






Gingivitis influences oral health-related quality of life in adolescents: findings from a cohort study

A gengivite influencia a qualidade de vida relacionada à saúde bucal de adolescentes: achados de um estudo de coorte

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ABSTRACT: *Introduction:* Oral health-related quality of life (OHRQoL) is affected by different clinical conditions. The aim of this study was to evaluate the impact of gingivitis on OHRQoL in adolescents. *Methodology:* This cohort study consisted of a random sample of 1,134 schoolchildren enrolled during 2012, in Santa Maria, Brazil. After two years, 743 adolescents were follow-up (response rate: 65.5%). Clinical, socioeconomic and OHRQoL data were collected. OHRQoL was assessed by the short Brazilian version of the Child Perceptions Questionnaire 11-14 (CPQ11-14), and gingival bleeding through Community Periodontal Index. Gingivitis was considered with the presence of 15% or more bleeding sites. Poisson regression models were used to evaluate the association between gingivitis and overall and domain-specific CPQ11-14 scores. Prevalence of gingivitis at baseline was considered the main predictor for the OHRQoL at follow-up. *Results:* Gingivitis at baseline was associated with higher overall CPQ 11-14 score (RR = 1.07; 95%CI 1.01 – 1.14), and emotional well-being (RR = 1.17; 95%CI 1.04 – 1.31), independently of other oral conditions and socioeconomic variables. *Conclusions:* The findings indicate that gingivitis negatively impacts the adolescents' OHRQoL. Moreover, gender, maternal schooling and household income were also associated with OHRQoL.

Keywords: Oral health. Quality of life. Gingivitis. Adolescents. Longitudinal Studies.

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RESUMO: *Introdução:* Qualidade de vida relacionada à saúde bucal (QVRSB) é afetada por diferentes condições clínicas. O objetivo deste estudo foi avaliar o impacto da gengivite na QVRSB de adolescentes. *Metodologia:* Este estudo de coorte consistiu em uma amostra aleatória de 1.134 escolares iniciado em 2012, na cidade de Santa Maria, Brasil. Após dois anos, 743 adolescentes foram acompanhados (taxa de resposta: 65,5%). Dados clínicos, socioeconômicos e de QVRSB foram coletados. A QVRSB foi avaliada pela versão brasileira curta do *Child Perceptions Questionnaire* 11-14 (CPQ11-14) e o sangramento gengival foi coletado através do Índice Periodontal Comunitário. Gengivite foi considerada com o indivíduo apresentando 15% ou mais locais de sangramento. Os modelos de regressão de Poisson foram utilizados para avaliar a associação entre gengivite e os escores total e específico do domínio do CPQ11-14. A prevalência de gengivite na primeira avaliação foi considerada o preditor principal para a QVRSB no acompanhamento. *Resultados:* A gengivite no baseline foi associada à maior pontuação geral do CPQ 11-14 (RR = 1,07; IC95% 1,01 – 1,14) e ao domínio de bem-estar emocional (RR = 1,17; IC95% 1,04 – 1,31), independentemente das outras condições orais e variáveis socioeconômicas. *Conclusão:* Os achados indicam que a gengivite impacta negativamente a QVRSB de adolescentes. Além disso, sexo, escolaridade materna e renda familiar mensal também foram associados à QVRSB.

Palavras-chave: Saúde bucal. Qualidade de vida. Gengivite. Adolescentes. Estudos longitudinais.

INTRODUCTION

Oral health-related quality of life (OHRQoL) describes the individual's subjective perspective based on presented oral symptoms and experiences, allowing researchers to establish a relationship between oral and general health¹. Several questionnaires focused on measuring the OHRQoL of children and adolescents have been developed and used as a source of clinical indicators². These questionnaires also described as Patient-Reported Outcomes (PRO) instruments collect information based on patients' perceptions regarding specific oral symptoms or general concepts, such as functional limitations, emotional and social well-being. In this sense, PRO instruments have assisted clinicians not only to find better oral therapies, but also to evaluate patient treatment outcomes³.

