
Article:
Alwadi, M.A.M. and Vettore, M.V. (2017) Are school and home environmental characteristics associated with oral health-related quality of life in Brazilian adolescents and young adults? Community Dentistry and Oral Epidemiology, 45 (4). pp. 356-364. ISSN 0301-5661

https://doi.org/10.1111/cdoe.12298

Title: Are school and home environmental characteristics associated with oral health-related quality of life in Brazilian adolescents and young adults?

Running head: Contextual factors and oral health impacts

Authors
Maram Ali M Alwadi[1,2]
Mario Vianna Vettore[1*]

Affiliation:
1. Unit of Dental Public Health, School of Clinical Dentistry, University of Sheffield
Address:
19 Claremont Crescent
School of Clinical Dentistry
University of Sheffield
Sheffield, UK
S10 5SX

2. Department of Dental Health , College of Applied Medical Sciences, King Saud University
Address:
College of Applied Medical Sciences
King Saud University
Riyadh, Saudi Arabia

*** Corresponding Author**
Email address: m.vettore@sheffield.ac.uk
Telephone: +44-0114-22653265
Fax: +44-0114-2717843

Abstract

Aim: The aim of this study was to test the association of contextual school and home environmental characteristics and individual factors with oral health-related quality of life (OHRQoL) in a representative sample of Brazilian adolescents and young adults.

Methods: Individual-level data from 3854 15-19-year-olds who participated in the Brazilian Oral Health Survey were pooled with contextual city-level data. The dependent variable was the frequency of impacts of oral disorders on daily performances (OIDP extent), as a measure of OHRQoL. Contextual school and home environmental characteristics were categorized into three equal groups according to tertiles of the contextual variable's scores (low, moderate and high). Individual demographic, socioeconomic and oral clinical measures were the covariates. The association between contextual and individual characteristics and OIDP extent was estimated using multilevel Poisson regression models.

Results: The mean of OIDP extent was 0.9 (standard error 0.1). Adolescents and young adults living in the cities with high levels of lack of security at school (RR 1.33; 95% CI = 1.02-1.74), moderate levels of bullying at school (RR 1.56; 95% CI = 1.20-2.03) and moderate levels of low maternal schooling (RR 1.43; 95% CI = 1.06-1.92) had a higher mean OIDP extent. Male sex, higher age, skin colour, poor individual socioeconomic status and worse oral clinical measures were also associated with higher mean of OIDP extent
OIDP extent.

Conclusion: Poor school and home environmental characteristics were independently associated with poor OHRQoL in individuals aged between 15 and 19 years. Our findings suggest that the place where they study and the maternal level of education are meaningful aspects for their oral health.

Introduction

Over recent years, social oral epidemiological research has adopted patient-reported outcome measures (PROMs), representing a shift in the assessment of oral health from a normative approach to a patient-centred perspective[1-3]. Oral health-related quality of life (OHRQoL) indicators are PROM measures that reflect people's satisfaction and comfort with respect to their oral health when performing daily activities and engaging in social activities[4,5]. Demographic and socioeconomic characteristics, dental clinical status and psychosocial factors have shown to be associated with OHRQoL[3,6-11].

Evidence for the role of contextual determinants in OHRQoL in adolescents is scarce. Low empowerment at neighbourhood level was associated with DMFT in adolescents[12]. High income inequality at the municipal level and lower access to domestic sewage where the adolescents resided were positively associated with untreated dental caries in adolescents[13,14]. In addition, the prevalence of dental pain in Brazilian schoolchildren was higher in areas with low social development[15], and the distribution of periodontal disease in adolescents varied significantly between schools according to their annual tuitions and fees[16]. Although adolescents' health have been influenced by specific social environments, including bullying behaviour and physical violence at school, studies addressing these predictors in oral health research are scarce[17-20].

The WHO Conceptual Framework for Action on the Social Determinants of Health provides a framework to evaluate the most relevant structural and intermediate social determinants of health[21]. According to this model, structural and intermediary social determinants of health are hierarchically organised in three categories within the contextual and individual levels. Structural social determinants include social contexts and socioeconomic stratification which in turn engenders differential exposure to health-damaging conditions. They operate through a set of intermediary determinants of health to shape health outcomes, including health-related behaviours, psychosocial and biological factors[21]. The WHO social determinants of health conceptual framework was adapted in this study (Fig. 1). Contextual school and home environmental indicators were second-level structural social determinants of health. Individual-level structural determinants included socioeconomic and demographic characteristics. Clinical oral measures were the intermediary biological predictors of OHRQoL. Individual socioeconomic factors and clinical measures moderate the relationship between contextual characteristics and OHRQoL.

The aim of the present study was to test the association of contextual school and home environmental characteristics and individual factors with OHRQoL in a representative sample

of the Brazilian population of adolescents and young adults aged between 15 and 19 years. The hypothesis of this study was that adolescents and young adults living in cities with poor school and home environmental characteristics are more likely to report poor OHRQoL.

