



Do untreated caries influence the school leaving of adolescents? A cohort study

Fernanda Ruffo Ortiz ^{1,2}, Thiago Machado Ardenghi ², Marilia Maroneze ^{2,3}, Saul Martins Paiva ¹, Isabela Almeida Pordeus ¹

The objective was assess the influence of untreated caries and socioeconomic status (SES) on school dropout among adolescents. A six-year cohort study was conducted with random sample of adolescents (12 years-old) who had been evaluated initially in 2012 from Santa Maria, Brazil. Sex, socioeconomic status (mother's education and household income), and untreated caries were collected at the baseline. The outcome variable was collected at the follow-up through self-report and was divided into three categories: adolescents who only studied, who studied and employed, and who school dropouts. A multinomial regression model was performed to assess the influence of oral disease and SES on school leaving, through relative risk ratio (RRR) and 95% confidence interval (95% CI). From of 1,134 adolescents evaluated at the baseline, 768 participants with a mean age of 17.5 years were re-evaluated at follow-up (67.8% response rate). Male (RRR: 2.31; 95%CI: 1.19–4.48) and adolescents with untreated caries at the baseline had an increment in school-leaving (RRR: 2.26; 95%CI: 1.12–4.56). Mothers with low education (RRR: 2.24; 95%CI: 1.09–4.61) had a higher probability of having children who leave school. Untreated caries and low SES in early adolescence can influence the tendency to school dropouts.

¹ Department of Pediatric Dentistry and Orthodontics, Faculty of Dentistry, Federal University of Minas Gerais, Belo Horizonte, Brazil.

² Department of Stomatology, Faculty of Dentistry, Federal University of Santa Maria, Santa Maria, Brazil.

³ SOBRESP Faculty of Health Sciences, Santa Maria, RS, Brazil.

Correspondence: Fernanda Ruffo Ortiz
e-mail: fernandaruffoortiz@gmail.com
Rua General Osório, 1495/101, Rosário do Sul, RS, Brazil. Zip code: 97.590-000 Phone number: +55(55) 999 22 37 15

Key Words: Oral health, Socioeconomic factors, Student dropouts, Adolescent, Longitudinal studies

Introduction

School dropouts has been defined as leave school before having completed secondary education, representing 20% of Brazilian adolescents and young people (1) and around a third of younger in developed countries (2). Its reasons are complex involved an imbalance in learning, low socioeconomic status (2), need to work, lack of interest (1) and possible health-related conditions, such as poor physical, psychological health, and social relationships (3).

Among oral conditions, untreated caries are the most prevalent (4). Dental caries may also cause several disabilities (5); thorough of symptoms, as toothache (6), leading to difficulty chewing and talking difficulty, and psychosocial factors, as well-being, impair to social relationships (7). Poor oral health has also been linked with psychological and emotional impact (8), such as sleep disorders, low self-esteem, and poor social interaction. It can affect environmental factors, including school and workplace (7).

Oral health problems are persistent and strongly associated with socioeconomic factors (9,10). Individuals born in poor socioeconomic backgrounds accumulate social problems, leading to a cycle of social and health inequalities throughout life (11). Moreover, health behaviors are often replicated, influenced by material conditions and social relationships (12). The burden of dental caries remains significant and poses a problem to public health (4). In addition, no study to date has evaluated the risk accumulation of dental caries in a poor school outcome, such as school dropout. Therefore, the present study aimed to assess the influence of untreated caries and socioeconomic status (SES) on school dropout among adolescents. Our hypothesis was that untreated caries and SES will influence students to become school dropout.

Material and methods

Ethical Approval

This study was approved by the Human Research Ethics Committee at Federal University of Santa Maria (protocol number 0127.0.243.000-11 [2012], and 66553117.4.0000.5346 [2018]). Signed consent from the adolescents and parents was obtained prior to data collection. The participants were diagnosed with oral problems and were referred for dental treatment.

