

Self-reported oral health and normative indices of dental caries among adolescents: a cohort study

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Abstract: This study assessed the association between self-reported oral health and the normative indices of dental caries in an adolescent population. This study is based on a 6-year data from a cohort, beginning in 2012, with 1,134 twelve-year-old adolescents. After three phases of data collection, 68% of the samples were followed up. Self-reported oral health was evaluated through the question: “Would you say that the health of your teeth, lips, jaws, and mouth is ...?”, and answers were categorized as “good” or “poor.” Calibrated dentists examined clinical conditions using the decayed, missing, and filled teeth (DMFT) index. Statistical analysis was performed using multilevel logistic regression models, considering the dependence of those observed thrice and adjusted for demographic, socioeconomic, and dental visit variables. Adolescents who evaluated their oral health as poor had higher mean DMFT (OR: 1.35; CI95% 1.22–1.50). When evaluated separately, decayed (OR: 2.43; CI95% 1.83–3.23) and missing (OR: 3.94; CI95% 1.26–12.26) teeth also presented significant results, showing poor self-reported oral health associated with a higher mean. Adolescents’ self-perceived oral health was associated with normative dental caries indices, and this association was maintained throughout adolescence.

Keywords: Adolescent; Dental Caries; Diagnosis Oral; Self Concept.

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Introduction

Self-reported oral health is the capacity of an individual to subjectively perceive and evaluate their oral health. It is influenced by the available information, knowledge, and previous experiences, along with the social, cultural, and historical context of each individual. In contrast, normative indices are needed by clinicians to evaluate the presence and severity of pathological conditions,^{1,2} including dental caries.

Dental caries represents an important public health problem in Brazil, and worldwide.³ Physical and pathological changes tend to occur prior to pain and functional disability. Consequently, it is difficult for the population to estimate the severity and need for treatment.⁴ In addition, genetic, biological, behavioral, social, and economic factors change as the individual develops through childhood, adolescence, and adulthood, and can change health perceptions. As the child matures, oral health

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takes on a socially important role, understood as a necessary aspect of their ability to relate to the world at all social levels.^{5,6}

Previous studies on self-reported oral health and normative indices have mainly involved older individuals⁷⁻⁹ and adults⁸⁻¹¹ through a cross-sectional design, with few studies involving adolescents.¹²⁻¹⁴ Health conditions affecting the function and quality of life, such as dental caries, are more easily perceived and associated with greater agreement between the professional and the patient.^{10,15} Moreover, due to the heterogeneity of adolescents aged 12–19 years, oral health conditions can be perceived differently.^{6,16} Presumably, older adolescents can handle situations regarding their oral health more accurately than younger adolescents.¹⁷ Therefore, understanding how changes throughout adolescence can influence the relationship between self-perceived oral health and clinical indicators is useful in decision-making and planning health actions.

This study aimed to assess the association between self-reported oral health and normative indices of dental caries in adolescents through a cohort study. We hypothesized that the self-reported oral health of adolescents is associated with the normative indices of dental caries, and this association remains over time.

Methodology

Ethical aspects

This study was approved by the Research Ethics Committee of the Federal University of Santa Maria (UFSM) in 2012 and 2018 (protocol numbers 0127.0.243.000-11 and 66553117.4.0000.5346, respectively) and the Research Ethics Committee of the University of São Paulo (USP) in 2014 (protocol number 30613714.0.0000.5421). Permission from the Santa Maria Municipal Department of Education and schools was requested for the three collections, in addition to the free and informed consent forms.