Materials and methods

Individual and city-level data of the state capitals and the Federal District in Brazil were combined in the present cross-sectional study. Individual characteristics were obtained from the Brazilian Oral Health Survey (SBBrasil Project) in 2010; this evaluated the oral health of a representative sample of Brazilian adolescents and young adults living in urban areas of the country[22]. The survey was approved by the Brazilian National Council of Ethics in Research. Contextual-level school and home environmental characteristics of the state capitals and the Federal District were obtained from the National School-Based Health Survey in Brazil[23].

The SBBrasil Project was an epidemiological study to characterise the oral health conditions of the different WHO age groups. Dental examinations were conducted according to the WHO guidelines for oral health surveys[24]. Individual demographic and socioeconomic characteristics data were collected in this survey[22], along with self-reported oral health. The contributors were invited to participate and were recruited from their homes.

The studied sample comprised adolescents and young adults aged between 15 and 19 years from the state capitals and the Federal District in Brazil. We excluded participants from the interior municipalities, those younger than 15 and older than 19 years old, and those with missing data for any investigated variable.

The SBBrasil Project included participants from 32 geographical domains, including 26 state capitals, the Federal District and five domains corresponding with the interior municipalities from every macro-geographical region in Brazil (Central-West, North, Northeast, Southeast and South)[25]. The sampling process used a stratified multistage cluster sampling method and the probability-proportional-to-size technique. Further details are available in Appendix 1 and in a previous publication[25].

Data from individual structured interviews and oral clinical examinations were recorded in participants' homes. Data collection was conducted by 10 fieldwork teams in each state capital and the Federal District. Each fieldwork team involved one dentist and one health care worker from the Brazilian Public Health Care System[22]. All examiners participated in a clinical calibration study before data collection in order to test inter-

examiner reliability using the consensus technique to estimate Kappa coefficients. The minimum satisfactory weighted Kappa was 0.65[24].

OHRQoL was assessed using the Brazilian version of the Oral Impacts on Daily Performance questionnaire (OIDP)[26,27]. The OIDP questionnaire contains nine items that evaluate the physical, social and psychological performances related to the impact of oral status on daily life activities in the preceding 6 months[26]. Respondents informed whether any of the following performances were affected by their oral conditions (response options: 0 = no; 1 = yes): 'eating and enjoying food', 'speaking and pronouncing clearly', 'cleaning teeth', 'sleeping and relaxing', 'smiling, laughing and showing teeth without embarrassment', 'maintaining usual emotional state without being irritable', 'carrying out major work or social role', 'enjoying contact with people' and 'doing sports'[26,27]. The frequency of OIDP items (OIDP extent) resulted in a discrete outcome measure ranging from 0 to 9, with higher values indicating poorer OHRQoL. The Cronbach's α for the OIDP was 0.78 (95%CI 0.77-0.79).

School environment and home environment data were obtained from the National School-Based Health Survey in Brazil (*Pesquisa Nacional de Saúde do Escolar – PeNSE*) in 2009[23]. The PeNSE survey assessed the risk and protective factors of health in students in the 9th year from private and public secondary schools in the state capitals and the Federal District in Brazil. The questions were those used by the Youth Risk Behavior Surveillance System/Centers for Disease Control and Prevention[28]. A two-stage stratified probabilistic cluster sampling method was used in PeNSE survey. The schools and the 9th grade class of the selected schools were the primary and the secondary sampling units, respectively[23]. Additional information regarding the methodology of the PeNSE survey is available in Appendix 2 and in a previous document[23].

The variables related to the school environment included a lack of security at school and bullying at school[23,28]. The former assessed whether the student missed school classes in the last 30 days because s/he did not feel safe at school (Yes/No). The latter was based on how often s/he had been mocked, teased, called names or intimidated in the last 30 days by one of her/his schoolmates so much that s/he were hurt, annoyed, upset, offended or ashamed. If students reported being bullied "sometimes" or "most of the time", they were categorised as victims of bullying.

Living with both parents and maternal level of schooling were used to assess the home environment[23,28]. Students were asked whether they currently lived with both parents (Yes/No). Maternal educational level was assessed through years of schooling and categorized as less than 9 years of schooling (incomplete primary education) or 9 years or

more of schooling. Full information on the PeNSE questionnaire is available elsewhere[23]. Data from individual responses concerning school and home environment obtained in the PeNSE survey were aggregated for each city as contextual measures.

All contextual measures were categorized into three groups according to tertiles of variables distribution (low, moderate and high) to assess whether there was a gradient in the association between OIDP extent and contextual variables. This approach has been used in previous research[3,12].

The individual variables were demographic, socioeconomic and clinical characteristics. Age, sex and ethnicity were considered as demographic characteristics. Ethnicity was assessed based on self-perception of skin colour using the following options: white, yellow, indigenous, brown and black. Socioeconomic characteristics were monthly family income, education and number of durable goods in the household. Family monthly income was originally registered in the Brazilian reais (R$) and then converted into the American dollars (US$) according to the following categories: < US$ 294, US$ 294-1465, and > US$1465. Education was measured according to the number of successful concluded years at school.