Study design and sample

A longitudinal study was conducted with adolescents from Santa Maria, Brazil. The study started in 2012 with a random sample of 1,134 12-year-old scholars. The sample was randomly selected from 20 public schools (out of 39 schools) in the city. In 2012, Santa Maria had 3,817 12-year-old adolescents (13), 85% of whom were enrolled in public schools (13). Sampling was conducted in two stages. The first stage involved public schools with probability selection equal to school size. The second stage involved all 12-year-old scholars enrolled in the selected schools (14).

In 2018, we carried out the second data collection of the study. All baseline participants were considered eligible. The participants were contacted by phone, through the public schools, and home visits. A total of 768 adolescents (response rate of 67.8%), with a mean age of 17.5 years, were reassessed.

Data Collection

Variables at the baseline

The co-variables were collected at the baseline in 2012.

Parents or guardians answered a structured questionnaire. The demographic and socioeconomic variables were sex (female/male), mother's education, and household income. Mother's education was collected in formal years of study (corresponding to primary education in Brazil) and dichotomized into completion of eight years of formal education (≥ 8 years/high) or less (<8 years/low). Household income was collected in amounts received in the month by all residents, and dichotomized by median (corresponding US\$ 450 during the collecting period). Toothache variables were collected through the following question, "Have you had toothache in the last six months (no or yes)?"

The four dentists evaluated the clinical variable. A calibration process for dental caries involving: theoretical classes, discussion of criteria for diagnostics, examination of extracted teeth, examination of pictures, and examination of 20 adolescents. The examiners obtained inter-examiner kappa values ranking from 0.77 to 0.82, and intra-examiner values ranking from 0.79 to 0.85. The clinical examinations were performed under natural light, using a dental mirror and periodontal probe (15). Dental caries were diagnosed through the Decayed, Missing, and Filled of permanent Teeth index (DMF-T) (15). The untreated caries variable was composed of the decayed component (D >0 component).

Outcome at follow-up

At follow-up, the adolescents answered questions on school and employment. The self-report outcome variable was composed of three categories: individuals who studied, in high school, college or technical course (only study); those who studied and/or employed (school/work); and those who left school before the minimum leaving age (school dropouts). Outcome was considered the incidence variable because at the baseline, the adolescents only studied. Statistical variables were modeled as categorical using dummy terms.

Statistical analyses

Descriptive analysis was performed to evaluate the sample characteristics at the baseline and follow-up, and differences between follow-up and non-follow-up adolescents (chi-square test). Comparison tests (chi-square and ANOVA) were performed for variables at the baseline and follow-up.

Multinomial regression was used to assess the influence of untreated caries and socioeconomic variables on the outcome. These relations were based on a previous study (16), including possible confounders for caries disease. In the unadjusted analysis, variables with $p < 0.20$ in one of the outcome categories were included in the adjusted analysis. The results were interpreted as relative risk ratio (RRR) and 95% confidence interval (95% CI) between the comparison, "school/work" and "only study", and "school dropout" and "only study." The reference category was "only study." In the adjusted analysis, the results were considered having a p -value < 0.05 ; the other variables remained in the model as adjustment. Analyses were performed using STATA 14.0 (STATA Corporation, College Station, TX, USA).

Results

Among the 1,134 adolescents invited, 768 (67.8%) agreed to participate at follow-up. The dropouts did not differ from the participants (Table 1). The majority of the adolescents belonged to a family with low SES and slightly less than half (42.1%) had untreated caries. After six years, 64.5% of the adolescents continued studying, 18.1% studied and worked, and 17.4% had dropped out of school.

Table 1. Descriptive analysis of the characteristics sample at the baseline, and comparative analysis between follow-up and dropouts. Santa Maria, Brazil.