Sample and design

A six-year follow-up cohort was evaluated to determine the aim of this study. The study began in 2012, with 1,134 twelve-year-old adolescents being randomly selected from public schools in Santa

Maria, RS. During this period, the municipality had 261,031 inhabitants, including 3,817 twelve-year-olds attending public schools.¹⁸

Sampling was performed using a double-stage conglomerate. The first stage involved 20 schools (out of 39 public schools) selected in the city's five administrative regions (center, south, east, west, and north). Subsequently, all 12-year-old adolescents attending these schools were invited to participate in the study.^{19,20}

In 2014, the first reevaluation was conducted with 771 participants, achieving a retention rate of 68%. The second reevaluation of the same adolescents was conducted in 2018, with 769 adolescents being re-evaluated (retention rate of 67.8%). In both reevaluations, if the participants were no longer enrolled at their home school, the teaching address of the new school was verified through the enrollment center, and the participants were sought through telephone contact and the addresses noted while collecting baseline information.

Methodological protocols, such as the administration of questionnaires and clinical examinations, were performed identically during the three evaluations of this cohort study.

Training process

An examiner well-versed in the use of the DMFT index (decayed, missing, and filled permanent teeth)²¹ was responsible for training four researchers in 2012, four in 2014, and seven in 2018. The training stage included theoretical classes, case discussions, laboratory practices, and school visits (calibration stage). The inter- and intra-examiner kappa values obtained were above 0.70 in all evaluations.

Self-reported oral health

Adolescents' self-reports were assessed through the global question, "c of your teeth, lips, jaws, and mouth is ...?" The answers were recorded as scores ranging from 0 to 5, with "0" indicating excellent, "1" indicating good, "2" indicating regular, "3" indicating bad, and "4" indicating poor oral health²². Subsequently, the responses were dichotomized into self-reported good (excellent/good) and poor (regular/bad/poor).

Clinical assessment

The examiners performed the clinical evaluation under natural lighting, using a “ball-point” probe and a mouth mirror at the schools and/or homes of the participants²¹.

Clinical examinations were performed according to the World Health Organization (WHO) criteria. The presence of decayed, missing, and filled teeth (DMFT indices) represented the evaluation, estimating the present and experienced dental caries in the permanent dentition²¹ through the complete index (DMFT) and its separate components. This variable was used continuously.

Adjustment variables

Covariates were collected at baseline and were considered possible adjustment variables for the association between self-reported oral health and normative indices of dental caries. The variables considered were demographic conditions (sex and skin color), socioeconomic status (mother’s education and household income), and dental visits, and information was collected using a self-administered questionnaire answered by the parents or legal guardians of the adolescents. Sex was recorded as “female” or “male” Skin color was classified according to the parents’ perception and later dichotomized as “White and Non-White.” The data regarding the mothers’ education was collected in the form of years of formal study and later categorized into “≥ 8 years” and “< 8 years.” Household income was collected in Real (R\$), representing the sum of all forms of income earned monthly by the family and was later dichotomized by the median in “≤ R\$ 100,000” and “> R\$ 100,000” (R\$ 100,000 corresponds to approximately USD 45,000 at baseline). Dental visits was marked as “yes” or “no” based on whether the adolescent had visited the dentist in the last 6 months.

Statistical analysis

Descriptive analyses were used to characterize the variables of self-reported oral health and normative indices using frequencies, means, and standard deviations (SDs). The sample was composed of individuals followed up during the three collections.

Tests were also performed to compare the follow-up and non-respondents. The Mann-Whitney test was performed to compare the self-reported oral health and dental caries indices.

Adjusted analyses were performed using multilevel logistic regression, taking into account the dependence of those observed at the time. A multilevel structure considered repeated self-reported oral health measures three times (first level) nested in the adolescents (second level). To evaluate the associations throughout adolescence, the analyses were adjusted for adolescents pooled in time points. The outcome was associated with DMFT and its separate components. The adjusted analyses were performed separately to avoid the interaction between the index components. All multilevel regression analyses were adjusted for demographic, socioeconomic, and dental visit variables. The results are shown as odds ratios (OR) and their respective 95% confidence intervals (CI). The measurement of the association between the outcome (poor self-reported oral health) over time, through mean scores of dental caries indices, is assessed by OR. Statistical significance was set at $p < 0.05$. All analyses were performed using STATA 14.0 (STATA Corp., College, USA).

