

# Oral health-related quality of life as a predictor of alcohol and cigarette consumption in adolescents

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**Abstract:** This study evaluated the influence of Oral Health-Related Quality of Life (OHRQoL) on the consumption of alcohol and cigarette use in adolescents. This prospective cohort began in 2012 (T1) with an initial random sample of 1134 12-year-old adolescents followed for 6 years in Santa Maria, southern Brazil. The present study comprised data from the two cohort reassessments that took place in 2014 (T2) and 2018 (T3). OHRQoL was measured with the Brazilian short version of the Child Perceptions Questionnaire (CPQ11-14) at T2. Socioeconomic, demographic, and oral health measures were also collected during this period. Alcohol and cigarette consumption (regular use) in the past 30 days was evaluated at T3 through questions in the of the National School Health Survey (PeNSE) questionnaire. A multilevel Poisson regression model was used to evaluate the influence of predictor variables on substance use. Of the 770 adolescents at T2, 575 and 576 adolescents were reassessed at T3 for alcohol and cigarette consumption, respectively. Adolescents with higher overall CPQ11-14 scores were at higher risk for regular consumption of alcohol (IRR 1.01; 95% CI 1.01-1.02) and cigarette (IRR 1.04; 95% CI 1.03-1.05). Non-white adolescents with low socioeconomic status, untreated dental caries, and who had not been to the dentist (last 6 months) were also associated with increased regular consumption of licit substances. Adolescents with worse OHRQoL presented a higher consumption of alcohol and cigarette. These findings are useful for planning public health strategies to improve adolescent OHRQoL and reduce the harmful substance use.

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## Introduction

Licit drugs are the most widely used harmful substances in the world, represented by cigarettes and alcohol, and are one of the greatest public health problems in both low- and high-income countries.<sup>1</sup> This consumption begins in adolescence, a transitional phase that favors the emergence of vulnerable and susceptible behaviors that can lead to the adoption of habits that are harmful to health.<sup>1</sup> In Brazil, the prevalence of alcohol and cigarette use among adolescents aged 10-19 years reaches

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34.9% and 9.3%, respectively.<sup>2</sup> Consequently, the use of these substances promotes social and financial damage to society, as well as a negative impact on the general and oral health of users.<sup>1</sup>

Sociocultural, environmental, and psychological factors have been identified as key theoretical pathways for the explanation of licit drug use in adolescence.<sup>3</sup> Psychosocial factors are also considered to be additional determinants of harmful substance use, which receive great attention due to their relationship with health risk behaviors.<sup>4</sup> Psychosocial factors are guided by psychosocial theory, which is concerned with the ways in which individuals perceive social inequities and the effects of these perceptions on health. Among psychosocial variables, the quality of life of an adolescent is associated with resilience to life's challenges and the establishment of health-related behaviors and healthy interpersonal relationships.<sup>5</sup>

Health-Related Quality of Life (HRQoL) represents the individual's perception of the impact of adversities on health in various domains of life, including physical, mental, and social.<sup>6</sup> Recent results have demonstrated that HRQoL has a predictive role in social relationships, adoption of addictions, and use of health services.<sup>7</sup> In addition, HRQoL prospectively predicts sustained remission of illicit drug use. These findings suggest that the relationship between HRQoL satisfaction and substance misuse is likely reciprocal and unidirectional, that is, substance use affects HRQoL and HRQoL affects substance use.<sup>8</sup>

Furthermore, Oral Health-Related Quality of Life (OHRQoL), a part of HRQoL that refers to the impact of oral disorders on an individual's normal functioning, has also been explored in the same field.<sup>9</sup> Previous results have demonstrated that impaired OHRQoL is associated with behavioral indicators, such as use of dental services in children.<sup>10</sup> It has also been observed that individuals with worse OHRQoL show an impaired subjective well-being, which may adversely affect behavioral habits.<sup>11</sup> In this sense, we believe that the possible association between OHRQoL and substance use is due to the physical and/or psychological distress that oral disorders can cause, impacting the individuals' OHRQoL.<sup>12</sup> This condition can promote stress and anxiety and

encourage unhealthy behaviors, such as alcohol and cigarette use.<sup>13</sup>

To our knowledge, no previous study has evaluated the effect of a subjective variable related to dental clinical conditions on the consumption of harmful substances. This relationship is particularly important, especially in adolescents, as the consumption of these substances can lead to chemical dependency and health-related problems at this stage and in adulthood, such as the occurrence of noncommunicable and infectious diseases, mental disorders, injuries, violence, homicides, and poisoning.<sup>1</sup> Therefore, this study aimed to evaluate the influence of OHRQoL on alcohol and cigarette use among adolescents. We hypothesized that adolescents with worse OHRQoL are more likely to consume harmful substances.