	Baseline N(%)	Follow-up N (%)	Non-follow-up N (%)	p-value*
Sex				0.07
Female	610 (53.8)	427 (55.6)	183 (50.0)	
Male	524 (46.2)	341 (44.4)	183 (50.0)	
Mother's education				0.89
High	702 (64.8)	473 (64.6)	229 (65.1)	
Low	382 (35.2)	259 (35.4)	123 (34.9)	
Household income				0.31
High	556 (53.7)	386 (50.5)	170 (51.3)	
Low	480 (46.3)	319 (49.5)	161 (48.7)	
Untreated caries				0.44
Without	657 (57.9)	451 (58.7)	206 (56.3)	
With	477 (42.1)	317 (41.3)	160 (43.7)	
Toothache				0.65
No	778 (73.8)	530 (74.2)	248 (72.9)	
Yes	276 (26.2)	184 (25.8)	92 (27.1)	
Outcome				
Only school	1,134 (100.0)	412 (53.7)	-	
School-work	0	293 (38.2)	-	
School dropouts	0	62 (8.1)	-	

*p-value between follow-up and dropout/non-follow-up. Mother's education: low (<8 years) and high (≥8 years); Household income: low (< US\$450) and high (≥ US\$450).

Table 2 shows the comparative analysis results between variables at the baseline and categories at the outcome. Most individuals with low SES and untreated caries were in the school dropouts category, compared with their peers ($p < 0.05$). The power for this study was evaluated through sample size. The statistical power was calculated by an proportion between exposed (adolescents with untreated dental caries and who school dropouts) of 62 (risk of disease of 11%) and unexposed (adolescents with untreated dental caries and who only school) of 412 (risk of disease of 52%), resulting in a sample power of 100%.

Table 2. Comparative analysis between variables at the baseline and categories at the outcome. Santa Maria, Brazil.

	Outcome			p-value*
	Only school N(%)	School-work N(%)	Scholl dropouts N(%)	
Sex				0.82
Female	241 (56.6)	158 (37.1)	27 (6.3)	
Male	171 (50.1)	135 (39.6)	35 (10.3)	
Mother's education				<0.01
High	265 (56.1)	186 (39.4)	21 (4.5)	
Low	132 (50.9)	95 (36.7)	32 (12.4)	
Household income				<0.01
High	210 (54.4)	157 (40.7)	19 (4.9)	
Low	166 (52.2)	115 (36.2)	37 (11.6)	
Untreated caries				0.04
Without	248 (55.0)	176 (39.0)	27 (6.0)	
With	164 (51.9)	117 (37.0)	35 (11.1)	
Toothache				0.04
No	293 (55.3)	208 (39.2)	29 (5.5)	
Yes	96 (52.4)	67 (36.6)	20 (11.0)	

*p-value: chi-square test for dichotomized variables and ANOVA for continuous variable. Mother's education: low (<8 years) and high (≥8 years); Household income: low (< US\$450) and high (≥ US\$450);

Multinomial regression was modeled by unadjusted and adjusted analyses. All variables presented $p < 0.20$ in the school dropouts category (Table 3) and were included in the adjusted analysis. In the final model, the outcome was associated with sex, mother's education, and untreated caries. Male participants had a higher probability of being school leavers (RRR: 2.31; 95%CI: 1.19–4.48). Mothers with low education increased the probability of having children who leave school (RRR: 2.24; 95%CI: 1.09–4.61).

Table 3. Unadjusted multinomial regress between variables baseline and outcome. Santa Maria, Brazil.

Baseline variables	Outcome			
	Only School (base outcome)		School dropouts	
	School-work RRR (95% CI)	p-value	RRR (95% CI)	p-value
Sex		0.23		0.03
Female	1		1	
Male	1.20 (0.89-1.63)		1.83 (1.06-3.13)	
Mother's education		0.88		<0.01
High	1		1	
Low	1.02 (0.74-1.41)		3.06 (1.69-5.51)	
Household income		0.64		<0.01
High	1		1	
Low	0.93 (0.68-1.27)		2.46 (1.37-4.44)	
Untreated caries		0.97		0.01
Without	1		1	
With	1.00 (0.74-1.36)		1.96 (1.14-3.36)	
Toothache		0.92		0.02
No	1		1	
Yes	0.98 (0.68-1.41)		2.10 (1.14-3.89)	

Mother's education: low (<8 years) and high (≥ 8 years); Household income: low (< US\$450) and high (\geq US\$450). RRR: Risk Relative Rate; CI: confidence interval.

