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Multimorbidity patterns of oral clinical conditions, social position and oral health-related quality of life in a population-based survey of 12 yr-old children

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Abstract

The aim of this study was to describe the patterns of multimorbidities of oral clinical conditions in children. The association between social position and number of oral clinical conditions, and the relationship of social position and number of oral clinical conditions with oral health-related quality of life (OHRQoL, measured using the Child-OIDP) were also investigated. The study analyzed data on 7,208 children aged 12 yr from the Brazilian Oral Health Survey (SBBrasil 2010). Cluster analysis based on the observed/expected (O/E) ratios identified six significant clusters of oral clinical conditions: (i) dental caries and missing teeth, (ii) dental caries and dental trauma, (iii) dental trauma and gingivitis, (iv) dental caries, missing teeth and dental trauma, (v) dental caries, dental trauma and gingivitis, (vi) all oral clinical conditions. Ordinal regression showed that poor social position was associated with greater number of oral clinical conditions. Poisson regression demonstrated that low social position and greater number of oral clinical conditions increased the likelihood of poor OHRQoL (Child-OIDP extent). The four oral clinical conditions clustered into six distinct clusters among Brazilian children. Multimorbidity of oral clinical conditions predicted poor OHRQoL. Social position was a greater relevance to multimorbidity of oral clinical conditions and children´s OHRQoL.

Key words: child, oral health, socioeconomic status, quality of life, cluster analysis

Multimorbidity and clustering of chronic diseases are emerging issues on the public health agenda because of the individual impact of multimorbidity on health status and quality of life as well as the economic impact on the health care system (1). Multimorbidity has been traditionally defined as the occurrence of at least two coexisting chronic diseases affecting older people (2). Nevertheless, the concept of multimorbidity is not limited to chronic diseases and its occurrence has been investigated in other age groups, including in children and adolescents (3-5). Investigations involving multimorbidity of oral conditions have received little attention since a large proportion of epidemiological studies in oral health has focused on the distribution of single oral conditions in different populations as well as on the identification of their determinants.

Different patterns of clustering of health-compromising behaviours were identified in 13-14 and 17-19-yr-old male adolescents randomly selected from public and private schools in Riyadh, Saudi Arabia (6). Low frequency of tooth brushing was associated with low fruit consumption and low physical activity, while high sugar consumption was associated with smoking and physical fighting (6). These findings may suggest that oral health conditions are unevenly distributed across the population, resulting in different clustering patterns of oral diseases in young people. This is also in accordance with the common risk factor approach that argues that oral health problems are determines by common causes (7). However, investigations involving multimorbidity and clustering of oral health conditions are scarce. Oral health policies and dental care planning have traditionally been developed considering single oral conditions at population level and the implications of multimorbidity

patterns of oral health conditions on oral health care organisation are unknown. It can be argued that children with multiple oral problems are at higher risk of receiving sub-optimal dental care and attend more dental services unnecessarily as a result of the inadequate treatment planning resulting in higher dental care costs.

According to the WHO, 60-90% of children have dental caries and gingivitis worldwide, and 16-40% of children aged 6-12 yr have experienced dental trauma (8). Despite the global improvement of children's oral health, dental caries and gingivitis still remain common conditions, affecting in particular those living in underprivileged social conditions (9-11). The role of socioeconomic inequalities on children's oral health is well established. Parents' occupation and education level, and low family income have been identified as predictors of dental caries and poor periodontal status in children and adolescents (12-14).

Oral health-related quality of life (OHRQoL) measures provide a multidimensional evaluation of the oral health status through the assessment of the impact of oral problems on person´s subjective well-being. Previous studies have investigated the predictors of OHRQoL in children, including demographic and socioeconomic aspects, psychosocial factors and clinical dental status (15, 16). Decayed and missing teeth, low income and low sense of coherence were significant predictors of poor OHRQoL in children (15). Moreover, children whose parents had a lower education level had more negative impacts on OHRQoL and higher occurrence of dental trauma (16). A recent systematic review concluded that family income and parental education were found to be

significant predictors of children's OHRQoL (17). Therefore, social inequalities are important determinants of oral health conditions and poor OHRQoL.

The present study was carried out to improve the understanding of the occurrence, patterns and predictors of multiple oral health conditions in children as well its relationship with OHRQoL using a representative sample of 12-yr-old children who participated in the last Brazilian national oral health survey. A theoretical framework encompassing social position indicators, demographic data, use of dental services, number of oral clinical conditions and OHRQoL was proposed (Fig. 1).

The aim of this study was to evaluate how four oral clinical conditions, dental caries, missing teeth, gingivitis and dental trauma, cluster among Brazilian children aged 12 yr. We also tested the relationship between social position and number of oral clinical conditions. Finally, the association of social position and number of oral clinical conditions with OHRQoL was assessed in this age group.

Material and methods

The project was approved by the Brazilian National Council of Ethics in Research (no. 15498) in compliance with Brazilian National Health Council Resolution 196/96. Information concerning the objectives of the study was provided to all parents and children. Written consent to participate in the study was provided by children's parents or guardians.

The studied population included 12-yr-old children who were examined and interviewed in the Brazilian national oral health survey (SBBrasil Project).

The SBBrasil Project was a nationwide epidemiological survey carried out in 2010 involving a representative sample from 32 geographical areas, including 26 state capitals, the Federal District and five domains corresponding to the interior municipalities from every Brazilian macro-geographical region (North, Northeast, Central-West, Southeast and South) (18). Oral health conditions of children, adolescents, adults and elderly people were assessed in accordance with international standards proposed by the World Health Organization (19). The SBBrasil Project was carried out in accordance with the WHO guidelines, which recommends the age of 12 yr to assess the oral health conditions of children in oral health surveys (19).

The inclusion criterion was 12 yr of age. Children without complete data for the investigated oral clinical conditions (dental caries, missing teeth, gingivitis and dental trauma) were excluded from the analysis.

A probabilistic cluster sampling technique was adopted to ensure representativeness. Twenty seven domains referred to the state capitals and the Federal District, and five domains were related to the interior municipalities of the regions. Census tract and municipality were the primary sampling units for the state capitals and for the interior, respectively. Individuals living in the census tracts were selected in the second sampling stage process for the state capitals and the Federal District. Households were selected in the secondary sampling stage process for the interior municipalities. Additional information regarding the sampling process is available elsewhere (20).

Individual interviews using structured questionnaires and dental clinical examinations were carried out by trained dentists and assistants from the National Health Care System in Brazil (Sistema Unico de Saude) at the

participant's home. The examiners and interviewers undertook a 40-h training before the field work data collection (18). There was one dentist and one interviewer in each field work team with a total of ten teams in each state capital and the Federal District. The number of field work teams in the interior municipalities varied from two to six depending on the size of the city. The consensus technique was the method employed to calibrate the 570 dentists who carried out the dental examinations. The examiners who did not reach a weighted kappa coefficient of 0.65 were excluded or replaced (19).