Most children and adolescents have adverse oral conditions, such as gingival bleeding, calculus, or dental plaque⁴. Gingivitis is an oral condition prevalent among children and adolescents⁵. In Brazil, national survey data indicate a prevalence of 27.1% of children and 33.8% of adolescents with gingival bleeding⁶.

Some studies reported negative impact of poor dental status on quality of life^{7,8}, as well as impact from dental trauma⁹, malocclusion¹⁰ and dental caries¹¹. Studies observed that self-reported gingival bleeding have a negative impact on the quality of life of adolescents^{12,13}. Gingivitis causes clinical symptoms such as edema and marginal bleeding, affecting esthetics and psychosocial behaviors. In addition, individuals can be upset, impairing their social relationships by affecting their self-esteem and OHRQoL¹⁴. Previous study¹⁵ also observed that children with gingival bleeding had higher overall CPQ11-14 scores

and domain-specific scores than their counterparts. Nevertheless, a national study with Thailand's young population found significant association only between extensive form of periodontal disease (PD) and OHRQoL in the 15 years-old groups¹⁶. Similarly, a systematic review showed that severe and extensive PD negatively impacted the OHRQoL¹⁷. However, the above mentioned studies have been mostly cross-sectional, with few assessing its influence on adolescents, and it is not possible to observe the exclusive effect of gingivitis on OHRQoL.

Understanding the impact of gingivitis and other oral conditions, such as caries and malocclusion, on OHRQoL can facilitate the acquisition of public resources for oral health care, and the development of public health programs by promoting preventive measures. Therefore, this study aimed to evaluate longitudinally the impact of gingival bleeding on oral health-related quality of life among adolescents.

METHODOLOGY

STUDY DESIGN AND SAMPLE

A longitudinal study was carried out with 12 years-old schoolchildren in Santa Maria, a southern of Brazil, in 2012. The city had 261,031 inhabitants, and nearly 85% of the 12-year-old adolescents were enrolled in city public schools, according to the Brazilian Institute of Geography and Statistics¹⁸. A two-stage sampling procedure considered 20 from a total of 39 public schools in all five administrative areas of the city. Only individuals who were physically and psychologically able to answer the questionnaire and those whose parents or guardians signed their participation authorization were included in the sample.

Sample size was calculated considering the following parameters¹⁵: prevalence of children with poor OHRQoL of 69.7%; ratio of unexposed to exposed of 3:1; prevalence ratio of ≥ 1.5 ; design effect of 1.6; and 30% to possible losses. The minimum sample was of 440 children. Because this is a larger study, the final sample consisted of 1,134 12-year-old schoolchildren. Clinical, socioeconomic, demographic and subjective variables were collected. A second examination was performed after two years (2014) with those adolescents who agreed to participate.

DATA COLLECTION

Clinical oral examinations and structured interviews were conducted by trained and calibrated examiners and trained interviewers, using standardized procedures in both assessments. The same methodological protocol was carried out in 2012 and 2014. The training and calibrating process totalized 36 hours, including theoretical explanation

of the diagnostic criteria, and clinical assess of different levels of oral health disorders. Subsequently, 20 adolescents were clinically examined twice with an interval of 2 weeks between each examination. These adolescents not were included in the final sample. The agreement values for dental caries, malocclusion, and dental trauma were above 0.70 ($\kappa > 0.70$).

Clinical data was collected using a Community Periodontal Index probe, plane dental mirror, and gaze under natural light, at the school. Clinical exams include gingival bleeding, dental caries, dental trauma, malocclusion, calculus, and dental plaque. The Community Periodontal Index (CPI) was used to assess gingival bleeding⁶. Six gingival sites per tooth were examined in all available teeth. Presence of 15% or more of sites with gingival bleeding was used as a threshold for classifying gingivitis¹⁵. The Decayed, Missing and Filled Surface Index (DMFS)¹⁹ was performed to assess dental caries. Prevalence of untreated dental caries was recorded by the 'D' component ($D \geq 1$) of the index¹³; and adolescents who presented at least one carious tooth were included in the untreated dental caries category. The prevalence of malocclusion was assessed according to the Dental Aesthetic Index (DAI) criteria and recorded as "present" (those with DAI scores > 25 points) or "absent" ($DAI \leq 25$)²⁰. Dental calculus and dental plaque were examined as present or absent in all teeth.

