








# Association among oral health and academic performance: a longitudinal study in a university in Southern Brazil

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**Declaration of Interests:** The authors certify that they have no commercial or associative interest that represents a conflict of interest in connection with the manuscript.

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<https://doi.org/10.1590/1807-3107bor-2023.vol37.0046>

Submitted: December 13, 2021  
Accepted for publication: December 6, 2022  
Last revision: January 24, 2023

**Abstract:** This longitudinal study aimed to investigate the association between self-perceived oral health, oral-health-related quality-of-life (OHRQoL), toothache, and university students' academic performance or dropout. A cohort of 2,089 students from 64 different courses at a public university in southern Brazil was interviewed in 2016 regarding their self-perceived oral health (Locker instrument; dichotomized into good/poor), OHRQoL (Oral Impacts on Daily Performances instrument, OIDP) and having had any toothache over the last 6 months (yes/no). After three years (2020), the academic records of 1,870 of these students were assessed, their average grade over all courses evaluated, and their dropout status was determined. Multivariable linear or logistic regression adjusting for gender, skin color, age, family income and maternal education was used to associate oral health variables (self-perceived oral health, OIDP, toothache) and academic performance or dropout. In 2016, 28.6% reported negative self-perceived oral health through the Locker instrument and 31.4% had toothache in the last 6 months. Over the next three years, 36.2% had dropped out. In multivariable regression, toothache in the last 6 months had a decrease of 0.32 ( $\beta$  -0.32, CI95% -0.59; -0.04) points in the final grade and were 35% (OR 1.35 CI95% 1.08; 1.69) more likely to dropout than students without toothache. In conclusion, this study showed that worse oral health conditions may be associated with worse academic performance or dropping out.

**Keywords:** Oral Health; Academic Performance; Quality of Life; Toothache.

## Introduction

Oral health is part of every individual's general health and is an essential element for quality of life.<sup>1,2</sup> Activities such as eating, smiling, and speaking directly contribute to the wellbeing and are connected to oral health conditions.<sup>3</sup> Oral diseases like dental caries and periodontal diseases may cause pain and discomfort and negatively impact daily and social activities.<sup>3</sup> Self-perceived oral health-related quality of life (OHRQoL) is the result of the interpretation of experiences and health status in the context of daily life,<sup>4</sup> and shows a high association with clinically observed oral conditions.<sup>5</sup> Self-perceived oral health and OHRQoL



may vary between genders, age groups, income or educational levels and settings.<sup>6</sup>

Individuals may neglect their oral health in situations involving high stress levels; for example, students in university settings may experience such stress.<sup>7</sup> Also, bad eating habits, alcohol and/or drug use could be harmful to the oral health conditions of this group.<sup>7</sup> Poor self-perceived oral health or symptoms like toothache may affect academic performance and result in absenteeism.<sup>8</sup>

Investigations between oral health and academic performance or absenteeism are more common in children.<sup>9</sup> The presence of toothache and the number of dental visits to treat oral problems are associated with absenteeism in adolescents,<sup>10</sup> but there is scarce evidence on the association between oral health and the academic performance of university students. A cross-sectional study found that the report of poorer self-perceived oral health was associated with the report of lower academic performance among university students, and that absenteeism was almost six times more prevalent in students who reported toothache.<sup>11</sup> So far, no longitudinal study is available allowing to infer on the chain of events and conditions or any causal associations. The objective of the present study was to investigate if self-perceived oral health, OHRQoL and having had toothache in the last 6 months are associated with academic performance and dropout of university students over a follow-up period of 3 years.

## Methodology

The reporting in this study followed the STROBE (Strengthening the Report of Observational Studies in Epidemiology)<sup>12</sup> statement for cross-sectional studies.

### Study design

This study is a longitudinal observational study with undergraduate students from the Federal University of Pelotas (UFPEL). All students who entered in the first academic semester of 2016 at UFPEL were eligible for the study, except those who were unable to complete the questionnaire. Two stages of data collection were performed: the first stage involved an evaluation of socioeconomic, demographic,

psychological, and oral health characteristics, and the second stage evaluated academic performance and dropout data.

## Setting

### First stage

The first stage of data collection was performed in the first semester of 2016 by a trained team comprised of graduate and undergraduate students who applied and supervised the responses to a self-administered questionnaire in classrooms by the students eligible for the study. Those students who were not enrolled in the first semester were excluded. Participating individuals signed an informed consent form before enrollment in the study, and the study was approved by the Ethic Committee. The sample size was defined considering the estimate of enrollments in the first semester of 2016 (3000 students), an exposure prevalence of 50%, an outcome prevalence in exposed individuals of 5%, power of 80% and  $\alpha = 5\%$ , totaling the estimated minimum sample size of 614 individuals.<sup>13</sup> A frequency estimate with a margin of error of 1.8 percentage points was obtained within a 95% confidence interval. For association analysis, this sample size is sufficient to detect a prevalence ratio of 1.4 or greater. Each course was visited until reaching the minimum sample size of 60% of the total number of students to obtain an acceptable response rate.<sup>13</sup> More information regarding the study methodology can be obtained elsewhere.<sup>13</sup>

Exposure variables for the present study were collected in this first stage.