Oral clinical conditions were assessed following the WHO's guidelines for oral health surveys (19) and included dental caries, missing teeth, dental trauma and gingivitis. Dental caries and missing teeth were assessed using the 'decay' (DT) and 'missing' (MT) components of the of the decayed, missing, filled teeth index (DMFT), respectively. The prevalence of dental caries and missing teeth was based on the occurrence of at least one decayed tooth (DT ≥ 1) and at least one missing tooth (MT ≥ 1). Dental trauma was assessed using a modified version of the O'Brien trauma index (21, 22). The eight incisors were assessed and categorised as (0) Tooth present without any evidence of trauma; (1) Unrestored enamel fracture that does not include dentine; (2) Unrestored fracture including enamel and dentine; (3) Unrestored fracture including enamel and dentine with pulp exposure; and (4) Missing tooth due to dental trauma. Children with at least one incisor coded ≥ 1 were considered with dental trauma. Gingivitis was recorded using the Community Periodontal Index (CPI) for each sextant, including bleeding on probing, calculus and shallow (4–5 mm) and deep (≥6 mm) periodontal pockets (19). A ball end CPI probe was employed to register CPI measures. Gingivitis was registered when bleeding on probing was

recorded in one or more sextants. Children who presented two or more dental clinical conditions were considered to have multimorbidity of oral clinical conditions.

The Brazilian Child-Oral Impacts on Daily Performance (Child-OIDP) was used to evaluate OHRQoL through individual interviews (23, 24). The oral impacts on quality of life is assessed using nine items about the impact of oral conditions on daily life activities related to the last 6 months. Physical, psychological and social performances are evaluated according to the following activities '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' (23 ,24). For each activity, the child was asked to inform whether the problem was caused by their teeth (yes/code 1) or not (no/code 0). Child-OIDP was analyzed as a discrete variable (extent) based on the final score obtained by simple counting of the oral impacts, ranging from zero (no impact) to nine (impact in all nine activities). The Cronbach's α coefficient of child-OIDP was 0.764.

Social position characteristics concerning family monthly income, education and number of durable goods in the household were obtained from the parents/caregivers (25). Family monthly income refers to the number of Brazilian minimal wages per family and was categorized as ≤ 500 Brazilian reais (R$), R$ 501–1500, R$ 1501–2500, ≥R$ 2501. This categorization was based on the fact that the Brazilian minimal wage was R$ 500 when the study was conducted. One Brazilian real corresponded to 0.586 US dollars. Children's

level of education was assessed according to the number of concluded years at school without failure, using the following categories: ≤5 yr, 6 yr and 7 yr. The 12-yr-old children are expected to have 7 yr of schooling in Brazil. The number of durable goods in the household was categorised as 0-5, 6-8 and ≥9 according to the existence of television, refrigerator, stereo, microwave, telephone, cell phone, washing machine, dishwasher, microcomputer and cars.

Demographic variables were sex and skin colour. Self-reported skin colour was assessed according to the categories proposed by the Brazilian Institute of Geography and Statistics as follows: white, yellow, indigenous, pardo and black (26). Children of white skin colour were the reference category. Use of dental services included dental attendance (yes or no) and time since the last visit to the dentist: < 1 yr, 1-2 yr and ≥3 yr (18).

Demographic and social position characteristics, use of dental services, prevalence of oral clinical conditions and OHRQoL measures were described by sex through proportions and means with their respective 95% confidence intervals (CIs). The comparison of demographic and social position variables, use of dental services and OHRQoL measures between groups of children with different number of oral clinical conditions was assessed using Pearson Chi-square test. OIDP total (extent) was compared between groups through Kruskal-Wallis test.

The patterns of multimorbidity of oral clinical conditions were assessed through examining the clustering of the four oral clinical conditions. Clustering of clinical oral conditions existed when the observed combination of conditions exceeds the expected prevalence of the combination. The expected prevalence of a specific combination of conditions was calculated on the basis of the

individual probabilities of each condition based on their occurrence in the study population (27). The observed/expected (O/E) ratios were examined by calculating the prevalence odds ratios (POR) and the 95% CI based on a Poisson distribution (28).

The association between social position measures and number of oral clinical conditions was assessed through bivariate and multivariable ordinal regression analysis to estimate the odds ratio (OR) and 95% CI. Initially, unadjusted associations between social position measures and covariates and number of oral clinical conditions were tested. The association between social position measures and number of oral clinical conditions was tested in Model 1. Demographic variables were added in Model 2 and use of dental services added in Model 3.

Multivariable Poisson regression analysis was used to test the association of social position and number of oral clinical conditions with OHRQoL adjusting for demographic characteristics and use of dental services. The results are presented as rate ratios (RR) and 95% CIs. Four statistical models were tested as follows: Model 1: social position measures; Model 2: model 1 plus demographic variables; Model 3: model 2 plus use of dental services variables; and Model 4: model 3 plus number of oral clinical conditions. In both regression analyses covariates that were significant at 10% ($P < 0.10$) in the unadjusted analyses were included in the multivariate analysis for adjustment.

Children with missing data concerning demographic data, social position measures and use of dental services variables were excluded from the regression analyses.

All analyses were carried out with SPSS version 22.0. The sampling complexity of the study was taken into account in the descriptive and multivariate analyses using sample weights.

Results

Of the 7,328 children aged 12 yr invited to participate in the 2010 Brazilian Oral Health Survey, 7,247 were examined and interviewed (response rate 98.9%). Complete data concerning the four oral clinical conditions, OIDP and demographic data were identified in 7,208 12-yr-old children (98.4% of the invited population). Missing data regarding social position measures and dental services variables were identified in 1,039 and 1,461 participants, respectively, resulting in 4,889 children with complete data for all variables. Missing data were randomly distributed among groups of number of oral clinical conditions.

Approximately half of the studied sample consisted of females (50.1%). Most participants had white skin colour (45.3%), have family income between R$501 and 1500 (53.4%) and 6 yr of schooling (39.5%). The average yr of children´s schooling was 5.70. More than 70% of the sample had at least six durable goods at home and 58% have visited the dentist during the last yr. The prevalence of dental caries, missing teeth, dental trauma and gingivitis was 41.5%, 5.8%, 21.0% and 26.6%, respectively. Overall, 34.4% of the participants reported at least one impact on OHRQoL. The most common performance influenced by oral health was eating (18.1%), followed by cleaning teeth (13.3%) and smiling (12.7%). The mean OIDP extent was 0.85. Demographic characteristics, social position, use of dental services, oral clinical conditions

and oral health-related quality of life measures were similar across genders (Table 1).

Demographic and social position characteristics, use of dental services and OHRQoL measures according to oral clinical conditions are presented in Table 2. The frequency of oral clinical conditions was similar in terms of sex and use of dental services characteristics. Children of pardo skin colour showed higher levels of dental caries and gingivitis compared to those of white skin colour. Dental caries, missing teeth and gingivitis were more prevalent among children of poor socioeconomic status. The prevalence of one or more OIDP items varied from 39.0% among children with gingivitis to 56.8% among those with missing teeth. The most prevalent performance influenced by all oral clinical conditions was ‘eating’. Oral impacts on ‘speaking’ was the less affected oral performance among those with dental caries, dental trauma and gingivitis, while ‘sports’ was the least affect performance among children with missing teeth (Table 2).