Socioeconomic and demographic characteristics were obtained through a questionnaire answered by parents. It includes information on: gender, skin color, parents' schooling and household income. Skin color was classified according to the Brazilian Institute of Geography and Statistics¹⁸ and dichotomized as "white" and "non-white". The parents' schooling was assessed according to years of schooling and dichotomized as ≥ 8 years and < 8 years (primary school). Household income was collected through the family income received on the last month, and subsequently were dichotomized according to the median of the distribution, corresponding to 1.6 Brazilian Minimum Wages (BMW) (approximately US\$ 450 on the baseline). The feasibility of the questionnaire was assessed in a sample of 20 parents who were not included in the final sample.

The short form of the Brazilian version of the Child Perception Questionnaire 11–14 (CPQ11–14)²¹ assessed OHRQoL in the participants. The questionnaire was applied in a face-to-face interview at the school, and prior to clinical examination. The CPQ11–14 structurally comprises 16 questions classified in four domains:

- oral symptoms: 4 questions;
- functional limitations: 4 questions;
- emotional well-being: 4 questions;
- social well-being: 4 questions.

The questions refer to the last three months, and had five possible answers, ranging from "never" to "every day". The scores were computed by adding all the points for each domain, and the total score ranged from 0 to 64; higher values correspond to worst OHRQoL status.

DATA ANALYSIS

Data were analyzed using statistical software Stata 14.0 (Stata Corporation, College Station, TX, USA). Outcomes were overall and domain-specific CPQ11–14 scores at follow-up (2014). The main predictor variable was gingivitis, which was dichotomized as either present (bleeding in 15% or more of sites) or absent (bleeding in < 15% of sites) at baseline (2012)¹⁵. Unadjusted analyses provided summary statistics assessing the association between the covariates and outcome. Models were fitted by Multivariable Poisson Regression analysis to assess the association between gingivitis and OHRQoL on the follow-up, after adjusted for all demographic, socioeconomic and clinical covariates. This strategy allowed for the estimation of Rate Ratios (RRs) among comparison groups, and their respective 95% confidence intervals. The RRs were calculated as the ratio of the arithmetic mean of CPQ11–14 scores between the exposed and unexposed groups.

ETHICS

The study protocol was approved by the Committee of Ethics in Research of the Universidade Federal de Santa Maria (2012) and by the Faculty of Public Health of Universidade de São Paulo (2014) (protocol number 0127.0.243.000-11 at 2012 and 30613714.0.0000.5421 at 2014). All the adolescents consented to participate, and their parents signed a term of consent before data collection. Adolescents who were diagnosed with oral problems were referred to and offered dental treatment.

RESULTS

A total of 1,134 12-year-old schoolchildren were enrolled at baseline (2012), and 743 adolescents were followed up in 2014. The response rate was 65.5%. Drop-outs occurred due to refusals on the second examination ($n = 162$), and participants that were not found ($n = 229$).

The mean age was 14.35 years at follow-up. In 2012, participants were predominately female, white skin color, almost half of the sample had a household income > 1.6 BMW, and parents with high schooling level (≥ 8 years). Approximately 42% of the participants presented untreated caries and malocclusion, and the prevalence of gingivitis was 26.24% (Table 1).

The description of overall and domain CPQ 11–14 scores are presented in Table 1. The mean of overall CPQ 11–14 scores was 9.34, standard deviation (SD) of 7.30 (range of 0 to 47) on the follow-up. The emotional well-being domain had the largest variation (range of 0 to 16). Additionally, the oral symptoms domain had the highest mean 3.36 (SD = 2.36), and the social well-being domain had the lowest mean 1.37 (SD = 1.97) on the follow-up.

Table 1. Individual characteristics of the sample from Santa Maria, Brazil, 2012 e 2014.