Results

Among the 1,134 participants at baseline, 743 in T2 and 749 in T3 were reassessed for dental caries. The losses at follow-up were due to participants not being found, participant refusal, or city change. The non-respondents did not differ from the participants, except in terms of dental visits in T3 (Table 1). However, sensitivity analysis through bootstrapping was performed for missing data, and the difference did not influence the results.

The sample power calculation was performed using G*Power 3.1.9.2 software for Windows, using a post hoc power analysis based on a small to moderate effect size (0.3), an α error probability of 0.05, and a total sample size of 749. The power of this study was 100%.

The mean DMFT in T1, T2, and T3 were 1.15 (SD = 1.56), 1.48 (SD = 1.79), and 1.63 (SD = 1.91), respectively. In T1 and T2, the highest means were

Table 1. Descriptive analysis of the baseline and follow-up and the comparative analysis between the follow-up and non-respondents.

Variable	Baseline	Follow-up T2	Non-respondents T2	p-value*	Follow-up T3	Non-respondents T3	p-value*
	n(%)	n(%)	n(%)		n (%)	n (%)	
Sex				0.507			0.07
Female	610 (53.8)	409 (53.1)	201 (55.2)		427 (55.6)	183 (50.0)	
Male	524 (46.2)	361 (46.9)	163 (44.8)		341 (44.4)	183 (50.0)	
Skin color				0.300			0.364
White	863 (77.5)	596 (78.4)	267 (75.6)		589 (78.3)	274 (75.9)	
Non-white	250 (22.5)	164 (21.6)	86 (24.4)		163 (21.7)	87 (24.1)	
Mother's education				0.162			0.89
≥ 8 years	702 (64.8)	469 (63.4)	233 (67.7)		473 (64.6)	229 (65.1)	
< 8 years	382 (35.2)	271 (36.6)	111 (32.3)		259 (35.4)	123 (34.9)	
Household income				0.309			0.31
> R\$ 1,000	556 (53.7)	374 (52.6)	182 (56.0)		386 (50.5)	170 (51.3)	
≤ R\$ 1,000	480 (46.3)	337 (47.4)	143 (44.0)		319 (49.5)	161 (48.7)	
Visit to dentist				0.097			0.016
No	514 (47.3)	338 (45.6)	176 (51.0)		365 (49.9)	149 (42.1)	
Yes	572 (52.7)	403 (54.4)	169 (49.0)		367 (50.1)	205 (57.9)	
Self-reported oral health				0.530			0.096
Good	629 (55.5)	432 (56.1)	197 (54.1)		439 (57.2)	190 (51.9)	
Poor	505 (44.5)	338 (43.9)	167 (45.9)		329 (42.8)	176 (48.1)	
DMFT [mean(SD)]	1.15 (1.56)	1.12 (1.57)	1.21 (1.55)	0.177	1.10 (1.50)	1.25 (1.69)	0.059
Decayed [mean(SD)]	0.89 (1.40)	0.86 (1.39)	0.97 (1.41)	0.094	0.85 (1.31)	1.00 (1.57)	0.273
Missing [mean(SD)]	0.02 (1.17)	0.02 (0.19)	0.00 (0.07)	0.953	0.02 (0.18)	0.01 (0.13)	0.824
Filled [mean(SD)]	0.26 (0.66)	0.26 (0.64)	0.26 (0.70)	0.501	0.26 (0.65)	0.26 (0.67)	0.483

*p-value between follow-up and non-respondents, by Chi-square and Mann-Whitney tests. DMFT: decayed, missing and filled permanent teeth; SD: standard deviation.

observed for decayed teeth and in T3 for filled teeth. There was an increase in the mean number of missing and filled teeth over time. The prevalence of poor self-reported oral health was 44.5% (n = 505) in T1, 46.1% (n = 344) in T2, and 51.7% (n = 396) in T3 (Table 2).