The frequency of children with one, two, three and four oral clinical conditions was 35.1, 21.4, 5.0 and 0.5%, respectively (Table 3). Demographic data, social position, time since last visit, and OHRQoL measures significantly differed between groups of number of oral clinical conditions. There was a gradient in the occurrence of number of oral clinical conditions across social position variables. The lower the family income, the lower schooling and the lower the number of durable goods, the higher the number of oral clinical conditions. There was a statistical difference in the prevalence of at least one impact on OHRQoL as well as in the prevalence of oral performances between groups with different number of oral clinical conditions (Table 3).

The observed and expected prevalences of the possible combinations of the oral clinical conditions are presented in Table 4. In six of the combinations, the observed and expected prevalences were statistically significantly different. The observed combined prevalence of dental caries and missing teeth, dental caries and dental trauma, and dental trauma and gingivitis was higher than could have been expected on the basis of the individual probabilities of these oral conditions alone. The combination of dental caries, missing teeth and dental trauma, and dental caries, dental trauma and gingivitis clustered with an O/E ratio of 3.5 (95 % CI: 2.9-4.1) and 1.7 (95 % CI: 1.5-1.9), which indicates that the proportion of children with these conditions were, respectively, 250% and 70% greater than the proportion that would be expected had the three oral clinical conditions occurred independently. The prevalence odds ratios (POR) of combinations of the four oral clinical conditions suggests they are clustered. The proportion with the four oral clinical conditions was 300% (O/E ratio = 4.00; 95 % CI: 2.8-5.3) greater than the proportion that would be expected had the four oral clinical conditions occurred independently. The statistical significance of the POR of each combination of the oral clinical conditions was assessed based on their 95% CI.

The association between social position variables and number of oral clinical conditions is presented in Table 5. Family income, skin colour and use of dental services variables were associated with the number of oral clinical conditions. Low family income and lower number of durable goods were associated with the number of oral clinical conditions in Model 1. Skin colour and use of dental services variables were inserted in models 2 and 3, respectively. In the final model (Model 3), low family income, low numbers of

durable goods and pardo skin colour were associated with the number of oral clinical conditions.

Poisson nested models investigated the association between social position, demographic variables, dental services, number of oral clinical conditions and OIDP extent (Table 6). In Models 1, 2 and 3, social position and demographic variables were associated with OIDP extent. In addition, dental attendance and time since the last visit to the dentist predicted OIDP extent in Model 3. OIDP extent was significantly higher for children with low family income, 5 or less years of schooling, male sex, indigenous and pardo skin colour, and greater number of oral clinical conditions (Model 4).

Discussion

The present study is the first epidemiological study that investigated the multimorbidity patterns and clustering of oral clinical conditions in children. The occurrence of dental caries, missing teeth, dental trauma and gingivitis was not independent in Brazilian children and six different clusters involving the four oral clinical conditions examined showed a statistical significance. Dental caries and dental trauma were present in five of the six clusters and despite the low prevalence missing teeth in the studied sample, this clinical condition was observed in three clusters. The cluster comprising dental caries and missing teeth was expected since the main cause of the latter is the severity of the former. However, other relevant clusters were observed between dental trauma and gingivitis, and caries and dental trauma. Moreover, the proportion of the four oral clinical conditions together was significantly higher than the expected

proportion of each condition individually assessed. These findings can be explained because the investigated oral clinical conditions in children share similar determinants including poor socioeconomic status and poor oral hygiene (7).

Although studies involving multimorbidity have been predominantly conducted in adults and older adults with chronic diseases (1, 2), our findings are in agreement with recent research involving other age groups that has shown that multiple chronic conditions (5, 29) and psychiatric disorders (30) are prevalent in children. According to our findings, the occurrence of two or more oral clinical conditions was found in 26.9% of the children, suggesting that multimorbidity is a phenomenon related to the distribution of different health conditions, including oral diseases.

In the present study, poor social position indicators were directly related to the number of oral clinical conditions. A similar study conducted in Scotland showed that physical multimorbidities were more prevalent among people living in more deprived areas compared to those living in the most affluent areas (4). The findings of our study confirm previous data on the role of social gradient in oral health (13, 31-34). Nevertheless, previous studies analysed the occurrence and severity of individual oral diseases such as caries (33, 34) and periodontal disease (13). The present study demonstrates that the role of social determinants of oral health is also relevant when multiple oral conditions is the outcome of interest. The proportion of children with three or four oral clinical conditions was significantly higher among children from low-income families, with fewer durable goods and with less than 5 yr of education. Previous studies explored the possible mechanisms by which social inequalities

influence oral health including psychological and behavioural factors and access to dental care. Oral health practices, including inadequate dental attendance, unhealthy dietary habits and poor oral hygiene were identified as relevant pathways linking low socioeconomic status and dental caries incidence in children (35). Moreover, maternal enabling factors, including education, cognitive ability and psychological distress, predicted caries in adolescents and was mediated by psychosocial stress and dental preventive behaviour (36).

The global reduction of oral diseases has been observed in Brazilian children during recent years. Data from the national oral health surveys in Brazil show a decline in caries levels in 12-yr-old children between 2003 and 2010 since the mean of DMFT reduced from 2.78 to 2.07 during this period (37). Although the current prevalence of childhood dental caries in Brazil can be considered low, untreated dental caries, gingivitis and other oral conditions are socially patterned and remain high among children from low-income families (9-11, 38).

Several studies have investigated the predictors of OHRQoL in children. Although a recent systematic review suggests the negative impact of malocclusion on children's OHRQoL (39), the present study focused on oral clinical conditions that have been related to common risk factors and poor social position. Dental caries and missing teeth have been reported as the most common oral conditions related to poor children's quality of life (15, 40, 41, 42). Other studies reported that children with dental trauma (16) and poor gingival status (42, 43) have more oral impacts in their quality of life than those without these conditions. Overall, our findings corroborate previous investigations since the number of oral clinical conditions was associated with higher impact on

children's OHRQoL. In addition, the prevalence of at least one impact on OHRQoL increased with the greater number of oral clinical conditions. However, no previous study has attempted to evaluate the relationship between the multimorbidity of oral clinical conditions and OHRQoL in children.

The influence of poor socioeconomic conditions on children's OHRQoL has also been reported. Children from low-income families (15, 42, 44), whose parents had lower education (16, 44), with low school achievement (42) and living in overcrowded households (44) have more negative impacts in OHRQoL. In our study, the independent association between poor social position measures, including low family income and lower child´s education, and OIDP extent in children are in agreement with the literature.

Despite the use of a large sample size and the innovative approach to investigate the multimorbidity and clustering of oral clinical conditions, the findings of this study are subject to some limitations. The present findings should not be applied to other age groups. The case definitions of the four oral clinical conditions were unable to discriminate children with different levels of severity and extent of dental caries, missing teeth, dental trauma and gingivitis. The cross-sectional design of the study restricts causal inference on the significant associations between social position, number of clinical oral conditions and OHRQoL. Although distinct clusters of oral clinical conditions were identified and they share similar risk factors (7), they represent different oral health problems, which should be considered in the interpretation of the findings.