### Second stage

The second stage of data collection took place between January and February 2020. For inclusion criteria, students who participated in the first stage and were still regularly enrolled in the Federal University of Pelotas were selected. The current academic status of each participant was checked in the institutional database using an individual code, by which it was possible to identify the student's status even if they changed their university course, or cancelled or abandoned their academic activities

(dropout). Also, the average grade of each student was collected from their university admission (2016) to the end of the second semester of 2019 through the integrated management system.

This study was approved by the Research Ethics Committee of Federal University of Pelotas under protocol number 49449415.2.0000.5317. All students invited to participate received an information letter about the study and provided informed consent.

## Variables

The evaluation of students' academic performance was measured continuously and summarized as the average grade considering all of the marks in the academic history of each individual. Dropout was dichotomized as "No" or "Yes", with students who canceled, abandoned, took a leave of absence or requested transfer to another institution were classified dropouts.

The exposure variables measured in the first collection (in 2016) were self-perceived oral health, toothache, and the impact of oral health conditions on quality of life. Self-perceived oral health was assessed using the validated Locker instrument,<sup>14</sup> with a single measurement item, simplifying the interpretation of multiple item scales with the question, "Compared with people your age, do you consider the health of your teeth, mouth and gums as: very good, good, regular, bad or very bad?" These five categories were subsequently dichotomized into positive self-perceived oral health (very good, good) and negative self-perceived oral health (regular, bad or very bad) for the statistical analysis. Toothache was assessed by asking the question, "Have you had a toothache within the past 6 months?", with "Yes" or "No" for answers. OHRQoL was measured by the validated "Oral Impacts on Daily Performances" (OIDP) instrument,<sup>15</sup> which aims to measure the impact of oral health conditions on an individual's ability to perform daily activities. The OIDP has nine questions which take into account the frequency that certain situations occurred over the course of the last 6 months. Answers ranged from 0 to 5, with 0 being never and 5 all or almost every day. The total score of this instrument was obtained

through a simple sum of all scores, ranging from 0 to 45. This variable was evaluated as numerical; the higher the score on OIDP, the higher the negative impact on oral health-related quality of life.<sup>16</sup>

We used gender, age, skin color, family income, and maternal education for covariates. All covariates were collected according to the interviewee's self-report. Gender was dichotomized into male and female, age was collected in discrete numerical form and categorized into four categories (16-17, 18-24, 25-34, 35 or more), and skin color was collected according to Brazilian Institute of Geography and Statistics (IBGE), and dichotomized into white, black/brown, indigenous and yellow. The family income was categorized into three categories ( $\leq$  R\$1000.00, 1001 to 5000.00, and  $\geq$  5001.00 in the Brazilian currency - Real), and maternal education was divided into four categories ("did not study or incomplete elementary school", "elementary school complete", "complete high school", and "complete University education").

## Statistical analysis

Data analysis was performed using the Stata version 15.0 statistical software program. First, a description of the data was performed using means, standard deviation, and relative and absolute frequencies. Analyzes were performed with the Pearson's Chi-squared test and Student's T-test. Crude and adjusted analysis were performed using Linear Regression ( $\beta$ ) for numerical outcome and Logistic Regression (Odds Ratios) for binary outcome. Robust variance estimates were used in linear regression models to deal with heteroscedasticity. The association of oral health variables with academic outcomes were adjusted by socioeconomic and demographic variables (gender, age, skin color, familiar income and maternal education), considering previous conceptual model.<sup>9,17,18</sup> Effect measures were presented with 95% confidence intervals (95% CI).

## Results

A total of 2,089 university students responded to a self-administered questionnaire (response rate 64.5%) in 2016. According to the distribution

of socioeconomic, demographic, and oral health characteristics of students at this stage, it was observed that the majority of students were female (52.3%), with white skin color (74.1%) and with family income between R\$1,001.00 and 5,000.00 (61.6%). The majority of participants were in the 18-24 age group (66.1%), with a mean age of 22.38 years and median of 19 years.

Next, 1,870 academic records were obtained from the system in 2020 (89.5% of the students of the first stage; 11.5% records could not be retrieved, mainly as the names written manually by each student in the first stage could not be re-identified). Of these, 1,193 were still student enrolled, had graduated, maintained their course re-option, or showed academic mobility, i.e. they were not dropouts. Thus, 677 were dropouts (cancellation, abandonment, leave of absence or transfer).