## Methodology

This study is reported according to STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) guidelines.<sup>14</sup>

### Ethical issues

The study protocol was approved by the Ethics Committee on Research of the Federal University of Santa Maria (UFSM) (CAEE: 665531174.0000.5346). A written informed consent form was obtained from all adolescents and their parents or legal guardians.

### Study setting and sample

This prospective cohort study with 6 years of follow-up began in 2012 (T1) with an initial sample of 1,134 12-year-old schoolchildren enrolled in public schools in Santa Maria, a city in southern Brazil. At that time, Santa Maria had about 261,031 inhabitants, including 3,817 12-year-old students, 85% of whom were enrolled in public schools.<sup>15</sup> The sample was obtained through a two-stage sampling procedure. The primary sampling units were all public schools in the city: a total of 20 out of 39 schools were randomly selected, with a probability proportional to the school size. The secondary sampling units included all 12-year-old students enrolled in the 20 selected schools, who were invited to take part in the study. Only adolescents who consented and

whose parents/guardians signed the consent form were included in the study ( $n = 1,134$ ). Further details regarding the methodological aspects are published elsewhere.<sup>16</sup> Participants were reassessed in two subsequent moments, in 2014 (T2) and 2018 (T3).

This research used data collected in the T2 and T3 follow-up assessments, totaling 4 years of follow-up. The sample size was calculated considering a prevalence of impact on OHRQoL of 46% in the non-exposed group (substance non-users) and 74% in the exposed group (substance users), confidence level of 95%, exposed/unexposed ratio of 2:1, design effect of 1.6, and statistical power of 90%.<sup>17</sup> Adding 30% for eventual losses resulted in a minimum sample of 325 adolescents. As this study is part of a cohort that evaluates other conditions, a larger sample than required was included.

### Follow-up assessment

All adolescents evaluated in 2012 were considered eligible and invited to participate in the second and third phases of follow-up. Data was collected from 770 individuals reassessed between September 2014 and May 2015, and 768 individuals reassessed between October 2017 and October 2018. Socioeconomic, demographic, and subjective variables were collected through face-to-face interviews with structured questionnaires. Pre-trained and calibrated examiners conducted clinical examinations.

Three methods were employed as search strategies. First, telephone calls were made to resume contact with participants and invite them to attend the pediatric dentistry clinic of the UFSM. A second alternative was to obtain lists of students enrolled in public schools in the city and review them in a school setting. Finally, researchers went to the home addresses of participants to locate individuals not found in the other two alternatives, and examined them in their home environment.

### Alcohol and cigarette (outcomes)

The consumption of alcohol and cigarette (considered licit substances for people over 18 years of age in Brazil) by adolescents was collected at T3, through a self-applied questionnaire including questions present in the National School Health Survey (PeNSE)

questionnaire.<sup>18</sup> PeNSE is a sample survey widely applied in the country and carried out by the Brazilian Institute of Geography and Statistics (IBGE). Further details on the PeNSE survey are published elsewhere.<sup>18</sup>

Regular consumption of alcohol and cigarette was measured numerically by the mean of days of consumption through the following questions: a) Regular cigarette use - "In the past month, on how many days did you smoke cigarettes?"; b) Regular alcoholic beverage use - "In the past month, on how many days did you drink at least one dose of alcohol?".<sup>18</sup> In the analysis, regular cigarette and alcohol consumption were used as quantitative variables. According to the PeNSE criteria, one dose of alcohol corresponds to a glass of beer, a glass of wine, and a serving of cachaça (typical Brazilian drink), or vodka, or whiskey, etc.<sup>18</sup> Substance use in the past 30 days among adolescents is a standard measure to indicate current consumption. These questions were applied to test internal consistency in 25 adolescents attending a dental clinic at UFSM. They presented similar socioeconomic profiles to the sample of this research, but were not participants in the cohort study. The Cronbach's  $\alpha$  was 0.84.