This study is the first to demonstrate the occurrence of different clusters of oral clinical conditions in children as well as the role of social position

on multiple oral clinical conditions and the importance of social position and the number of oral clinical conditions on children's OHRQoL. The innovative approach in oral epidemiology to investigate the multimorbidity patterns of oral clinical conditions suggests that oral diseases in children remain of public health importance due to their high prevalence and impact on individual's quality of life. In addition, oral health inequalities were also related to multiple oral clinical conditions. Organisation and delivery of oral health care as well as the development of public policies aiming to reduce social inequalities and improve children's oral health should consider the multimorbidity of oral conditions approach.

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Conflict of interest declaration

The authors declare that they have no conflict of interest.

References

1. VOGELI C, SHIELDS AE, LEE TA, GIBSON TB, MARDER WD, WEISS KB, BLUMENTHAL D. Multiple chronic conditions: prevalence, health consequences, and implications for quality, care management, and costs. *J Gen Intern Med* 2007; **22**:391-395.

2. PRADOS-TORRES A, CALDERÓN-LARRAÑAGA A, HANCCO-SAAVEDRA J, POBLADOR-PLOU B, VAN DEN AKKER M. Multimorbidity patterns: a systematic review. *J Clin Epidemiol* 2014; **67**: 254-266.

3. MERCER SW, SMITH SM, WYKE S, O'DOWD T, WATT GC. Multimorbidity in primary care: developing the research agenda. *Family Practice* 2009; **26**: 79-80.

4. BARNETT K, MERCER SW, NORBURY M, WATT G, WYKE S, GUTHRIE, B. Epidemiology of multimorbidity and implications for health care, research, and medical education: a cross-sectional study. *Lancet* 2012; **380**: 37-43.

5. CLARK NM, LACHANCE L, BENEDICT MB, LITTLE R, LEO H, AWAD DF, WILKIN MK. The extent and patterns of multiple chronic conditions in low-income children. *Clin Pediatr (Phila)* 2015; **54**: 353-358.

6. ALZAHRANI SG, WATT RG, SHEIHAM A, ARESU M, TSAKOS G. Patterns of clustering of six health-compromising behaviours in Saudi adolescents. *BMC Public Health* 2014; **14**: 1215.

7. SHEIHAM A, WATT RG. The common risk factor approach: a rational basis for promoting oral health. *Community Dent Oral Epidemiol* 2000; **28**:399-406.

8. WORLD HEALTH ORGANIZAION. Oral Health Fact Sheet No. 318. 2012. Available at: http://www.who.int/mediacentre/factsheets/fs318/en/

9. ANTUNES JL, PERES MA, JAHN GM, LEVY BB. The use of dental care facilities and oral health: a multilevel approach of schoolchildren in the Brazilian context. *Oral Health Prev Dent* 2006; **4**: 287-294.

10. JENKINS WM, PAPAPANOU PN. Epidemiology of periodontal disease in children and adolescents. *Periodontol 2000* 2001; **26**: 16-32.

11. LAURIS JR, DA SILVA BASTOS R, DE MAGALHAES BASTOS JR. Decline in dental caries among 12-year-old children in Brazil, 1980-2005. *Int Dent J* 2012; **62**: 308-314.

12. PERES MA, DE OLIVEIRA LATORRE MDO R, SHEIHAM A, PERES KG, BARROS FC, HERNANDEZ PG, MAAS AM, ROMANO AR, VICTORA CG. Social and biological early life influences on severity of dental caries in children aged 6 years. *Community Dent Oral Epidemiol* 2005; **33**: 53-63.

13. LÓPEZ R, FERNANDEZ O, BAELUM V. Social gradients in periodontal diseases among adolescents. *Community Dent Oral Epidemiol* 2006; **34**:184-196.

14. SKINNER J, JOHNSON G, BLINKHORN A, BYUN R. Factors associated with dental caries experience and oral health status among New South Wales adolescents. *Aust N Z J Public Health* 2014; **38**: 485-489.

15. BAKER SR, MAT A, ROBINSON PG. What psychosocial factors influence adolescents' oral health? *J Dent Res* 2010; **89**: 1230-1235.

16. FREIRE-MAIA FB, AUAD SM, ABREU MH, SARDENBERG F, MARTINS MT, PAIVA SM, PORDEUS IA, VALE MP. Oral Health-Related Quality of Life and Traumatic Dental Injuries in Young Permanent Incisors in Brazilian Schoolchildren: A Multilevel Approach. *PLoS One* 2015; **10**: e0135369.

17. KUMAR S, KROON J, LALLOO R. A systematic review of the impact of parental socio-economic status and home environment characteristics on children's oral health related quality of life. *Health Qual Life Outcomes* 2014; **12**: 41.

18. RONCALLI, A. G., SILVA, N. N., NASCIMENTO, A. C., FREITAS, C. H. S. M., CASOTTI, E., PERES, K. G., MOURA LD, PERES MA, FREIRE MDO C, CORTES MI, VETTORE MV, PALUDETTO JÚNIOR M, FIGUEIREDO N, GOES PS, PINTO RDA S, MARQUES RA, MOYSÉS SJ, REIS SC, NARVAI PC. L. (2012). Relevant methodological issues from the SBBrasil 2010 Project for national health surveys. *Cad Saude Publica* 2012; **28**: S40–S57.

19. WORLD HEALTH ORGANIZATION. Oral health surveys: basic methods, 4th edn. Geneva: World Health Organization, 1997.

20. SILVA NN, RONCALLI AG. Sampling plan, weighting process and design effects of the Brazilian Oral Health Survey. *Revista de Saude Publica* 2013; **47(suppl 3)**: 3-11.

21. O'BRIEN M. Children's dental health in the United Kingdom 1993. London: Her Majesty's Stationery Office; 1994.

22. CORTES MI, MARCENES W, SHEIHAM A. Prevalence and correlates of traumatic injuries to the permanent teeth of schoolchildren aged 9-14 years in Belo Horizonte, Brazil. *Dent Traumatol* 2001; **17**: 22-26.

23. ADULYANON S, VOURAPUKJARU J, SHEIHAM A. Oral impacts affecting daily performance in a low dental disease Thai population. *Community Dent Oral Epidemiol* 1996; **24**: 385-389.

24. CASTRO RAL, CORTES MIS, LEAO AT, PORTELA MC, SOUZA IPR, TSAKOS G, SHEIHAM A. Child-OIDP index in Brazil: Cross-cultural adaptation and validation. *Health Qual Life Outcomes* 2008; **6**: 68.

25. LYNCH J, KAPLAN G. Chapter 1 Socioeconomic Position. In: *Social Epidemiology*. New York: Oxford University Press, 2003.

26. TRAVASSOS C, WILLIAMS D. The concept and measurement of race and their relationship to public health: A review focused on Brazil and the United States. *Cadernos de Saude Publica* 2004; **20**: 660–678.

27. SCHUIT AJ, VAN LOON JM, TIJHUIS M, OCKÉ MC. Clustering of lifestyle risk factors in a general adult population. *Prev Med* 2002; **35**: 219-224.

28. BRESLOW NE, DAY NE. Statistical methods in cancer research. The design and analysis of cohort studies. *IARC Sci Publ* 1987;**82**: 1-406.