Untreated decayed teeth, missing teeth and periodontal conditions were assessed[24]. Untreated decayed teeth and missing teeth were assessed using the 'decayed' and 'missing' components of the DMFT index. Periodontal conditions were recorded using the Community Periodontal Index (CPI). Periodontal examinations were conducted using a ball end CPI probe to register bleeding on probing (gingivitis), dental calculus and pocket depths in each sextant[24]. The number of sextants affected by each periodontal condition was recorded and ranged from 0 to 6.

All analyses were conducted using Stata 14.0 software, with sampling weights used. Demographic characteristics, socioeconomic data, OIDP extent and oral health measures were described through means and proportions with their respective 95% Confidence Intervals (95% CIs).

The multilevel structure for the analysis included 3,854 adolescents and young adults aged 15-19 years (level 1) grouped into 27 cities (level 2). Multilevel models were used to estimate the variation in OIDP extent across cities (random effects) and the effects of contextual school and home characteristics on OIDP extent, adjusted for individual variables (fixed effects). The association of contextual and individual independent variables with OIDP extent was tested through multilevel Poisson regression using fixed effect models with random intercept. The results are presented as rate ratios (RR) and 95% CIs.

Bivariate Poisson regression was used to test associations between OIDP extent and independent contextual and individual variables. Variables with $P < 0.20$ were considered for the multivariable multilevel analysis. Six statistical models were tested according to the proposed theoretical model (Fig 1.) as follows: Model 1 school environment variables; Model 2, Model 1 plus home environment measures; Model 3, Model 2 plus individual demographic and socioeconomic variables; and Model 4, Model 3 plus clinical oral health measures. Variables that remained significant at 5% ($P < 0.05$) were retained in the analysis for adjustment. Variance and standard error for OIDP extent (discrete measure) across cities (random effects) were used to assess the variation in the outcome at the contextual level. The significance of the variance at city-level was obtained from Wald statistic through the ratio of the variance and the standard error following a Chi-square distribution. Detailed explanation concerning the use of multilevel analysis is available in Appendix 3.

Results

A total of 5445 adolescents and young adults aged 15-19 years were interviewed and examined in the SBBrasil Project (response rate = 92.5%). Of those, 4207 lived in the state capitals and the Federal district. Missing data on individual socioeconomic variables and DMFT were identified in 296 and 57 participants, respectively. Thus, the analysed sample comprised 3854 participants with complete data for all investigated variables.

The prevalence of at least one oral impact on quality of life in the last six months was 34.5% (95% CI 29.6-39.6). The three performances most commonly affected by oral conditions were 'eating' (19.4 %; 95% CI 16.1-23.2), 'cleaning teeth' (14.1%; 95% CI 11.4-17.2) and 'smiling' (12.8%; 95% CI 10.4-15.7). 'Studying' (4.9%; 95% CI 3.7-6.4) and 'doing sport' (3.4 %; 95% CI 2.4-5.0) were the least affected performances.

Demographic and socio-economic characteristics and oral health measures of the participants and sex categories are summarized in Table 1. Approximately half of the study sample consisted of girls (53.5%) and one quarter of the respondents were 15 years old. The participants' skin colour was predominantly brown and most adolescents and young adults had monthly family income between US$ 294 and US$1465. The average number of years of schooling was 8.8. Socio-economic characteristics were similar between girls and boys. The mean OIDP extent was 0.9. The mean untreated decayed teeth and missing teeth were 1.6 and 0.3, respectively. The average number of sextants with gingivitis, dental calculus and pocket

depths were 1.2, 1.2 and 0.2, respectively (Table 1).

Table 2 presents the distribution of OIDP and oral clinical measures according to demographic and socio-economic characteristics. Individuals with higher OIDP extent and poor clinical measures were older and had worse socio-economic conditions. OIDP extent and the severity of oral clinical measures varied across ethnic categories. Participants with indigenous ethnicity showed higher OIDP extent, untreated decayed teeth and missing teeth.

The non-adjusted analysis of the relationship of contextual and individual variables with OIDP extent is presented in Table 3. In the unadjusted analysis, the mean of OIDP extent was statistically associated with contextual measures of bullying at school and maternal schooling ($P \leq 0.05$). Adolescents and young adults aged 18 and 19 years have higher OIDP extent than those aged 15 years. Sex and ethnicity were associated with OIDP extent. The mean OIDP extent was significantly higher among low-income family participants, among those with lower education and worse oral clinical measures (Table 3).

The multivariable Poisson models are presented in Table 4. In Model 1, lack of security at school and bullying at school variables were associated with OIDP extent. Contextual measure of maternal schooling was inserted in Model 2. Lack of security at school, bullying at school, maternal schooling and all demographic and socio-economic variables were associated with a higher mean OIDP extent in Model 3. In the final model (Model 4), adolescents and young adults living in cities with higher levels of lack of security at school were 33% more likely to have a higher mean of OIDP extent than those living in cities with lower levels (RR = 1.33; 95% CI 1.02–1.74). The mean OIDP extent was 1.56 times higher for individuals in the cities in the moderate tertile of bullying at school (RR = 1.56; 95% CI 1.20–2.03) than for those in the cities in the lower tertile. In addition, adolescents and young adults in cities in the moderate tertile of maternal schooling had a 43% higher mean OIDP extent (RR = 1.43; 95% CI 1.06–1.92) than those in the cities in the low tertile. All demographic characteristics, socio-economic conditions and clinical measures were associated with OIDP extent in the final model. The mean OIDP extent was significantly higher in older participants, females, those of indigenous, brown or black ethnicity, and among those from a lower-income family or with less schooling. The OIDP extent was higher among participants with more untreated dental caries, missing teeth and gingivitis. The variance of OIDP extent at city-level was statistically significant in Models 1-4 suggesting the multi-level approach using a random intercept was relevant in the statistical modelling.