In addition, 28.6% of the students reported a negative self-perceived oral health and 31.4% of students reported having had toothache in the last 6 months (Table 1). The average grade was 6.2 (SD 2.4) (Table 1).

The crude associations between academic performance and oral health are shown in Table 2. We found a negative perception of oral health to be associated with a significantly reduced average grade ( $\beta$  -0.34; 95%CI: -0.59--0.09). The mean academic score for students with no impact on OHRQoL (OIDP = 0) was 6.4 (95%CI: 6.26--6.54). For each point in the OIDP score, there is a decrease of 0.05 in the academic grade ( $\beta$  -0.05; 95%CI: -0.08--0.03). We similarly found that the grade also decreased with decreasing OHRQoL ( $\beta$  -0.05; 95%CI: -0.08--0.03). A similar, significant association was reported between having had a toothache and grade ( $\beta$  -0.25; 95%CI: -0.49--0.01). After adjusting for potential cofounders, the association between self-perceived oral health and performance was not significant any longer, while the association with OIDP was significant ( $\beta$  -0.05; 95%CI: -0.07--0.02). Toothache remained showing a significant association ( $\beta$  -0.32; 95%CI: -0.59--0.04) (Table 2).

The crude associations between academic dropout and oral health variables are described in Table 3. Again, we found that poor self-perceived oral health increased the risk of dropout (OR 1.24;

95% CI 1.01-1.53), as did poor OHRQoL (OR 1.27; 95%CI: 1.05--1.54) and having had a toothache (OR 1.30; 95%CI: 1.07--1.59). After adjusting for demographic and socioeconomic variables, only toothache remained significantly associated with dropout (OR 1.35; 95%CI: 1.08--1.69) (Table 3).

## Discussion

The association between oral health and academic performance has not been well investigated. In a previous cross-sectional study, we found that oral health and academic performance were associated, while it was not fully clear if there is any causality implied.<sup>11</sup> The present longitudinal study aimed to investigate the association between self-perceived oral health, OHQoL and university students' academic performance and dropout rate. Based on our results, associations were found for both grades and dropping out in the crude analysis for the three covariates; while association was found in the adjusted analysis for the two outcomes with toothache, and in the OIDP scores only with the outcome of grades.

The average final grade of students with positive self-perceived oral health was higher when compared to students with negative self-perception. Negative perception may be associated with pain and discomfort, constituting conditions which prevent full concentration on academic activities, such as paying attention in classes or studying at home.<sup>9</sup> Toothache affects both the quality of life and academic performance, with university students reporting difficulties in performing certain activities due to toothache, such as in speaking, sleeping or eating and drinking.<sup>8</sup> Some studies with school-aged children have shown that impaired oral health contributes to attention difficulties during class, absenteeism and poor performance.<sup>9,18</sup> A previous study in this cohort of University students showed that impaired oral health increased absenteeism and reduced academic performance.<sup>11</sup>

Studies show that dissatisfaction with oral health is directly related to dental pain in the last six months<sup>8</sup> and that this condition generates other impacts on quality of life, such as difficulty in

**Table 1.** Sample characteristic for the two follow-ups (2016 and 2020) (n = 2080).

Variable (n*)	n	%
Sex (n = 2080)		
Male	993	47.7
Female	1087	52.3
Group skin color (n = 2045)		
White	1515	74.1
Black/Brown	508	24.8
Indigenous	7	0.3
Yellow	15	0.7
Age (n = 2080)		
16-17 years	312	15.0
18-24 years	1375	66.1
25-34 years	215	10.3
35 or more	178	8.6
Family income in Reais (n= 1717)		
≤ 1000,00	280	16.3
1001 a 5000,00	1057	61.6
≥ 5001,00	380	22.1
Maternal education (n= 2058)		
Did not study or incomplete elementary school	470	22.8
Elementary school complete	272	13.2
Complete high school	649	31.6
Complete University education	667	32.4
University dropout until 2019/20 (n= 1870)		
No (still enrolled/graduated/with course reoption/academic mobility)	1193	63.8
Yes (canceled/abandoned/took a leave of absence/requested transference to other institution)	677	36.2
Self-perceived of oral health (n = 2075)		
Positive	1482	71.4
Negative	593	28.6
Toothache (n = 2072)		
No	1421	68.6
Yes	651	31.4
	Mean	SD
Final grade of the university student (n = 1867)	6.2	2.4
OIDP (n = 2009)	3.3	4.4

\*Incomplete for some covariates due to missing data. These missing data were treated as losses. 2080 participants from the first stage and 1070 participants from second stage.

eating, brushing teeth, irritability, nervousness, and shame when smiling.<sup>19,20</sup> Our findings are in agreement with the literature, as students who reported toothache in the last six months had worse

academic performance compared to students who did not report it. University dropout was also associated with dental pain. Students who reported toothache in the last six months have a higher chance to avoid

**Table 2.** Crude and multiple linear regression coefficient ( $\beta$  and 95% CI) for the association between student's grades and oral health variables (n = 1870).