29. FAZELI FARSANI S, SOUVEREIN PC, VAN DER VORST MM, KNIBBE CA, DE BOER A, MANTEL-TEEUWISSE AK. Chronic comorbidities in children with type 1 diabetes: a population-based cohort study. *Arch Dis Child* 2015; **100**: 763-768.

30. XIAOLI Y, CHAO J, WEN P, WENMING X, FANG L, NING L, HUIJUAN M, JUN N, MING L, XIAOXIA A, CHUANYOU Y, ZENGUO F, LILI L, LIANZHENG Y, LIJUAN T, GUOWEI P. Prevalence of Psychiatric Disorders among Children and Adolescents in Northeast China. *PLoS One* 2014; **9**: e111223.

31. SABBAH W, TSAKOS G, CHANDOLA T, SHEIHAM A, WATT RG. Social gradients in oral and general health. *J Dent Res* 2007; **86**: 992-996.

32. BERNABE E, SABBAH W, DELGADO-ANGULO EK, MURASKO JE, GANSKY SA. Income gradients in oral health according to child age. *Eur J Oral Sci* 2015; **123:** 260-266.

33. MATHUR MR, TSAKOS G, MILLETT C, ARORA M, WATT R. Socioeconomic inequalities in dental caries and their determinants in adolescents in New Delhi, India. *BMJ Open* 2014; **4**: e006391.

34. PERERA I, EKANAYAKE L. Social gradient in dental caries among adolescents in Sri Lanka. *Caries Res* 2008; **42**: 105-111.

35. GAO XL, HSU CY, XU YC, LOH T, KOH D, HWARNG HB. Behavioral pathways explaining oral health disparity in children. *J Dent Res* 2010; **89**:985-990.

36. NELSON S, LEE W, ALBERT JM, SINGER LT. Early maternal psychosocial factors are predictors for adolescent caries. *J Dent Res* 2012; **91**: 859–864.

37. LAURIS, J. R., DA SILVA BASTOS, R. & DE MAGALHAES BASTOS, J. R. 2012. Decline in dental caries among 12-year-old children in Brazil, 1980-2005. *Int Dent J,* 62**,** 308-14.

38. ARDENGHI TM, PIOVESAN C, ANTUNES JL. Inequalities in untreated dental caries prevalence in preschool children in Brazil. Rev Saude Publica 2013; **47 Suppl 3**: 129-137.

39. DIMBERG L, ARNRUP K, BONDEMARK L. The impact of malocclusion on the quality of life among children and adolescents: a systematic review of quantitative studies. *Eur J Orthod* 2015; **37**:238-247

40. ALSUMAIT A, ELSALHY M, RAINE K, COR K, GOKIERT R, AL-MUTAWA S, AMIN M. Impact of dental health on children's oral health-related quality of life: a cross-sectional study. *Health Qual Life Outcomes* 2015; **13**: 98.

41. BIAZEVIC MGH, RISSOTTO RR, MICHEL-CROSATO E, MENDES LA, MENDES MOA. Relationship between oral health and its impact on quality of life among adolescents. *Braz Oral Res* 2008; **22**: 36-42.

42. 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 Suppl 3**: 19-28.

43. TOMAZONI F, ZANATTA FB, TUCHTENHAGEN S, DA ROSA GN, DEL FABRO JP, ARDENGHI TM. Association of gingivitis with child oral health-related quality of life. *J Periodontol* 2014; **85**: 1557-1565.

44. PAULA JS, LEITE ICG, ALMEIDA AB, AMBROSANO GMB, PEREIRA AC, MIALHE FL. 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.

Figure legend

Figure 1. Theoretical framework for the study of social position, number of oral clinical conditions and oral health-related quality of life.

Table 1. Demographic characteristics, social position, use of dental services, prevalence of oral clinical conditions and oral health-related quality of life of the participants.

Variable	Study sample	Female	Male
	% (95 % CI)	% (95 % CI)	% (95 % CI)
Demographic characteristics			
Skin colour			
White	45.3 (41.2-49.4)	45.9 (40.9-50.9)	44.7 (39.0-50.4)
Yellow	1.9 (1.1-3.2)	2.2 (1.3-3.5)	1.6 (0.5-4.7)
Indigenous	0.8 (0.3-2.1)	0.4 (0.2-0.7)	1.2 (0.3-4.1)
Pardo	41.2 (37.3-45.2)	40.8 (36.6-45.0)	41.6 (36.3-47.1)
Black	10.9 (7.8-15)	10.8 (7.2-16.0)	11.0 (8.2-14.7)
Social position			
Family income (R$)			
<500	18.2 (15.2-21.6)	20.2 (16.5-24.5)	16.1 (13.0-19.8)
501-1500	53.4 (49.1-57.4)	52.7 (47.3-58.1)	53.8 (48.1-59.5)
1501-2500	18.6 (14.7-23.3)	18.0 (14.1-22.8)	19.2 (13.1-27.3)
>2500	9.9 (7.3-13.4)	9.1 (6.4-12.6)	10.8 (7.4-15.6)
Education (years)			
≤ 5	34.2 (30.3-38.2)	31.4 (26.4-36.8)	36.9 (32.3-41.9)
6	39.5 (35.2-43.9)	42.1 (36.5-47.8)	36.9 (32.6-42.4)
7	26.4 (22.7-30.4)	26.5 (22.4-31.1)	26.2 (21.5-31.4)
Number of durable goods			
0 to 5	29.1 (24.6-34)	28.5 (23.9-33.5)	29.7 (24.3-35.7)
6 to 8	40.8 (37.4-44.4)	42.5 (38.3-46.7)	39.2 (35.2-43.3)
≥ 9	30.1 (25-35.8)	29.0 (23.1-35.8)	31.2 (25.7-37.2)
Use of dental services			
Dental visits			
Yes	81.4 (77.6-84.7)	82.8 (78.2-86.6)	80.0 (75.7-83.8)
No	18.6 (15.3-22.4)	17.2 (13.4-21.8)	20.0 (16.2-24.3)
Time since last dental visit			
< 1 year	58.0 (52.1-63.6)	57.0 (49.5-64.2)	59.0 (52.1-65.6)
1 – 2 years	30.8 (26-36.1)	29.9 (25.0-35.3)	31.8 (25.8-38.5)
≥ 3 years	11.2 (8.7-14.3)	13.1 (9.0-18.6)	9.2 (6.7-12.5)
Oral clinical conditions			
Decayed teeth	41.5 (37.2-46.0)	40.9 (35.6-46.4)	42.2 (37.6-47.0)
Missing teeth	5.8 (4.5-7.5)	5.4 (3.6-8.0)	6.3 (4.8-8.3)
Dental trauma	21.0 (19.0-23.2)	19.8 (17.1-22.7)	22.3 (19.1-25.9)
Gingivitis	26.6 (22.6-31.0)	24.8 (20.5-29.8)	28.3 (23.7-33.5)
OHRQoL			
OIDP ≥ 1	34.3 (29.7-39.1)	36.7 (31.4-42.4)	31.8 (26.8-37.2)
OIDP Eating	18.1 (15.3-21.2)	19.5 (16.1-23.4)	16.7 (13.7-20.2)
OIDP Speaking	5.4 (4.1-7.1)	6.3 (4.2-9.2)	4.5 (3.0-6.6)
OIDP Cleaning teeth	13.3 (10.9-16.2)	16.2 (12.9-20.1)	10.4 (8.1-13.3)
OIDP Sleeping	8.5 (6.9-10.6)	9.0 (7.0-11.6)	8.1 (6.1-10.6)
OIDP Smiling	12.7 (10.5-15.2)	13.4 (10.6-16.9)	11.9 (9.4-15.0)
OIDP Emotional state	11.6 (9.4-14.1)	12.3 (9.7-15.5)	10.8 (8.4-13.8)
OIDP Study	5.0 (3.6-6.8)	6.2 (4.0-9.5)	3.8 (2.5-5.6)
OIDP Social contact	6.0 (4.8-7.5)	7.1 (5.3-9.5)	4.9 (3.5-6.9)
OIDP Sport	4.3 (3.0-6.2)	3.7 (2.4-5.8)	5.0 (3.3-7.4)
	Mean (95 % CI)	Mean (95 % CI)	Mean (95 % CI)
OIDP total	0.85 (0.71-0.98)	0.94 (0.77-1.10)	0.76 (0.61-0.91)