Discussion

The present findings support the hypothesis that poor contextual school and home environmental characteristics are related to poor OHRQoL in individuals aged between 15 and 19 years. Our results also suggest that OHRQoL was negatively related to poor individual socioeconomic indicators, greater number of untreated decayed and missing teeth, and poor gingival status in adolescents and young adults.

The WHO social determinants of health conceptual framework was adapted according to the hypothesis of the study. This approach was useful to select the independent variables based on a theoretical ground and for the multilevel statistical modelling. The robust sample size of the study and the multi-level multivariable analysis reduced the bias of the observed estimates and increased their precision.

Previous studies investigated the contextual social effects in the distribution of oral conditions in adolescents[12-14,16]. However, PROMs were considered in few investigations in children and adults[1-3,9]. Only one study assessed the relationship between contextual characteristics and oral health-related PROM in adolescents[15]. Adolescents living areas with low HDI were more likely to report dental pain compared to those living in more affluent areas[15]. A previous research tested the association between contextual social determinants and OHRQoL. Adults living in cities with worse social conditions had a greater likelihood of a poor OHRQoL[3]. As far as we know, this is the first study conducted to verify the association between contextual-level social determinants and OHRQoL in adolescents and young adults. Our findings on the relationship between periodontal measures and OHRQoL in younger adults are in accordance with previous studies[29,30].

Our findings support previous evidence on the harmful influence of contextual features on adolescents' oral health[9,12-16]. However, past research on the relationship between contextual social characteristics and oral health in adolescents predominantly assessed the possible effect of broad contextual social determinants, including social development and income inequality, on clinical oral outcomes. The association between specific social contexts such as school environment and home environment on oral health-related PROM were not explored yet.

The impact of inadequate school environment and home conditions on adolescent's health and wellbeing has been highlighted. Recent studies consistently reported that higher levels of psychological distress[20], lower self-esteem and depression[17] in adolescents were related to bullying and lack of security at school. However, no previous research investigated the contextual effects of school environment and home conditions on individual's health. It

has also been hypothesized that school environment can offer greater opportunities to improve physical and mental health as well as to build self-esteem and confidence of children and young people[31].

Possible explanations for our findings are the positive impact of school policies aiming to reduce bullying and violence which in turn influences health through the development of a health promoting environment. Children from health-promoting schools had significantly better OHRQoL and less oral impacts on cleaning teeth compared to children from control schools[32,33]. Health-promoting schools have been related to the improvement of children's oral health. The prevalence of decayed teeth and dental trauma was lower in health-promoting schools in Brazil compared to those without health promotion programmes[34]. Furthermore, improvements in the gingival status were observed among schoolchildren from health-promoting schools in Tanzania but not among those from the control schools[33]. Our findings corroborate the potential benefits of health-promoting schools on adolescent's oral health.

School environment and home environment may also affect adolescent's and young adult's OHRQoL through direct and indirect psychosocial pathways. Psychosocial factors were considered direct predictors of adolescent's OHRQoL[6,7,35]. The direct psychosocial mechanism suggests that students living in cities with high levels of school bullying and adolescents peer aggression may experience more psychological distress, depression and worse wellbeing that increases the susceptibility to oral diseases and to oral impacts [18,20,35]. The indirect psychosocial effects may operate via low of social support and low social networks at school, which in turn may influence oral health through social isolation and contribute to the adoption of unhealthy behaviours[36]. The association between contextual low maternal schooling and poor OHRQoL is underpinned by the socioeconomic explanations in oral health inequalities[36]. High parental education has positive consequences on attitudes towards adolescent's oral health. Temporal trends analysis on adolescent's oral health behaviours related to maternal educational inequalities showed that poor oral hygiene habits, unhealthy diet and cigarette experimentation were inversely associated with maternal schooling[37].

The cross-sectional nature of the data imposes limits concerning the temporal relationship between the investigated predictors and OHRQoL. The inclusion of young adults aged 19 years in the study might resulted in information bias since some of them were not at school when the PeNSE survey was conducted. In addition, the WHO conceptual framework was not fully addressed since important structural and intermediary determinants of health.

OIDP extent is considered a straightforward measure by providing a clearer picture of impacts. However, it can be considered a simpler measure than the total score and the OIDP intensity measure since it does not reflect the frequency and severity of oral impacts, resulting in a lower capacity to discriminate groups. Therefore, comparisons between studies using different OIDP measures should be cautious. There is scope for more comprehensive research on the relationship between social determinants and OHRQoL. Longitudinal studies exploring additional social determinants of health and therefore addressing the WHO social determinants of health framework more comprehensively have the potential to clarify the pathways between structural and intermediary social determinants and oral health outcomes.