### Oral health-related quality of life

At T2, the adolescents answered the Brazilian short version of the Child Perceptions Questionnaire for 11- to 14-year-old children (CPQ11-14) through face-to-face interviews with previously trained interviewers.<sup>19</sup> This short form contains 16 questions on the frequency of events in four domains: oral symptoms (OS), functional limitation (FL), emotional well-being (EW), and social well-being (SW). Each question measures the frequency of events related to teeth, lips, and jaws in the past 3 months and it has five possible answers on a Likert scale ranging from 0 to 4: "Never" = 0; "Once or twice" = 1; "Sometimes" = 2; "Often" = 3; "Every day/almost every day" = 4. The final score is calculated by the sum of all scores for each domain, and it can range from 0 to 64. Higher scores represent worse OHRQoL.

### Covariates

All covariates were measured at T2. A structured questionnaire, applied to parents or guardians,

provided information about sex, age, race, household income, and adolescent oral health measures. The questionnaire was answered in person if the participant was evaluated in a clinical setting or at home. If a participant was evaluated in a school, the parent/guardian answered the questionnaire by telephone. Race was classified based on the criteria of the IBGE and dichotomized as “White” and “Non-White”.<sup>15</sup> Household income was recorded in Brazilian reais (R\$ - official Brazilian currency) for all individuals living in the house in the last month and converted to terciles. Oral health measures included dental visits in the previous 6 months and adolescents’ self-perception of gingival bleeding.

Clinical examinations were conducted by 4 trained and calibrated examiners, according to international criteria standardized by the World Health Organization (WHO)<sup>20</sup> under natural light using a plane dental mirror and WHO periodontal probe (CPI; “ball point”), in a private setting. Untreated dental caries (corresponding to a non-zero D component in the Decayed, Missing, and Filled teeth index - DMFT) was measured according to the WHO criteria.<sup>20</sup> Kappa statistics (inter and intra-examiner) for dental caries measures were higher than 0.7.

## Data analyses

Data analysis was performed with STATA 14 (StataCorp. 2014. Stata Statistical Software: Release 14.1. College Station, TX: StataCorp LP). The outcomes were regular alcohol and cigarette consumption, and were analyzed as continuous variables. All descriptive analyses considered the sampling weight, using the “svy” commands in Stata for complex data samples.

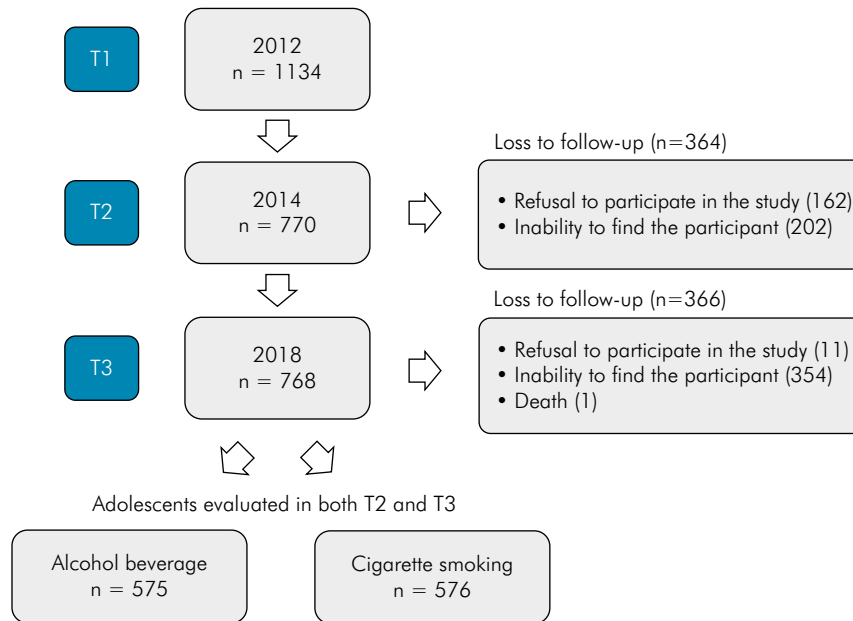
Multilevel Poisson regression models were used to estimate the association between outcomes and explanatory variables, according to a previous theoretical model.<sup>21</sup> In the multilevel assessment, adolescents (first level) were nested in their schools (second level). Multilevel models allow estimating the incidence rate ratio (IRR) and its 95% CI. In this approach, variables with a p-value < 0.25 in the unadjusted model were included in the adjusted model through a stepwise forward procedure. In the final model, all variables with a p-value < 0.05 were considered statistically associated with alcohol

and cigarette use. The multilevel model used the scheme of fixed effect with a random intercept. The goodness of fit of the model was evaluated using the deviance (-2 log likelihood) and the median incidence rate ratio (MIRR). Significant changes in the fitting of the models were assessed using the likelihood ratio test.