CI = Confidence Interval
Total sample, *n* =7208; Female, *n* = 3628; Male, *n* = 3580. The *n* varied from 7208 (Sex, Skin colour and OIDP) to 1461 (Time since last dental visit).

Table 2. Distribution of oral clinical conditions according to demographic characteristics, social position, use of dental services and oral health-related quality of life (*N*=7208).

	Decayed teeth	Missing teeth	Dental trauma	Gingivitis
	% (95 % CI)	% (95% CI)	% (95% CI)	% (95% CI)
Total	41.5 (37.2-46.0) N = 3160	5.8 (4.5-7.5) N = 455	21.0 (19.0-23.2) N =1578	26.6 (22.6-31.0) N = 2146
Demographic characteristics				
Sex				
Female	40.9 (35.6-46.4)	5.4 (3.6-8.0)	19.8 (17.1-22.7)	24.8 (20.5-29.8)
Male	42.2 (37.6-47.0)	6.3 (4.8-8.3)	22.3 (19.1-25.9)	28.3 (23.7-33.5)
Skin colour				
White	36.1 (31.1-41.5)	4.6 (2.8-7.5)	20.6 (17.0-24.9)	21.2 (16.9-26.4)
Yellow	45.0 (22.1-70.2)	5.7 (2.2-14.3)	22.7 (10.1-43.3)	20.7 (10.5-36.6)
Indigenous	17.0 (4.9-44.6)	31.0 (14.7-53.8)	36.6 (23.0-52.7)	13.5 (4.1-36.6)
Pardo	47.8 (43.3-52.3)	6.4 (5.0-8.1)	21.7 (18.8-24.8)	33.5 (29.2-38.0)
Black	41.7 (29.9-54.4)	6.9 (3.7-12.5)	19.1 (14.5-24.6)	24.7 (15.3-37.3)
Social position				
Family income (R$)				
<500	58.7 (52.8-64.4)	11.9 (7.6-18.2)	16.5 (13.2-20.4)	35.4 (29.0-42.3)
501-1500	42.1 (36.4-47.9)	5.6 (4.3-7.4)	20.9 (18.3-23.7)	26.7 (21.9-32.1)
1501-2500	36.6 (28.3-45.6)	2.9 (1.2-6.5)	22.8 (15.9-31.7)	20.9 (14.5-29.1)
>2500	20.2 (15.1-26.7)	2.4 (0.7-8.0)	23.3 (14.5-35.1)	20.9 (15.1-28.1)
Education (years)				
≤ 5	48.5 (42.4-54.7)	9.7 (6.7-13.7)	20.7 (16.6-25.3)	32.6 (27.4-38.3)
6	39.0 (31.5-47.0)	4.6 (3.2-6.6)	18.6 (15.6-22.1)	26.4 (20.9-32.6)
7	37.7 (32.4-43.3)	4.8 (3.1-7.4)	25.1(20.3-30.6)	27.1 (21.7-33.3)
Number of durable goods				
0 to 5	56.2 (52.1-60.3)	8.1 (6.3-10.2)	19.4 (16.7-22.5)	39.3 (33.8-45.0)
6 to 8	35.8 (29.8-42.2)	6.9 (4.6-10.2)	22.0 (18.4-26.2)	19.9 (15.6-24.9)
≥ 9	35.2 (27.7-43.5)	2.3 (1.1-4.5)	20.9 (15.5-27.6)	23.5 (17.0-31.5)
Use of dental services				
Dental visits				
Yes	39.6 (35.4-44.0)	5.7 (4.3-7.5)	21.3 (18.7-24.0)	25.4 (21.2-30.2)
No	50.5 (43.0-58.0)	6.7 (4.3-10.1)	20.0 (16.1-24.5)	32.0 (26.4-38.1)
Time since last dental visit				
< 1 year	37.1 (33.1-41.1)	6.3 (4.4-8.9)	20.7 (17.3-24.4)	25.1 (21.0-29.6)
1 – 2 years	42.1 (35.4-49.0)	5.1 (3.2-8.1)	22.9 (17.9-28.9)	24.2 (18.0-31.7)
≥ 3 years	48.2 (37.2-59.4)	3.9 (1.8-8.0)	17.8 (12.9-24.0)	32.2 (23.2-42.7)
OHRQoL	% (95 % CI)	% (95 % CI)	% (95 % CI)	% (95 % CI)
OIDP ≥ 1	44.8 (39.6-50.0)	56.8 (45.9-67.0)	39.0 (31.9-46.7)	49.5 (44.1-54.8)
OIDP Eating	25.3 (21.6-29.4)	32.3 (20.8-46.5)	20.7 (15.5-27.1)	26.0 (22.3-30.1)
OIDP Speaking	6.2 (4.1-9.3)	13.2 (4.5-32.9)	4.8 (3.1-7.3)	6.8 (4.7-9.7)
OIDP Cleaning teeth	19.5 (15.4-24.3)	16.3 (10.5-24.3)	17.9 (12.4-25.1)	20.4 (15.4-26.4)
OIDP Sleeping	15.0 (12.2-18.3)	19.8 (13.3-28.5)	8.7 (6.2-12.0)	14.5 (11.3-18.4)
OIDP Smiling	16.4 (13.1-20.3)	22.0 (11.8-37.2)	15.5 (11.6-20.5)	18.4 (14.9-22.4)
OIDP Emotional state	16.3 (13.2-20.1)	18.6 (12.1-27.4)	12.7 (9.2-17.1)	16.7 (12.9-21.2)
OIDP Study	7.5 (5.7-9.9)	12.6 (7.3-20.7)	8.2 (4.4-15.0)	8.1 (6.0-10.8)
OIDP Social contact	9.6 (7.5-12.2)	12.3 (7.4-19.8)	7.5 (4.7-11.9)	10.6 (7.6-14.5)
OIDP Sport	6.6 (4.7-9.2)	9.7 (6.2-14.9)	4.9 (2.9-8.2)	7.8 (5.1-11.6)
	Mean (95 % CI)	Mean (95 % CI)	Mean (95 % CI)	Mean (95 % CI)
OIDP total	1.22 (1.02-1.42)	1.56 (1.20-1.93)	1.01 (0.79-1.22)	1.29 (1.07-1.50)

CI = Confidence Interval

Table 3. Distribution of the number of oral clinical conditions according to demographic characteristics, social position, use of dental services and oral health-related quality of life.