Conclusions

Our findings support the hypothesis that poor school and home environmental characteristics were associated with worse OHRQoL among adolescents and young adults. School environment and home environment are important contextual social determinants of oral health in Brazilian adolescents and young adults. Actions towards the improvement of schools' security and the implementation of anti-bullying campaigns should be components of health promotion strategies in the schools with a strong potential to reduce oral health inequalities. Social policies aiming to improve maternal education should also be considered to improve oral health of adolescents and young adults.

References

1. Turrell G, Sanders AE, Slade GD, Spencer AJ, Marcenes W. The independent contribution of neighborhood disadvantage and individual-level socioeconomic position to self-reported oral health: a multilevel analysis. Community Dent Oral Epidemiol 2007;35:195-206.

2. Paula J, Leite I, Almeida A, Ambrosano G, Pereira A, Mialhe F. The influence of oral health conditions, socioeconomic status and home environment factors on schoolchildren's self-perception of quality of life. Health Qual Life Outcomes 2012;10:6.

3. Vettore MV, Aqeeli A. The roles of contextual and individual social determinants of oral health-related quality of life in Brazilian adults. Qual Life Res 2016;25:1029-42.

4. Locker D, Allen F. What do measures of 'oral health-related quality of life' measure? Community Dent Oral Epidemiol 2007;35:401-11.

5. Sischo L, Broder H. Oral health-related quality of life: What, why, how, and future implications. J Dent Res 2011;90:1264-70.

6. Baker SR, Mat A, Robinson PG. What psychosocial factors influence adolescents' oral health? J Dent Res 2010;89:1230-5.

7. Foster Page LA, Thomson WM, Ukra A, Farella M. Factors influencing adolescents' oral health-related quality of life (OHRQoL). Int J Paediatr Dent 2013;23:415-23.

8. Peres KG, Cascaes AM, Leão AT, Côrtes MI, Vettore MV. Sociodemographic and clinical aspects of quality of life related to oral health in adolescents. Rev Saude Publica 2013;47:19-28.

9. Guedes RS, Piovesan C, Antunes JL, Mendes FM, Ardenghi TM. Assessing individual and neighborhood social factors in child oral health-related quality of life: a multilevel analysis. Qual Life Res 2014;23:2521-30.

10. Krisdapong S, Somkotra T, Kueakulpipat W. Disparities in early childhood caries and its impact on oral health-related quality of life of preschool children. Asia Pac J Public Health 2014;26:285-94.

11. Huang DL, Park M. Socioeconomic and racial/ethnic oral health disparities among US older adults: Oral health quality of life and dentition. J Public Health Dent 2015;75:85-92.

12. Pattussi MP, Hardy R, Sheiham, A. The potential impact of neighborhood empowerment on dental caries among adolescents. Community Dent Oral Epidemiol 2006;34:344-50.

13. Celeste RK, Nadanovsky P, Ponce de Leon A, Fritzell J. The individual and contextual pathways between oral health and income inequality in Brazilian adolescents and adults. Soc Sci Med 2009;69:1468-75.

14. Vazquez Fde L, Cortellazzi KL, Kaieda AK, Bulgareli JV, Mialhe FL, Ambrosano GM, et al. Individual and contextual factors related to dental caries in underprivileged Brazilian adolescents. BMC Oral Health 2015;15:6.

15. Peres MA, Peres KG, Frias AC, Antunes JL. Contextual and individual assessment of dental pain period prevalence in adolescents: a multilevel approach. BMC Oral Health 2010;10:20.

16. Lopez R, Frydenberg M, Baelum V. Contextual effects in the occurrence of periodontal attachment loss and necrotizing gingival lesions among adolescents. Eur J Oral Sci 2009;117:547-54.

17. Chang FC, Lee CM, Chiu CH, Hsi WY, Huang TF, Pan YC. Relationships among cyberbullying, school bullying, and mental health in Taiwanese adolescents. J Sch Health 2013;83:454-62.

18. Kvist T, Annerbäck EM, Sahlqvist L, Flodmark O, Dahllöf G. Association between adolescents' self-perceived oral health and self-reported experiences of abuse. Eur J Oral Sci 2013;121:594-9.

19. Nijs MM, Bun CJ, Tempelaar WM, de Wit NJ, Burger H, Plevier CM, et al. Perceived school safety is strongly associated with adolescent mental health problems. Community Ment Health J 2014;50:127-34.

20. Thomas HJ, Chan GC, Scott JG, Connor JP, Kelly AB, Williams J. Association of different forms of bullying victimisation with adolescents' psychological distress and reduced emotional wellbeing. Aust N Z J Psychiatry 2016;50:371-9.

21. WHO. A conceptual framework for action on the social determinants of health. World Health Organization: Geneva; 2010.

22. Roncalli AG, Silva NN, Nascimento AC, Freitas CHSM, Casotti E, Peres KG, et al. Relevant methodological issues from the SBBrasil 2010 Project for national health surveys. Cad Saude Publica 2012;28:S40–S57.

