per the methodology from previously published studies (Krisdapong et al. 2012, Krisdapong et al. 2012; Tomazoni et al. 2014). Other clinical characteristics, such as gingival redness and swelling, were not considered. Edema, gingival color alteration and gingival bleeding in adolescents aged 11 to 16 years were evaluated in a previous study (Maromeze et al. 2018). They described that edema and gingival bleeding in the anterior region was associated with worse CPQ_{11-14} scores. Thus, other clinical symptoms of gingivitis could have an influence in OHRQoL and these characteristics should be considered in future investigations. Also, it is necessary to consider that gingival bleeding could have been a consequence of an excess of pressure during probing. However, all examiners were previously trained and calibrated in our study. Thus, it is unlikely that bleeding on probing could be the result of excessive force during probing.

One limitation of our study is its cross-sectional design. Cross-sectional studies cannot be used to infer causality, because the exposure (gingivitis) and the outcome (worse quality of life) are simultaneously assessed. However, it is important to emphasize that this type of study is necessary to identify the frequency of oral conditions from specific populations and to identify the relevant variables that should be considered in future prospective investigations. Since this was the first survey conducted on a representative sample of 12-year old adolescents from Quito, we believe that our results bring important new information that can be used in the prevention and treatment of oral conditions in this group. Randomized controlled trials should be conducted to evaluate the impact of the prevention and treatment of gingivitis on the children's quality of life.

Conclusion

Considering the limitations of the present study, we observed that gingivitis negatively impacted the quality of life of 12 years-old Ecuadorian school children living in Quito.

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