Variables	0	1	2	3	4	
	% (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)	P
Total	37.9 (33.2-42.9)	35.1 (31.7-38.7)	21.4 (18.2-24.9)	5.0 (4.0-6.3)	0.5 (0.3-0.8)	
Demographic characteristics						
Sex						
Female	49.3 (43.9-54.8)	56 (50.8-61.1)	44.5 (37.9-51.2)	39.1 (29.9-49.2)	45.6 (21.6-71.9)	0.012
Male	50.7 (45.2-56.1)	44 (38.9-49.2)	55.5 (48.8-62.1)	60.9 (50.8-70.1)	54.4 (28.1-78.4)	
Skin colour						0.001
White	51.6 (46.3-56.9)	44.5 (38.8-50.3)	40 (32.2-48.3)	26.2 (18.3- 36.0)	37 (17.4-62.1)	
Yellow	2.3 (0.8-6.5)	1.2 (0.7-2.1)	2.1 (1-4.3)	1.7 (0.5-5.4)	8.7 (1.2-42.4)	
Indigenous	0.9 (0.3-2.8)	0.3 (0.1-0.7)	1.4 (0.4-4.9)	0.1 (0-0.4)	0	
Pardo	34.3 (29.5-39.5)	41.9 (37.3-46.6)	47.3 (40.0-54.8)	63.3 (53.2-73)	21.2 (9.1-42)	
Black	10.9 (6.3-18.2)	12.1 (8.7-16.7)	9.2 (6.7-12.3)	8.4 (4.4-15.3)	33.1 (11.5-65.2)	
Social position						
Family income (R$)						<0.001
<500	12.4 (8.8-17.2)	18.2 (14.8-22.2)	25.3 (19.5-32)	29.5 (21.6-38.8)	31.0 (14-55.4)	
501-1500	52.0 (45.3-58.7)	55.8 (50.4-61.1)	51.2 (43.8-58.5)	53.1 (43.4-62.5)	59.6 (35.1-80.1)	
1501-2500	21.4 (16.1-27.8)	17.7 (14-22.2)	17.3 (10.5-27.3)	11.1 (6.7-17.7)	5.2 (1.4-16.7)	
>2500	14.1 (9.3-20.4)	8.3 (5.4-12.5)	6.2 (3.8-10.1)	6.4 (3.2-12.4)	4.2 (0.6- 23.8)	
Education (years)						0.023
≤ 5	29.7 (24.4-35.5)	33.4 (28.5-38.6)	38.9 (31.8-46.5)	47.8 (36.2-59.7)	57.4 (31.5-79.9)	
6	43.7 (37.2-50.4)	38.4 (33.1-44.0)	38.6 (31.9-45.8)	22.1 (15.7-30.0)	35.6 (16.1-61.3)	
7	26.6 (21-32.2)	28.3 (23.2-33.9)	22.5 (17.3-28.6)	30.1 (17.9-46.0)	7.0 (2.1-21.2)	
Number of durable goods						<0.01
0 to 5	19.0 (13.9-25.4)	30.2 (25.4-35.5)	42.6 (34.8-48.8)	40.8 (30.8-51.6)	60.2 (31.4-83.4)	
6 to 8	45.0 (38.1-52.2)	42.6 (38.2-47.2)	32.2 (26.5-38.4)	34.0 (24.8-44.6)	35.5 (13.2-66.6)	
≥ 9	36.0 (28.7-43.)	27.2 (21.3-33.9)	26.2 (18.6-35.6)	25.2 (14-41.1)	4.3 (0.9-18.1)	
Use of dental services						
Dental visits						0.232
Yes	84.0 (77.7-88.8)	82.2 (77.8-85.9)	76.9 (70-82.5)	76.9 (62-87.2	69.8 (34.7-90.9)	
No	16.0 (11.2-22.3)	17.8 14.1-22.2)	23.1 (17.5-30)	23.1 (12.8-38)	30.2 (9.1-65.3)	
Time since last dental visit						0.003
< 1 year	64.3 (54.6-72.9)	49.5 (43.2-56)	59.8 (50.5-68.5)	61.1 (50.5-70.7)	59.6 (35.5-79.8)	
1 – 2 years	27.7 (10.1-36.8)	36.0 (30.3-42)	27.4 (21.4-34.2)	34.2 (24.9-44.9)	17.3 (6.5-38.9)	
≥ 3 years	8.0 (5.5-11.6)	14.5 (11-18.9)	12.8 (8.3-19.2)	4.7 (2.7-8.1)	23.1 (9-47.6)	
OHRQoL						
OIDP ≥ 1	21.5 (16.3-27.7)	36.4 (31.3-41.9)	45.8 (38.7-53.1)	63.0 (52.6-72.3)	68.5 (44.2-85.6)	< 0.001
OIDP Eating	11.6 (8.3-16.0)	16.3 (12.9-20.3)	28.6 (22.8-35.1)	33.5 (24.3-44.2)	31.1 (10.0-64.6)	< 0.001
OIDP Speaking	4.6 (2.8-7.4)	4.2 (2.7-6.4)	8.8 (5.1-14.6)	5.9 (3.5-9.7)	2.0 (0.3-13.7)	< 0.001
OIDP Cleaning teeth	6.6 (4.3-10.1)	15.0 (11.5-19.5)	17.2 (12.8-22.7)	34.2 (23.0-47.6)	19.9 (7.8-42.2)	< 0.001
OIDP Sleeping	4.1 (2.4-6.8)	8.0 (6.0-10.7)	11.9 (8.2-17.0)	27.8 (19.4-38.2)	47.9 (23.2-73.7)	< 0.001
OIDP Smiling	8.1 (5.8-11.4)	11.8 (9.2-14.9)	20.6 (15.2-27.4)	18.3 (12.3-26.3)	25.5 (11.1-45.4)	< 0.001
OIDP Emotional state	7.1 (4.7-10.6)	12.4 (9.4-16.1)	15.1 (10.8-20.6)	22.4 (15.2-31.6)	4.8 (17.5-69.1)	< 0.001
OIDP Study	1.9 (1.0-3.5)	6.0 (3.5-10.0)	5.3 (3.8-7.4)	16.9 (10.3-26.6)	40.9 (17.1-69.8)	< 0.001
OIDP Social contact	2.5 (1.4-4.1)	5.7 (3.9-8.2)	10.6 (6.9-15.7)	14.5 (8.6-23.3)	19.9 (6.8-45.7)	< 0.001
OIDP Sport	2.3 (1.0-5.1)	3.7 (2.3-5.9)	7.2 (4.2-12.2)	9.5 (5.5-15.8)	28.7 (11.7-5)	< 0.001
	Mean (95 % CI)	Mean (95 % CI)	Mean (95 % CI)	Mean (95 % CI)	Mean (95 % CI)	
OIDP total	0.48 (0.34-0.63)	0.83 (0.68-0.98)	1.25 (0.96-1.54)	1.83 (1.44-2.22)	2.56 (1.56-3.56)	<0.001

CI = Confidence Interval
P values refer to Pearson Chi-square test for categorical variables and Kruskal-Wallis test for OIDP total
Demographic and OHRQoL variables, n=7208; Social position measures, n = 1,039; Dental services variables, n = 1,461

Table 4. Clustering of oral clinical conditions in children (*N*=7208).