23. IBGE. Pesquisa Nacional de Saúde Escolar – PeNSE. Banco de dados agregados. Instituto Brasileiro de Geografia and Estatística: Rio de Janeiro, 2009. http://www.ibge.gov.br/home/estatistica/populacao/pense/

24. WHO. Oral health surveys, basic methods (4th ed.). World Health Organization: Geneva, 1997.

25. Silva NN, Roncalli AG. Sampling plan, weighting process and design effects of the Brazilian Oral Health Survey. Rev Saude Publica 2013;47(suppl 3):3-11.

26. Adulyanon S, Vourapukjaru J, Sheiham A.. Oral impacts affecting daily performance in a low dental disease Thai population. Community Dent Oral Epidemiol 1996;24:385-9.

27. Castro RAL, Cortes MI, Leão AT, Portela MC, Souza IP, Tsakos G, et al. Child-OIDP index in Brazil: Cross-cultural adaptation and validation. Health Qual Life Outcomes 2008;6:68.

28. Brener ND, Kann L, Shanklin S, Kinchen S, Eaton DK, Hawkins J, et al. Methodology of the youth risk behavior surveillance system-2013. MMWR Recomm Rep 2013;62:1-20.

29. Nagarajappa R, Batra M, Sanadhya S, Daryani H, Ramesh G. Relationship between oral clinical conditions and daily performances among young adults in India - a cross sectional study. J Epidemiol Glob Health 2015;5:347-57.

30. Ng SKS, Leung WK. Oral health-related quality of life and periodontal status. Community Dent Oral Epidemiol 2006;34:114-22.

31. Langford R, Bonell CP, Jones HE, Pouliou T, Murphy SM, Waters E, et al. The WHO Health Promoting School framework for improving the health and well-being of students and their academic achievement. Cochrane Database Syst Rev 2014;16:CD008958.

32. Yusof ZY, Jaafar N. Health promoting schools and children's oral health related quality of life. Health Qual Life Outcomes. 2013;11:205.

33. Mbawalla H, Masalu JR, Masatu M, Åstrøm AN. Changes in adolescents' oral health status following oral health promotion activities in Tanzania. Acta Odontol Scand 2013;71:333-42.

34. Moysés ST, Moysés SJ, Watt RG, Sheiham A. Associations between health promoting schools' policies and indicators of oral health in Brazil. Health Promot Int 2003;18:209-18.

35. Åstrøm AN, Lie SA, Mbawalla H. Do self-efficacy and depression predict oral impacts on daily performances across time? A 2-yr follow-up of students in Tanzania. Eur J Oral Sci 2016;124:358-67.

36. Sisson KL. Theoretical explanations for social inequalities in oral health. Community Dent Oral Epidemiol 2007;35:81-8.

37. Freire Mdo C, Jordão LM, Malta DC, Andrade SS, Peres MA. Socioeconomic inequalities and changes in oral health behaviors among Brazilian adolescents from 2009 to 2012. Rev Saude Publica 2015;49:50-60.

List of figure and tables captions

Table 1. Demographic, socio-economic characteristics and oral health measures of the participants (N = 3854)

Variable	**Study sample** % / Mean (95% CI	**Female participants** % / Mean (95% CI	**Male participants** % / Mean (95% CI
Socio-demographic variables			
Age (years), %			
15	24.6 (21.5-28.0)	23.3 (19.8-27.1)	26.2 (22.1-30.6)
16	18.2 (16.1-20.6)	16.3 (13.9-18.9)	20.6 (17.0-24.7)
17	18.2 (16.1-20.6)	17.4 (14.9-20.2)	18.2 (16.1-20.5)
18	18.1 (14.9-21.8)	18.9 (15.2-23.3)	17.2 (13.9-21.1)
19	20.9 (18.7-23.2)	24.2 (21.0-27.8)	17 (14.1-20.2)
Skin colour, %			
White	39.4 (34.9-44.0)	38.6 (34.1-43.3)	40.3 (34.4-46.5)
Yellow	0.6 (0.4-1.0)	0.6 (0.4-1.1)	0.6 (0.3-1.1)
Indigenous	0.6 (0.2-1.5)	0.3 (0.1-0.7)	1.0 (0.3-3.2)
Brown	43.7 (40.1-47.4)	43.5 (38.6-48.5)	44.0 (39.2-48.9)
Black	15.7 (11.6-20.8)	17.0 (11.9-23.6)	14.1 (10.6-18.6)
Monthly family income (**US$**), %			
> 1465	13.1 (10.5-16.3)	11.4 (8.6-15.0)	15.1 (11.6-19.4)
294-1465	72.0 (67.4-76.1)	73.3 (68.4-77.7)	70.4 (64.6-75.5)
< 294	14.9 (12.2-18.1)	15.3 (12.4-18.7)	14.5 (11.3-18.4)
Years of schooling, mean	8.9 (8.5-9.3)	9.1 (8.7-9.6)	8.7 (8.3-9.1)
Number of durable goods, mean	7.2 (6.8-7.6)	7.1 (6.7-7.5)	7.4 (7.0-7.8)
Oral health measures			
OIDP	0.9 (0.7-1.1)	1.1 (0.9-1.4)	0.7 (0.5-0.8)
Untreated decayed teeth, mean	1.6 (1.4-1.7)	1.6 (1.4-1.8)	1.6 (1.2-1.9)
Missing teeth, mean	0.3 (0.3-0.4)	0.4 (0.3-0.5)	0.3 (0.2-0.3)
Gingivitis, mean	1.2 (1.0-1.5)	1.2 (1.0-1.5)	1.2 (1.0-1.5)
Dental calculus, mean	1.2 (1.0-1.4)	1.1 (0.9-1.4)	1.2 (1.0-1.4)
Pocket depths, mean	0.2 (0.1-0.3)	0.2 (0.1-0.3)	0.2 (0.1-0.2)