## Results

Of the 1,134 adolescents assessed at baseline, 770 (67.9% retention rate) and 768 (67.7% retention rate) participants were re-evaluated at T2 and T3, respectively. However, only those participants who were evaluated in both T2 and T3 were considered in this study (4 years of follow-up). Therefore, the final sample was 575 adolescents for the alcohol beverage outcome and 576 adolescents for the cigarette-smoking outcome. In the null model, it was observed that schools influenced the consumption of harmful substances, according to the obtained p-value (alcohol:  $p < 0.05$ ; cigarette:  $p = 0.001$ ). The fixed intercept for the variables alcohol and cigarette use in the null model was 2.70 and 1.75, while the random intercept (deviance) was 1.38 and 0.11 for the respective variables. Poisson multilevel modeling showed a significant effect of contextual level for alcohol and cigarette consumption, respectively (MIRR = 1.333 and MIRR = 1.980). The mean age of adolescents was 14.3 years (Standard Deviation [SD] 0.7) at T2 and 17.5 years (SD 0.6) at T3. Sixty percent and 16.2% of adolescents were regular users of alcoholic beverages and cigarettes, respectively. At T2, the OS, FL, EW, and SW domains that make up the CPQ11-14 had the following means: 3.36 (SD 2.36), 2.44 (SD 2.52), 2.19 (SD 3.20), and 1.37 (SD 1.97). Reasons for dropouts are presented in Figure. There were no statistical differences between participants and non-participants in T2 and T3 ( $p > 0.05$ ) (data not shown).

Table 1 shows regular alcohol and cigarette consumption according to predictor variables measured at T2. The adolescents were predominantly girls, white, and lived in households with income less than R\$ 880.00. The prevalence of untreated dental caries was approximately 40% for both outcomes. The mean overall CPQ11-14 score was 9.28 (Standard



**Figure.** Flowchart of participants in the 3 different phases of cohort follow-up.

Error [SE] 0.3) for alcohol consumption and 9.24 (SE 0.3) for cigarette consumption. It was observed that adolescents with a higher mean of regular alcohol and cigarette consumption were boys, non-white, and those belonging to the lowest household income tercile. Consumption was also higher in adolescents with worse OHRQoL and untreated dental caries.

Table 2 shows the multilevel Poisson analysis for regular consumption of alcohol. After adjustment, higher overall CPQ11-14 scores were associated with consumption of alcohol (IRR 1.01; 95% CI 1.01-1.02). Regular consumption was also higher among boys, non-white, and those belonging to families with lower income (lowest tercile). Not visiting the dentist in the past 6 months was also associated with higher consumption of alcohol beverage. In addition, lack of perception of gingival bleeding was a protective variable against alcohol consumption.

Table 3 shows the multilevel Poisson analysis for regular cigarette smoking. After adjustment, adolescents who had a worse OHRQoL showed higher regular cigarette use (IRR 1.03; 95% CI 1.02-1.04). Use was also higher in boys and adolescents with poorer socioeconomic status. The presence of untreated dental caries and absence of dental visits in the past 6 months were considered predictors of cigarette use.

## Discussion

This longitudinal study confirmed the hypothesis that individuals with worse OHRQoL have higher regular alcohol and cigarette consumption. Findings also suggest that demographic (sex and race), socioeconomic (household income), and oral health measures (dental visits, untreated dental caries, and self-perception of gingival bleeding) are related to regular consumption of licit substances. To the best of our knowledge, there are few studies evaluating the influence of OHRQoL on behavioral outcomes,<sup>10,11</sup> and there are no studies evaluating its relationship with consumption of licit drugs, especially in a sample of adolescents.