Variables	Baseline n (%)	Follow-up n (%)
Gender		
Female	610 (53.79)	390 (52.49)
Male	524 (46.21)	353 (47.51)
Skin color		
White	863 (76.10)	574 (77.25)
Non-white	271 (23.90)	169 (22.75)
Household income		
≥ 1.6 BMW	556 (53.67)	371 (68.96)
< 1.6 BMW	480 (46.33)	167 (31.04)
Maternal schooling		
≥ 8 years	702 (64.76)	406 (68.24)
< 8 years	382 (35.24)	189 (31.76)
Paternal schooling		
≥ 8 years	628 (60.74)	357 (63.19)
< 8 years	406 (39.26)	208 (36.81)
Gingival bleeding		
< 15% sites	851 (75.04)	532 (72.09)
≥ 15% sites	283 (24.96)	206 (27.91)
Untreated dental caries		
Absent	657 (57.94)	410 (55.18)
Present	477 (42.06)	333 (44.82)
Malocclusion		
Absent	651 (57.46)	374 (50.61)
Present	482 (42.54)	365 (49.39)
CPQ (overall)	10.24 (7.59)*	9.34 (7.30)*
Oral symptoms	3.48 (2.51)*	3.36 (2.36)*
Functional limitation	2.46 (2.42)*	2.44 (2.52)*
Emotional well-being	2.67 (3.05)*	2.16 (3.15)*
Social well-being	1.62 (2.11)*	1.37 (1.97)*

BMW: Brazilian minimum wage (approximately US\$450 during the data gathering period at baseline); *mean (standard deviation).

In the unadjusted analysis, adolescents with gingivitis ($\geq 15\%$ sites) were associated to the CPQ11–14 overall score, emotional and social well-being domains ($p = 0.00$). The mean CPQ11–14 for adolescents with $< 15\%$ sites with gingival bleeding was 9.04 ($SD = 7.21$) and for those with $\geq 15\%$ sites with gingival bleeding was 10.21 ($SD = 7.53$) (data not showed).

Table 2 shows the Poisson regression unadjusted analysis. OHRQoL (overall) was related to all covariates. Adolescents with $\geq 15\%$ sites with bleeding had higher scores on the emotional ($RR = 1.29$; $95\%CI 1.16 - 1.43$) and social well-being ($RR = 1.26$; $95\%CI 1.10 - 1.44$) domains.

Table 2. Multivariable unadjusted assessment of overall Child Perceptions Questionnaire 11-14 (CPQ11-14) scores on follow-up associating dental clinical and socioeconomic variables at baseline (2012). Santa Maria, Brazil.

Variables	CPQ (overall scale)*	Domain			
		Oral symptoms*	Functional limitation*	Emotional well-being*	Social well-being*
Gender					
Female	1	1	1	1	1
Male	0.78 (0.74 – 0.82)	0.88 (0.81 – 0.95)	0.63 (0.57 – 0.69)	0.81 (0.73 – 0.89)	0.79 (0.70 – 0.89)
Skin color					
White	1	1	1	1	1
Non-white	1.12 (1.06 – 1.18)	1.00 (0.91 – 1.10)	0.99 (0.88 – 1.10)	1.38 (1.24 – 1.53)	1.26 (1.10 – 1.45)
Household income					
≥ 1.6 BMW	1	1	1	1	1
< 1.6 BMW	1.15 (1.09 – 1.21)	1.03 (0.95 – 1.12)	1.06 (0.96 – 1.17)	1.47 (1.33 – 1.63)	1.16 (1.02 – 1.31)
Maternal schooling					
≥ 8 years	1	1	1	1	1
< 8 years	1.20 (1.14 – 1.26)	1.04 (0.96 – 1.13)	1.16 (1.05 – 1.27)	1.54 (1.40 – 1.70)	1.18 (1.04 – 1.34)
Paternal schooling					
$< 15\%$ sites	1	1	1	1	1
$\geq 15\%$ sites	1.13 (1.07 – 1.19)	1.04 (0.96 – 1.14)	1.03 (0.93 – 1.15)	1.29 (1.16 – 1.43)	1.26 (1.10 – 1.44)

Continue...

Table 2. Continuation.