Table 3 shows the comparative analysis of self-reported oral health, DMFT, and its components. Adolescents reporting their oral health as poor had higher means of DMFT, decayed, and missing teeth.

The adjusted analysis of multilevel regression is presented in Table 4. Adolescents with higher means of DMFT were more likely to self-report their oral health as poor over time (OR: 1.35; CI95% 1.22–1.50). When evaluated separately, the decayed and missing teeth

also showed significant results, demonstrating that a higher mean of decayed (OR: 2.43; CI95% 1.83–3.23) and missing (OR: 3.94; CI95% 1.26–12.26) teeth was associated with poor self-reported oral health. In contrast, filled teeth were not associated with poor self-reported oral health (p > 0.05). The results were adjusted for demographic, socioeconomic, and dental visit variables, and the adolescents were pooled in time points, showing the results of associations throughout adolescence.

Discussion

This study aimed to assess the association between self-reported oral health and normative indices of

Table 2. Descriptive analysis of DMFT indices, its components, and self-reported oral health.

Variable	Mean (SD)	Median	Min-Max	Total
T1				
DMFT	1.15 (1.56)	0.5	0-10	1.134
Decayed	0.89 (1.39)	0	0-10	1.134
Missing	0.02 (0.17)	0	0-3	1.134
Filled	0.26 (0.65)	0	0-5	1.134
Self-reported oral health n (%)				
Good	629 (55.5)			1.134
Poor	505 (44.5)			1.134
T2				
DMFT	1.48 (1.79)	1	0-12	743
Decayed	0.84 (1.34)	0	0-10	743
Missing	0.06 (0.28)	0	0-3	743
Filled	0.57 (1.08)	0	0-8	743
Self-reported oral health n (%)				
Good	403 (53.9)			747
Poor	344 (46.1)			747
T3				
DMFT	1.63 (1.91)	1	0-15	749
Decayed	0.21 (0.69)	0	0-10	749
Missing	0.12 (0.54)	0	0-6	749
Filled	0.98 (1.53)	0	0-15	749
Self-reported oral health n (%)				
Good	370 (48.3)			766
Poor	396 (51.7)			766

DMFT: Decayed, missing and filled permanent teeth; SD: standard deviation.

Table 3. Comparative analyses between self-reported oral health and decayed, missing, and filled teeth.

Variable	Self-reported oral health					p-value*
	Good		Poor			
	N	Mean (SD)	N	Mean (SD)		
T1						
DMFT	629	0.93 (1.38)	505	1.42 (1.72)	< 0.01	
Decayed	629	0.67 (1.16)	505	1.18 (1.61)	< 0.01	
Missing	629	0.01 (0.09)	505	0.03 (0.22)	< 0.01	
Filled	629	0.27 (0.66)	505	0.24 (0.66)	0.28	
T2						
DMFT	400	1.19 (1.62)	343	1.81 (1.92)	< 0.01	
Decayed	400	0.54 (1.03)	343	1.19 (1.56)	< 0.01	
Missing	400	0.03 (0.22)	343	0.08 (0.34)	0.01	
Filled	400	0.58 (1.13)	343	0.57 (1.02)	0.60	
T3						
DMFT	362	1.36 (1.76)	387	1.87 (2.00)	< 0.01	
Decayed	362	0.09 (0.34)	387	0.33 (0.89)	< 0.01	
Missing	362	0.06 (0.34)	387	0.18 (0.67)	< 0.01	
Filled	362	0.96 (1.55)	387	0.99 (1.51)	0.71	

*Mann-Whitney. SD: Standard Deviation.

Table 4. Multilevel logistic analysis between the self-reported oral health and normative indices of dental caries.