Adolescents with untreated caries at the baseline had an increment in school dropouts at the follow-up R: 2.26; 95%CI: 1.12–4.56) (Table 4).

Table 4. Adjusted multinomial regress between variables baseline and outcome. Santa Maria, Brazil.

Baseline variables	Outcome			
	Only School (base outcome)		School dropouts	
	School-work RRR (95% CI)	p-value*	RRR (95% CI)	p-value*
Sex		0.43		0.01
Female	1		1	
Male	1.14 (0.82-1.58)		2.31 (1.22-4.63)	
Mother's education		0.49		0.03
High	1		1	
Low	1.14 (0.78-1.65)		2.18 (1.05-4.51)	
Household income		0.36		0.62
High	1		1	
Low	0.85 (0.59-1.21)		1.19 (0.58-2.44)	
Untreated caries		0.70		0.02
Without	1		1	
With	0.94 (0.66-1.51)		2.26 (1.12-4.56)	
Toothache		0.99		0.41
No	1		1	
Yes	1.00 (0.66-1.51)		1.37 (0.65-2.86)	

Mother's education: low (<8 years) and high (≥ 8 years); Household income: low (< US\$450) and high (\geq US\$450); RRR: Risk Relative Rate; CI: confidence interval.

Discussion

The findings of this study confirmed our hypothesis. Dental caries, mother's educational level, and sex influenced the likelihood of school dropout in adolescents. Mother's education was considered a proxy for SES. Still, to our knowledge, this longitudinal study is the first to evaluate the relations between dental caries and school dropout among adolescents.

Education is a measure of socioeconomic status. It is required by adolescents and young people to determine future employment opportunities and income. Individuals belonging to the low education group have poor self-rated health, mainly for financial and psychological reasons (17). These individuals tend to have an increased probability of leaving school to work and help with the family income (18). Adverse childhood SES can influence adverse adult SES and its behaviors. So, socio-biological mechanisms can result in adverse educational attainment and lower adult SES (19). People tend to remain in the same social group, subjected to an iterative process between social, economic, and health relations, it can become a repetitive cycle between SES and health relationships.

Individuals with untreated caries tend to be from families with low SES. Their poor oral health tends to persist throughout life, and their behaviors do not change (9). Its behaviors may be related to fewer visits for dental services and less health education. Consequences of the adverse effects of oral diseases may have an impact on educational attainment, future projections of employment, lower wages, and lower prospects for improvement (19). Moreover, dental caries affect different domains of quality of life. The psychological and social impact of diseases, such as pain, functional limitation, and effect of appearance on self-esteem and interaction with others, could interfere with daily activities (5,6). The negative emotions caused by diseases, can make the individual feels unhappy (14), leading psychological distress (8). Therefore, health behaviors may be related to other circumstances of adolescent life as well, including educational achievement (20).

Medical studies have shown that adolescent sickness can contribute to the persistent problem of school dropout, where SES affects high school completion through its effect on health (16). Further, these associations are showed with chronic and mental health disorders (21) and health-related problems (3). It may alter physical and mental performances, as higher levels of sleepiness and more frequent illness (21). In this sense, dental caries can also lead to difficulty sleeping owing to pain and affect the individual's physical, emotional and social domains (22). Thus, we cannot disregard the relationship between oral health and education.

Our findings showed an increased likelihood for leaving school before the minimum leaving age among the male participants. One previous study reported that men have lower rates of completing secondary education (23). Their reason for leaving may be low academic performance (24) and financial; that is, to help the family (18). This relates to the highest number of men in the labor market.