Variables	CPQ (overall scale)*	Domain			
		Oral symptoms*	Functional limitation*	Emotional well-being*	Social well-being*
Untreated dental caries					
Absent	1	1	1	1	1
Present	1.09 (1.05 – 1.15)	1.01 (0.94 – 1.10)	1.09 (0.99 – 1.19)	1.26 (1.14 – 1.39)	1.06 (0.93 – 1.20)
Malocclusion					
Absent	1	1	1	1	1
Present	1.18 (1.12 – 1.23)	0.99 (0.91 – 1.07)	1.05 (0.96 – 1.15)	1.51 (1.37 – 1.66)	1.50 (1.32 – 1.69)

*Unadjusted multivariable Poisson regression model, shown as rate ratio (95% confidence interval); BMW: Brazilian minimum wage (approximately US\$ 450 during the data gathering period at baseline); CPQ: Child Perceptions Questionnaire.

After adjustment, gingivitis was associated with overall CPQ11–14 score (RR = 1.07; 95%CI 1.01 – 1.14) and the emotional well-being domain (RR = 1.17; 95%CI 1.04 – 1.31). Adolescents who had gingivitis at baseline reported worse OHRQoL on the follow-up. Malocclusion was also a clinical condition related to higher CPQ11–14 scores in the overall score (RR = 1.18; 95%CI 1.12 – 1.24). In addition, demographic and socioeconomic variables related to CPQ11–14 were: gender, maternal schooling and household income (Table 3).

DISCUSSION

This cohort assessed the influence of gingivitis on the OHRQoL of the adolescents. The results indicated that gingivitis in childhood had a significant impact on adolescents' self-perceived quality of life. According to our understanding, this was the first study to evaluate the longitudinal impact of gingivitis on the OHRQoL of adolescents.

In the present study, gingivitis was associated with OHRQoL in the CPQ11–14 overall score, and in the emotional well-being domain. Gingivitis is the most common periodontal disease in children and adolescents. The association between gingivitis and OHRQoL can be explained by esthetic self-perception. Gingivitis presents clinical signs, such as redness and swelling of the gums, that may affect self-esteem and social interactions due to negative impacts on smiling, studying, and the self-perception of oral health needs^{15,22}. Otherwise, individuals who are satisfied with their appearance are more self-confident and have more self-esteem. Self-esteem is closely related to the emotional well-being. It has been associated with better OHRQoL, and adolescents' adherence to treatment in the future²³.

Table 3. Multivariable adjusted assessment of overall Child Perceptions Questionnaire 11-14 (CPQ11-14) scores on follow-up associating dental clinical and socioeconomic variables at baseline (2012). Santa Maria, Brazil.

Variables	CPQ (overall scale)*	Domain			
		Oral symptoms*	Functional limitation*	Emotional well-being*	Social well-being*
Gender					
Female	1	1	1	1	1
Male	0.77 (0.73 – 0.81)	0.89 (0.81 – 0.96)	0.62 (0.56 – 0.69)	0.77 (0.69 – 0.86)	0.80 (0.71 – 0.92)
Skin color					
White	1	1	1	1	1
Non-white	0.98 (0.92 – 1.04)	0.96 (0.86 – 1.06)	0.92 (0.81 – 1.04)	1.03 (0.91 – 1.17)	1.05 (0.90 – 1.23)
Household income					
≥ 1.6 BMW	1	1	1	1	1
< 1.6 BMW	1.08 (1.02 – 1.14)	1.04 (0.95 – 1.13)	1.01 (0.91 – 1.12)	1.28 (1.14 – 1.43)	1.03 (0.90 – 1.19)
Maternal schooling					
≥ 8 years	1	1	1	1	1
< 8 years	1.13 (1.07 – 1.20)	1.03 (0.94 – 1.13)	1.14 (1.03 – 1.27)	1.29 (1.16 – 1.45)	1.12 (0.97 – 1.29)
Gingival bleeding					
< 15% sites	1	1	1	1	1
≥ 15% sites	1.07 (1.01 – 1.14)	1.04 (0.95 – 1.15)	0.98 (0.88 – 1.10)	1.17 (1.04 – 1.31)	1.14 (0.99 – 1.32)
Untreated dental caries					
Absent	1	1	1	1	1
Present	1.05 (1.00 – 1.11)	0.98 (0.90 – 1.07)	1.10 (0.99 – 1.22)	1.14 (1.03 – 1.27)	1.00 (0.88 – 1.15)
Malocclusion					
Absent	1	1	1	1	1
Present	1.18 (1.12 – 1.24)	0.99 (0.91 – 1.08)	1.07 (0.97 – 1.19)	1.47 (1.33 – 1.64)	1.51 (1.32 – 1.72)