Average grade	$\beta$ (crude)	95%CI	$\beta$ (adjusted)*	95%CI
Negative self-perceived of oral health (ref.: positive)	-0.34**	-0.59– -0.09	-0.24	-0.52– 0.04
OIDP (score)	-0.05**	-0.08– -0.03	-0.04*	-0.07– -0.02
Having had toothache (ref.: no)	-0.25**	-0.49– -0.01	-0.32*	-0.59– -0.04

\*Adjustment final model: sex, skin color, age, family income and maternal education. \*\*p < 0.05

**Table 3.** Crude and adjustment logistic regression (OR and 95% CI) for the association between university dropout and oral health variables (n = 1870).

University dropout	OR (crude)	95%CI	OR (adjustment)*	95%CI
Negative self-perceived of oral health (ref.: positive)	1.24**	(1.01–1.53)	1.17	(0.93–1.49)
Score OIDP with impact (ref.: without impact)	1.27**	(1.05–1.54)	1.21	(0.97–1.51)
Having had toothache (ref.: no)	1.30**	(1.07–1.59)	1.35*	(1.08–1.69)

\*Adjustment final model: sex, skin color, age, family income and maternal education. \*\*p < 0.05.

university classes. No studies have been found that associate dental pain and avoiding university classes in the literature; however, toothache has serious impacts on quality of life and can lead to academic dropout. The literature points out different reasons for students dropping out, with the factors being related to the individual, situational factors and related to the educational system.<sup>21</sup> In this study, factors related to the institution and the educational system were not measured.

Studies show that one of the reasons which leads students to avoid university are grades obtained during the course, with those students with poor academic performance being more likely to leave.<sup>22,23</sup> We found a significant relationship between toothache and lower academic performance, having a joint relationship for academic avoidance. Starting an undergraduate course poses a series of behavioral changes upon the students' lifestyle,<sup>24,25</sup> which can expose individuals to adaptive crises, which in turn can interfere with academic performance and health conditions.<sup>26</sup> Assessing OHRQoL enables evaluating functional, psychological, and social aspects, as well as discomfort or pain.<sup>27</sup> With increasing OIDP (lower OHRQoL), we found a significant decrease in academic performance. This could be explained by the fact that oral diseases have physical and psychological impacts, which may compromise daily activities including university performance.

Conditions such as dental pain and discomfort can limit the presence and performance of students in the classroom, in addition to affecting self-esteem and causing psychological problems, negatively impacting the quality of life of these individuals, and indirectly impacting their performance in academic assessments.<sup>28</sup> Oral health status has also been associated with depression and stress.<sup>7</sup>

This study comes with a number of strengths and limitations. First, this is one of few studies focusing on the association of academic performance of students (not children) and oral health, which additionally uses a longitudinal design. The latter allows to employ the principle of temporality between exposures and outcome to infer on causality. Second, the high response rate makes it likely that our findings well reflect the target population. Third, performance (via grades) and dropout were unbiased, as they were drawn from independent data collection systems. Fourth, and as a limitation, we only used self-reported oral health variables, which is subjective and may not reflect clinical health or treatment need.<sup>29</sup> On the other hand, self-perceived reports are obviously relevant when it comes to evaluating individuals' physical, psychological, and social welfare.<sup>30</sup>

Oral health conditions are characterized by being strong markers of social inequity, since the worst conditions are precisely observed in individuals from more socially and economically vulnerable

groups,<sup>31</sup> and this fact may have influenced our findings. Within the limitations of this study, we found a significant association between oral health and academic performance and dropout. Oral health conditions affect the physical and mental well-being of university students, impacting the quality of life, and consequently academic performance.

## Conclusion

There was a significant association between self-reported oral health conditions and academic performance. Students who have suffered dental pain and those with higher impact in Oral Health Related Quality of Life presented worse academic performance in university. In addition, having suffered dental pain was associated with a higher probability of university dropout. Thus, it is important

to develop oral health actions which encompass this young population group who are undergoing adaptive changes in their lives in this new cycle of entering university. It is known that this life cycle phase is a good time to develop healthier habits which can be perpetuated throughout life. Oral healthcare actions by educational institutions should be considered, such as the promotion of oral health and prevention of oral and general health for students.

## Acknowledgment

*Fundação de Amparo à Pesquisa do Estado do Rio Grande do Sul, Grant/Award Number: 16.0471-4; Coordenação de Aperfeiçoamento de Pessoal de Nível Superior, Grant/Award Number: #001. Also, the Conselho de Desenvolvimento Científico e Tecnológico (CNPq) for the scholarship to the undergraduate students (RUP and YMC).*

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