Variable	OR (CI95%)	p-value
DMFT*	1.35 (1.22–1.50)	0.000
Decayed*	2.43 (1.83–3.23)	0.000
Missing*	3.94 (1.26–12.26)	0.018
Filled*	1.12 (0.90–1.38)	0.316

OR: odds ratio; *Separate analyzes adjusted by sex, skin color, household income, mother's education, and visited to dentist.

dental caries among adolescents in three evaluations, as part of a longitudinal study. Moreover, this study is one of the first to evaluate whether this association is maintained over time through adolescence.

Although some authors have not found an association between the evaluations of patients and dentists regarding the oral conditions in adolescents,^{12,13} adults,⁴ and older people,⁷ the association was present in the three evaluations, regardless of age, in this population, corroborating the results of studies carried out in adults^{8,10,15} and older individuals.^{2,8,10}

Adolescents with higher means of DMFT were likely to rate their oral health as poor, as was the case when the components were evaluated in isolation, such as decayed or missing teeth. Three important aspects can possibly explain these results: a) individuals with access to dental services receive guidance regarding oral health. Similarly, schools are strategic places for carrying out educational programs involving oral health, allowing the individual to acquire knowledge regarding health problems²³; b) oral diseases can cause esthetic problems that, in turn, may be accompanied by psychosocial discomfort, affecting the adolescents' self-esteem and modifying how the individual is affected by the problem experienced;^{24,25} c) This association can also be seen in interaction with social, cultural, psychological, and environmental factors due to the effects of pain or discomfort.¹⁰ Such results can be justified because clinical oral health conditions affecting function and quality of life are more easily perceived by the individual.^{4,10,15}

In contrast, when analyzed separately, filled teeth were not associated with the normative index, which was consistent with the results of studies in which the oral health-related quality of life was positively

influenced by treated cavities.^{26,27} This result can be interpreted as filled teeth being perceived needs of the past which have already been solved or attenuated.^{11,15,27} Self-reporting of filled teeth would be a consequence of the opportunity to receive dental treatment and can be associated with health care and psychological well-being.²⁸ In addition, dental treatments can control pain and sensitivity, improve the ability to chew, restore esthetics when performed on anterior teeth, and benefit social interactions, thereby improving the oral health-related quality of life.²⁹ These findings suggest that the benefits of the restorative treatment of dental caries show the importance of policies related to health behaviors in children and adolescents.²⁷

The subjective reactions of the patients to their oral conditions have a strong influence on their perceived health. Although patients have difficulty in assessing their specific clinical status, their perceptions play an important role in the dental treatment plan and understanding of their health behaviors.^{2,12} Thus, these results can support the development of more sensitive questions and enable the development of strategies in schools and communities. Perceptions of individuals' clinical conditions can be used for screening purposes to plan oral health services and prioritize large populations.^{7,9-11,13} The perception of poor oral health by Individuals can help in encouraging visits and allow screening at places with few resources, where clinical examinations are not accessible or are unavailable.² Moreover, the foundation of disease prevention is laid down during adolescence, especially since the prevalence of caries and periodontal disease tends to increase with age.

This study has some limitations that must be considered. The DMFT index only reports caries attacks and does not show significant losses due to periodontal disease or due to prosthetic and orthodontic reasons. Thus, the participants' responses may have been influenced by the presence of other perceived oral health needs. Nevertheless, this study has positive aspects that deserve to be highlighted. A random sample of adolescents with a comprehensive age range of 12–19 years was chosen, supporting the ability to generalize the results in the target population, including adolescents who lived in a

medium-sized city similar to Santa Maria. As this was a longitudinal study, it was possible to follow the evolution of adolescents' perceptions assessed over six years, with a low number of losses and refusals. Likewise, the use of instruments with good levels of validity and reproducibility, recommended by the WHO and applied by trained researchers following a protocol, contributed to increasing the internal validity of the present study.

Conclusion

In conclusion, the self-reported oral health of adolescents was associated with the normative indices of dental caries, with the association persisting throughout adolescence. Self-perception can provide reliable information regarding oral health, and oral health strategies can be designed to benefit the health of the population studied.

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