*Adjusted multivariable Poisson regression model, shown as rate ratio (95% confidence interval); BMW: Brazilian minimum wage (approximately US\$ 450 during the data gathering period at baseline; CPQ: Child Perceptions Questionnaire.

Thus, adolescents may be more likely to feel worried or upset about their oral health status due to gingivitis, which can affect other areas of their life.

There are different clinical parameters to detect periodontal diseases, its extent and the grade of the disease²⁴. Although we used a common index for diagnosis of gingivitis (CPI)²⁵, few studies evaluate the effect of periodontal diseases in its initial phase on OHRQoL, making it difficult to compare. The majority of studies showed the negative impact of dental caries, malocclusion and dental trauma on OHRQoL⁹⁻¹¹. Some studies have evaluated the impact of periodontal disease on quality of life. However, most did not consider gingival bleeding as a clinical parameter.

Nevertheless, our findings are in accordance with previous studies, which observed association between gingivitis and negative impacts on OHRQoL in adolescents^{12,15,16,22}. An oral health survey carried out with Thai population showed that gingivitis was associated with impact on smiling, studying and social contact in 12-year-olds, and with impact on smiling in 15-year-olds²². The presence and extent of gingival bleeding was associated mainly with emotional limitation domains of the CPQ11–14¹⁵. Additionally, a systematic review showed an association between periodontal diseases (gingivitis and periodontitis) and OHRQoL¹⁷. However, it was not possible to analyze the isolated effect of gingivitis in that population.

The participants with lower household income and whose mother had fewer years of formal education (< 8 years) had higher CPQ11–14 overall scores than their counterparts. Individuals with lower socioeconomic condition have difficulties accessing health services, hygiene amenities, and social resources in general; which influence tooth brushing, health-related behavior, and worst oral health status. Furthermore, gingivitis is a disease affected by oral hygiene, and there is a socioeconomic gradient for its occurrence, that is, low income and low schooling determine high levels of disease^{26,27}.

Females had worse OHRQoL than males. It is assumed that girls are more likely to report higher impact on their OHRQoL, despite brushing their teeth more often than their counterparts²⁸. Females are more engaged in health behaviors and less exposed to risk factors²⁴. Thus, females have greater health care and a more detailed self-perception of their conditions, and consequently perceive a worse OHRQoL than boys, being more demanding with their health status.

Our study presents some limitations and highlights. The main limitation is the response rate at follow-up (65.5%). However, as a longitudinal study, drop-outs are expected since it is difficult to stay in touch with all participants. In addition, the CPQ11–14 questionnaire did not provide specific issues of gingival disease. Previous studies have already used generic questionnaires to measure the negative effect of periodontal diseases on OHRQoL^{15,22}. Another limitation is that gingivitis can be a transient disease. Despite this, gingivitis was prevalent in the same schoolchildren at baseline and follow-up in our sample, and its incidence was low. Our study highlighted the role of gingival health in adolescents' OHRQoL. In this sense, OHRQoL measures supplementary normative indicators, and it can improve dental services planning. Therefore, future research with a path analysis would be essential in order to know by which ways gingivitis in childhood can influence the quality of life in adolescence.

CONCLUSION

The findings of this study showed that gingivitis negatively impact the adolescents' OHRQoL, independent of other oral conditions and socioeconomic disparities. These results are important in the planning of public policies that attempt to reduce the consequences of inequalities in oral health for adolescents, and society as a whole.

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