Table 2. Sample distribution of OIDP and oral clinical measures according to demographic and socio-economic characteristics (N = 3854)

Variable	OIDP Mean (95% CI)	Decayed teeth Mean (95% CI)	Missing teeth Mean (95% CI)	Gingivitis Mean (95% CI)	Dental calculus Mean (95% CI)	Pocket depths Mean (95% CI)
Socio-demographic variables						
Age (years), %						
15	0.6 (0.7-1.0)	1.4 (12-1.6)	0.1 (0.1-0.2)	1.2 (0.9-1.5)	1.0 (0.8-1.3)	0.2 (0.1-0.3)
16	0.6 (0.4-0.8)	1.3 (1.1-1.6)	0.2 (0.1-0.3)	1.3 (1.0-1.7)	1.1 (0.8-1.4)	0.1 (0.1-0.1)
17	0.9 (0.7-1.2)	1.5 (1.3-1.8)	0.3 (0.2-0.4)	1.0 (0.8-1.3)	1.1 (0.8-1.3)	0.2 (0.1-0.3)
18	1.0 (0.6-1.3)	1.6 (1.4-1.9)	0.4 (0.3-0.6)	1.1 (0.8-1.4)	1.2 (0.9-1.5)	0.3 (0.2-0.4)
19	1.2 (0.9-1.6)	2.0 (1.6-2.4)	0.6 (1.4-0.8)	1.5 (1.2-1.8)	1.5 (1.2-1.8)	0.2 (0.1-0.4)
Skin colour, %						
White	0.9 (0.7-1.1)	1.1 (1.0-1.3)	0.3 (0.2-0.3)	1.0 (0.8-1.3)	1.0 (0.8-1.2)	0.2 (0.0-0.4)
Yellow	1.1 (0.6-1.7)	2.0 (1.0-3.1)	0.4 (0.1-0.6)	1.2 (0.5-1.9)	1.2 (0.6-1.8)	0.3 (0.1-0.6)
Indigenous	3.2 (0.2-6.2)	3.4 (1.3-5.8)	0.9 (0.0-1.9)	0.9 (0.0-1.7)	0.8 (0.0-1.6)	1.3 (0.2-2.4)
Brown	1.0 (0.8-1.2)	1.9 (1.6-2.2)	0.4 (0.3-0.5)	1.5 (1.2-1.8)	1.5 (1.2-1.7)	0.2 (0.1-0.3)
Black	0.8 (0.4-1.2)	1.6 (1.3-2.0)	0.4 (0.2-0.6)	1.0 (0.7-1.3)	0.8 (0.6-1.0)	0.1 (0.1-0.2)
Monthly family income (**US$**), %						
> 1465	0.6 (0.4-0.8)	0.8 (0.5-1.1)	0.2 (0.1-0.2)	0.9 (0.6-1.2)	0.9 (0.6-1.2)	0.1 (0.0-0.2)
294-1465	0.9 (0.7-1.1)	1.6 (1.4-1.8)	0.4 (0.3-0.5)	1.3 (1.0-1.5)	1.2 (1.0-1.4)	0.2 (0.1-0.3)
< 294	1.1 (0.8-1.4)	2.1 (1.7-2.4)	0.3 (0.2-0.4)	1.3 (1.0-1.6)	1.4 (1.1-1.7)	0.2 (0.1-0.3)
Years of schooling, %						
≥ 9 years	0.7 (0.5-0.8)	1.3 (1.1-1.5)	0.2 (0.2-0.3)	1.0 (0.8-1.2)	1.0 (0.8-1.2)	0.2 (0.1-0.2)
< 9 years	1.3 (1.0-1.5)	2.0 (1.7-2.5)	0.5 (0.4-0.6)	1.6 (1.3-1.9)	1.5 (1.2-1.8)	0.2 (0.2-0.3)
Number of durable goods, %						
8-11	0.7 (0.5-1.0)	1.4 (1.1-1.7)	0.2 (0.1-0.3)	1.3 (1.0-1.6)	1.1 (0.9-1.4)	0.2 (0.1-0.3)
0-7	1.1 (0.9-1.3)	1.7 (1.6-1.9)	0.4 (0.3-0.5)	1.2 (1.0-1.5)	1.2 (1.0-1.4)	0.2 (0.1-0.3)

Table 3. Unadjusted association between contextual and individual variables and OIDP extent, determined using multilevel Poisson regression (N = 3854).