N oral clinical conditions	Dental caries	Missing teeth	Dental trauma	Gingivitis	Observed Prevalence (%)	Expected prevalence (%)	Ratio O/E	95% IC
0	-	-	-	-	37.9	36.4	1.1	1.0-1.1
1	+	-	-	-	19.1	22.7	0.8	0.8-0.9
1	-	+	-	-	0.9	2.0	0.5	0.4-0.6
1	-	-	+	-	9.0	8.5	0.8	0.8-0.9
1	-	-	-	+	9.5	11.5	1.1	1.0-1.2
2	+	+	-	-	2.0	1.4	1.4*	1.2-1.7
2	+	-	+	-	5.0	6.1	1.4*	1.3-1.5
2	+	-	-	+	11.1	8.2	0.8	0.8-0.9
2	-	+	+	-	0.2	0.5	0.3	0.2-0.5
2	-	+	-	+	0.2	0.7	0.3	0.2-0.6
2	-	-	+	+	2.8	3.1	3.1*	2.9-3.3
3	+	+	+	-	0.5	0.4	3.5*	2.9-4.1
3	+	+	-	+	1.8	0.5	1.4	1.0-1.9
3	+	-	+	+	3.7	2.2	1.7*	1.5-1.9
3	-	+	+	+	0.1	0.2	0.9	0.3-1.1
4	+	+	+	+	0.5	0.1	4.0*	2.8-5.3

+: oral clinical condition present, - : oral clinical condition absent
CI = Confidence Interval; *P < 0.05

Table 5. Ordinal regression of the association of social position, demographic characteristics, use of dental services with the number of oral clinical conditions in children (N = 4,889).

	Unadjusted		Model 1		Model 2		Model 3	
Variables	OR	CI 95%	OR	CI 95%	OR	CI 95%	OR	CI 95%
Social position								
Family income (R$)								
> 2501	1		1		1		1	
1501-2500	1.50	0.94 – 2.41	1.41	0.86 – 2.31	1.40	0.87 – 2.26	1.43	0.89 – 2.31
501-1500	1.91	1.24 – 2.95	1.61	0.97 – 2.66	1.58	0.97 – 2.56	1.63	1.03 – 2.56
< 500	3.30	2.18 – 4.99	2.21	1.34 – 3.64	2.14	1.31 – 3.51	2.24	1.28 – 3.93
Education (years)								
7	1							
6	1.12	0.81 – 1.56						
≤ 5	0.73	0.52 – 1.02						
Number of durable goods								
9 or more	1		1		1		1	
6 to 8	0.89	0.64 – 1.24	1.00	0.66 – 1.49	0.99	0.67 – 1.47	1.02	0.66 – 1.58
0 to 5	1.37	0.98 – 1.92	1.91	1.23 – 2.97	1.83	1.19 – 2.81	1.86	1.18 – 2.93
Demographic characteristics								
Skin colour								
White	1				1		1	
Yellow	1.13	0.31 - 4.12			0.92	0.27 – 3.13	0.71	0.17 – 2.97
Indigenous	1.40	0.88 – 2.23			1.16	0.66 – 2.01	1.27	0.73 – 2.21
Pardo	1.70	1.40 – 2.06			1.34	1.09 – 1.65	1.32	1.02 – 1.72
Black	1.19	0.78 – 1.84			0.90	0.58 – 1.40	0.83	0.58 – 1.20
Use of dental services								
Dental visits								
Yes	1						1	
No	1.40	1.04-1.88					1.07	0.73 – 1.59
Time since last dental visit								
< 1 year	1						1	
1 – 2 years	1.17	0.85 – 1.61					1.06	0.77 – 1.44
≥ 3 years	1.41	1.02 – 1.93					1.22	0.86 – 1.72

OR: Odds ratio, CI: Confidence Intervals

Table 6. Poisson regression between social position, demographic characteristics, use of dental services and OIDP extent in children (N = 4,889).

	Unadjusted		Model 1		Model 2		Model 3		Model 4	
Variables			RR	IC95%	RR	IC95%	RR	IC95%	RR	IC95%
Socioeconomic position										
Family income (R$)										
> 2501	1		1		1		1		1	
1501-2500	1.28	1.20-1.39	1.31	1.15-1.49	1.29	1.13-1.47	1.37	1.19-1.57	1.10	0.91-1.34
501-1500	1.67	1.58-1.79	1.59	1.41-1.78	1.54	1.37-1.73	1.70	1.50-1.93	1.25	1.04-1.50
< 500	1.97	1.85-2.13	1.78	1.56-2.02	1.71	1.50-1.93	1.94	1.69-2.22	1.43	1.17-1.76
Education (years)										
7	1		1		1		1		1	
6	1.06	0.97-1.16	1.06	0.97-1.16	1.07	0.97-1.17	1.12	1.01-1.23	1.12	0.99-1.27
≤ 5	1.22	1.18-1.32	1.16	1.08-1.25	1.17	1.09-1.26	1.24	1.14-1.34	1.36	1.20-1.53
Number of durable goods										
≥ 9	1		1		1		1		1	
6 to 8	1.17	1.13-1.24	1.00	0.93-1.08	0.99	0.91-1.06	0.98	0.90-1.06	0.94	0.83-1.06
0 to 5	1.43	1.37-1.51	1.17	1.09-1.27	1.14	1.05-1.23	1.18	1.08-1.28	1.01	0.88-1.16
Demographic characteristics										
Sex										
Female	1				1		1		1	
Male	1.29	1.25-1.34			1.29	1.22-1.35	1.27	1.20-1.34	1.31	1.20-1.43
Skin colour										
White	1				1		1		1	
Yellow	1.43	1.27-1.63			1.37	1.15-1.64	1.44	1.17-1.77	1.13	0.95-1.77
Indigenous	1.86	1.61-2.18			1.66	1.34-2.04	1.67	1.33-2.10	1.74	1.15-2.65
Pardo	1.28	1.24-1.34			1.17	1.11-1.23	1.12	1.06-1.19	1.16	1.05-1.29
Black	1.33	1.26-1.42			1.17	1.07-1.28	1.14	1.04-1.26	1.05	0.89-1.25
Use of dental services										
Dental visits										
Yes	1						1		1	
No	0.66	0.63-0.70					0.62	0.58-0.66	0.92	0.82-1.04
Time since last dental visit										
< 1 year	1						1		1	
1 – 2 years	1.07	1.03-1.13					0.98	0.92-1.05	0.87	0.78-0.98
≥ 3 years	1.26	1.21-1.32					1.13	1.06-1.21	0.91	0.77-1.08
Oral clinical conditions										
Number of oral clinical conditions	1.55	1.50-1.62							1.50	1.44-1.57

RR: Rate ratios, CI: Confidence Intervals.