This study has a number of strengths and limitations. Strength includes the longitudinal design. The participants were followed from the beginning to the end of adolescence, with a six-year follow-up and with an acceptable retention rate. The oral variable, untreated caries was determined using normative measures by calibrated dentists. The model variables followed a previous study (16); race was not included because, in our sample, the majority declared themselves white, rendering the discriminatory power of race as low. Toothache was included as a possible confounded, because school dropouts could have been due to dental pain stages and not only due to caries lesions. As for limitations, educational attainment and employment data were self-reported; however, studies commonly use self-reported variables (18,23). Moreover, our study did not evaluate external and individual factors, such as school characteristics, social networks, and pregnancy. The baseline samples included only public schools; nonetheless, 85% of the students in the city were enrolled in public schools. In addition, according to our knowledge, few studies have been conducted on school dropouts, hampering comparisons. Despite these limitations, our findings provide additional evidence on the relation between variations in SES and health.

Adverse conditions in the initial stages of life bring consequences for a lifetime; therefore, interventions to reduce inequities in health and education need to focus on early life. Public strategies are needed for the prevention and treatment of caries, as well as public policies valuing education for all generations, through conditions favorable for health improvement and involving universal measures (25). Moreover, promotion strategies for health education need to consider the different cognitive abilities and behavioral stages among adolescents.

In conclusion, untreated caries and socioeconomic status in early adolescence can influence the tendency to school dropout. Promotion strategies are needed to prevent and reduce inequalities early in life.

Resumo

O objetivo foi avaliar a influência da cárie dentária não tratada e do status socioeconômico (SES) sobre o abandono escolar dos adolescentes. Foi realizado um estudo de coorte de seis anos de acompanhamento com uma amostra aleatória de adolescentes (12 anos de idade) avaliados inicialmente em 2012 em Santa Maria, Brasil. Sexo, status socioeconômico (educação da mãe e renda familiar) e cárie não tratada foram coletados no início do estudo. A variável de desfecho foi coletada no acompanhamento por meio do autorrelato e foi dividida em três categorias: adolescentes que apenas estudavam, aqueles que estudavam e trabalhavam e quem tinha abandonado a escola. Um modelo de regressão multinomial foi realizado para avaliar a influência da doença bucal e do SES sobre o abandono escolar, por meio da razão de risco relativo (RRR) e intervalo de confiança de 95% (IC95%). Dos 1.134 adolescentes avaliados no início do estudo, 768 participantes com idade média de 17,5 anos foram reavaliados no acompanhamento (taxa de resposta de 67,8%). Meninos (RRR: 2,31; IC 95%: 1,19– 4,48) e adolescentes com cárie não tratada no início do estudo tiveram um incremento no abandono escolar (RRR: 2,26; IC 95%: 1,12–4,56). Mães com baixa escolaridade (RRR: 2,24; IC95%: 1,09–4,61) tiveram maior probabilidade de ter filhos que abandonaram a escola. Cárie dentária não tratada e baixo SES no início da adolescência pode influenciar a tendência de evasão escolar.

References:

1. Instituto Brasileiro de Geografia e Estatística. I.B.G.E. [internet]. PNAD Contínua Educação – 2019 [cited 2020 Jul 17]. Available from:: www.ibge.gov.br. 2020
2. De Witte K, Cabus S, Thyssen G, Groot W, van den Brink HM. A critical review of the literature on school dropout. *Educational Research Review* 2013;10:13–28.
3. Chau K, Kabuth B, Causin-Brice O, Delacour Y, Richoux-Picard C, Verdin M, et al. Associations between school difficulties and health-related problems and risky behaviours in early adolescence: A cross-sectional study in middle-school adolescents in France. *Psychiatry research* 2016;244:1-9.
4. Kassebaum NJ, Smith AGC, Bernabé E, Fleming TD, Reynolds AE, Vos T, et al. Global, Regional, and National Prevalence, Incidence, and Disability-Adjusted Life Years for Oral Conditions for 195 Countries, 1990-2015. A Systematic Analysis for the Global Burden of Diseases, Injuries, and Risk Factors *J Dent Res*. 2017;96(4):380–7.
5. Locker D, Quiñonez C. To what extent do oral disorders compromise the quality of life? *Community Dent Oral Epidemiol* 2011;39(1):3–11.
6. Barasuol JC, Santos PS, Moccelini BS, Magno MB, Bolan M, Martins-Júnior PA. et al. Association between dental pain and oral health-related quality of life in children and adolescents: A systematic review and meta-analysis. *Community Dent Oral Epidemiol* 2020; 8(4):257-263.
7. Sischo L, Broder HL. Oral Health-related Quality of Life: What, Why, How, and Future Implications. *J Dent Res* 2011;90:1264–70.
8. Silveira MF, Marôco JP, Freire RS, Martins AMEDBL, Marcopito LF. Impact of oral health on physical and psychosocial dimensions: an analysis using structural equation modeling. *Cad Saude Publica* 2014;30:1169-1182.
9. Thomson WM, Poulton R, Milne BJ, Caspi A, Broughton JR, Ayers KMS. Socioeconomic inequalities in oral health in childhood and adulthood in a birth cohort. *Community Dent Oral Epidemiol* 2004;(1):345–53.
10. De Andrade FB, Antunes JLF, de Souza Junior PRB, Lima-Costa MF, de Oliveira C. Life course socioeconomic inequalities and oral health status in later life: ELSI-Brazil. *Rev Saude Publica* 2018;52:1–11.
11. Marmot M. Social justice, epidemiology and health inequalities. *Eur J Epidemiol* 2017;32(7):537–46.
12. Moor I, Spallek J, Richter M. Explaining socioeconomic inequalities in self-rated health : a systematic review of the relative contribution of material, psychosocial and behavioural factors. *J Epidemiol Community Health* 2017;71(6),565-575.
13. Instituto Brasileiro de Geografia e Estatística. I.B.G.E. Dados do Universo – Rendimento; 2010.
14. Tuchtenhagen S, Bresolin CR, Tomazoni F, da Rosa GN, Del Fabro JP, Mendes FM, et al. The influence of normative and subjective oral health status on schoolchildren's happiness. *BMC Oral Health* 2015;15:15.
15. WHO. Oral health surveys, basic methods. 4 ed. 1997.

16. Sznitman SR, Reisel L, Khurana, A. Socioeconomic background and high school completion: Mediation by health and moderation by national context. *J Adolesc* 2017;56:118-126.
17. Granström F, Molarius A, Garvin P, Elo S, Feldman I, Kristenson M. Exploring trends in and determinants of educational inequalities in self-rated health. *Scand J Public Health* 2015;43(7):677-686.
18. Haas SA, Glymour MM, Berkman LF. Childhood health and labor market inequality over the life course. *J Health Soc Behav* 2011;52(3):298-313.
19. Braveman P, Barclay C. Health disparities beginning in childhood: a life-course perspective. *Pediatrics* 2009;124:163-175.
20. Koivusilta L, Arja R, Andres V. Health behaviours and health in adolescence as predictors of educational level in adulthood: a follow-up study from Finland. *Soc Sci Med* 2003;57(4):577-593.
21. Drake C, Nickel C, Burduvali E, Roth T., Jefferson C., Pietro B. The pediatric daytime sleepiness scale (PDSS): sleep habits and school outcomes in middle-school children. *Sleep* 2003;26(4):455-458.
22. Feldens CA, Ardenghi TM, Dullius AIDS, Vargas-Ferreira F, Hernandez PAG, Kramer PF. Clarifying the impact of untreated and treated dental caries on oral health-related quality of life among adolescents. *Caries Res* 2016;50(4):414-421.
23. Von dem Knesebeck O, Verde PE, Dragano N. Education and health in 22 European countries. *Soc Sci Med* 2006;63(5):1344-51.
24. Doll JJ, Eslami Z, Walters L. Understanding why students drop out of high school, according to their own reports. *SAGE Open* 2013;3:1-15.
25. Diderichsen F, Hallqvist J, Whitehead M. Differential vulnerability and susceptibility: how to make use of recent development in our understanding of mediation and interaction to tackle health inequalities. *Int J Epidemiol* 2019;48(1):268-274.

Received: 10/11/2020
Accepted: 15/02/2021