Variable	Variance[a]	β	SE	RR[b]	95%CI	P
Contextual variables						
School environment						
Lack of security at school	0.378 (0.056)[c]					
Moderate		-0.179	0.186	0.84	0.58-1.21	0.334
High		0.286	0.179	1.33	0.94-1.89	0.110
Bullying at school	0.382 (0.056)[c]					
Moderate		0.426	0.181	1.53	1.07-2.19	0.019
High		0.274	0.188	1.31	0.91-1.90	0.147
Home environment						
Living with both parents	0.417 (0.060)[c]					
Moderate		0.136	0.202	1.15	0.77-1.70	0.500
High		0.149	0.202	1.16	0.78-1.73	0.461
Maternal schooling < 9 years	0.380 (0.056)[c]					
Moderate		0.445	0.192	1.56	1.07-2.27	0.021
High		0.063	0.176	1.07	0.75-1.51	0.719
Individual variables						
Age						
15				1		
16		0.081	0.054	1.08	0.98-1.21	0.136
17		0.089	0.054	1.09	0.98-1.22	0.096
18		0.276	0.052	1.32	1.19-1.46	<0.001
19		0.312	0.051	1.37	1.24-1.51	<0.001
Sex						
Male				1		
Female		0.387	0.036	1.47	1.37-1.59	<0.001
Skin colour						
White						
Yellow		0.401	0.122	1.49	1.18-1.90	0.001
Indigenous		0.433	0.150	1.54	1.15-2.07	0.004
Brown		0.315	0.041	1.37	1.26-1.49	<0.001
Black		0.364	0.059	1.44	1.28-1.61	<0.001
Monthly family income (**US$**)						
> 1465						
294-1465		0.538	0.064	1.71	1.51-1.94	<0.001
< 294		0.793	0.075	2.21	1.91-2.56	<0.001
Education		-0.104	0.007	0.90	0.89-0.91	<0.001
Untreated decayed teeth		0.126	0.005	1.13	1.12-1.14	<0.001
Missing teeth		0.116	0.007	1.12	1.11-1.14	<0.001
Gingivitis		0.126	0.009	1.13	1.12-1.15	<0.001
Dental calculus		0.115	0.009	1.12	1.10-1.14	<0.001
Pocket depths		0.134	0.016	1.14	1.11-1.18	<0.001

[a] Variance at the city level (standard error) was obtained through random effects
[b] RR rate ratio
[c] $P \leq 0.05$

Table 3. Unadjusted association between contextual and individual variables and OIDP extent, determined using multilevel Poisson regression (N = 3854).

Variable	Variance[a]	β	SE	RR[b]	95%CI	P
Contextual variables						
School environment						
Lack of security at school	0.378 (0.056)[c]					
Moderate		-0.179	0.186	0.84	0.58-1.21	0.334
High		0.286	0.179	1.33	0.94-1.89	0.110
Bullying at school	0.382 (0.056)[c]					
Moderate		0.426	0.181	1.53	1.07-2.19	0.019
High		0.274	0.188	1.31	0.91-1.90	0.147
Home environment						
Living with both parents	0.417 (0.060)[c]					
Moderate		0.136	0.202	1.15	0.77-1.70	0.500
High		0.149	0.202	1.16	0.78-1.73	0.461
Maternal schooling < 9 years	0.380 (0.056)[c]					
Moderate		0.445	0.192	1.56	1.07-2.27	0.021
High		0.063	0.176	1.07	0.75-1.51	0.719
Individual variables						
Age						
15				1		
16		0.081	0.054	1.08	0.98-1.21	0.136
17		0.089	0.054	1.09	0.98-1.22	0.096
18		0.276	0.052	1.32	1.19-1.46	<0.001
19		0.312	0.051	1.37	1.24-1.51	<0.001
Sex						
Male				1		
Female		0.387	0.036	1.47	1.37-1.59	<0.001
Skin colour						
White						
Yellow		0.401	0.122	1.49	1.18-1.90	0.001
Indigenous		0.433	0.150	1.54	1.15-2.07	0.004
Brown		0.315	0.041	1.37	1.26-1.49	<0.001
Black		0.364	0.059	1.44	1.28-1.61	<0.001
Monthly family income (**US$**)						
> 1465						
294-1465		0.538	0.064	1.71	1.51-1.94	<0.001
< 294		0.793	0.075	2.21	1.91-2.56	<0.001
Education		-0.104	0.007	0.90	0.89-0.91	<0.001
Untreated decayed teeth		0.126	0.005	1.13	1.12-1.14	<0.001
Missing teeth		0.116	0.007	1.12	1.11-1.14	<0.001
Gingivitis		0.126	0.009	1.13	1.12-1.15	<0.001
Dental calculus		0.115	0.009	1.12	1.10-1.14	<0.001
Pocket depths		0.134	0.016	1.14	1.11-1.18	<0.001

[a] Variance at the city level (standard error) was obtained through random effects
[b] RR rate ratio
[c] $P \leq 0.05$