The psychosocial theory supports the relationship between OHRQoL and consumption of harmful substances, as it supports the idea that psychological growth occurs through stages and phases, depending on the interaction between the individual and his or hers context.<sup>4</sup> Previous studies have shown that feelings of subordination or inferiority encourage the development of stressful responses, which can have consequences for physical and mental health.<sup>22</sup> Psychosocial factors, such as OHRQoL, also influence the individual's perception of their position in society,

**Table 1.** Sample characteristics and distribution of regular alcohol and cigarette consumption according to demographic, socioeconomic, and oral health variables at T2.

Variables (T2) <sup>a</sup>	Alcohol use (T3) <sup>b</sup>		Cigarette use (T3) <sup>b</sup>	
	(n = 575)		(n = 576)	
	n (%)	Mean (SE) <sup>c</sup>	n (%)	Mean (SE) <sup>c</sup>
<b>Demographic variables</b>				
<b>Sex</b>				
Girls	316 (53.4)	2.5 (0.3)	318 (53.5)	1.5 (0.4)
Boys	259 (46.6)	2.8 (0.1)	258 (46.5)	2.0 (0.4)
<b>Race</b>				
White	446 (79.9)	2.5 (0.1)	448 (80)	1.7 (0.3)
Non-white	121 (20.1)	3.2 (0.8)	120 (20)	2.0 (0.6)
<b>Socioeconomic variables</b>				
<b>Household income in R\$<sup>d</sup></b>				
Highest (3 <sup>rd</sup> tercil)	144 (36.5)	2.3 (0.3)	145 (36.7)	0.7 (0.3)
Medium (2 <sup>nd</sup> tercil)	119 (27.2)	2.9 (0.5)	118 (27.1)	1.9 (0.5)
Lowest (1 <sup>st</sup> tercil)	149 (36.3)	3.4 (0.4)	148 (36.2)	2.6 (0.7)
<b>Oral health measures</b>				
<b>Dental visits (last 6 months)</b>				
Yes	252 (54)	2.7 (0.3)	252 (54)	1.3 (0.4)
No	219 (46)	3.0 (0.3)	218 (46)	2.0 (0.5)
<b>Self-perception of gingival bleeding</b>				
Yes	353 (61.3)	2.8 (0.3)	351 (61)	1.8 (0.3)
No	207 (38.7)	2.2 (0.3)	210 (39)	1.8 (0.3)
<b>Untreated dental caries</b>				
Without	333 (60.8)	2.5 (0.2)	335 (60.9)	1.4 (0.2)
With	226 (39.2)	2.7 (0.3)	225 (39.1)	2.2 (0.5)
	Coefficient <sup>e</sup>	Mean (SE) <sup>c</sup>	Coefficient <sup>e</sup>	Mean (SE) <sup>c</sup>
OHRQoL (CPQ overall score)	0.1*	9.28 (0.3)	0.05	9.24 (0.3)

<sup>a</sup>Taking into account the sampling weight; <sup>a</sup>T2, 2-year follow-up; <sup>b</sup>T3, 6-year follow-up; <sup>c</sup>SE: standard error; <sup>d</sup>R\$, Real (R\$4.04 is equivalent to US\$1.00 approximately); <sup>e</sup>Spearman correlation; \*p < 0.05.

promoting social marginalization and, consequently, antisocial behavior.<sup>23</sup> Some studies have reported the relationship between psychosocial factors and alcohol and cigarette consumption among adolescents and young adults.<sup>4,13</sup> It has been argued that individuals with worse psychosocial factors are more likely to use harmful substances.<sup>4,13</sup> Notwithstanding, results have shown that frustrations in early developmental periods are capable of promoting chemical dependence.

The concept of OHRQoL embraces the biopsychosocial model of health in which symptoms, physical functioning, and emotional and social well-being are considered.<sup>24</sup> Previous studies have found that emotional well-being and social well-being domains seem to be closely related to substance use in adolescence.<sup>25</sup> Situations that promote anxiety

regarding social situations can exert their influence and make adolescents prone to taking risks.<sup>25</sup> Also, an interaction between emotions and social contrast with smoking was identified in this study.<sup>25</sup> Thus, individuals who feel vulnerable to socially stressful stimuli tend to adopt the perceived smoking behaviors of those in their social circle.<sup>13</sup> Furthermore, economic vulnerability is strongly associated with worse OHRQoL, as the behavioral limitations and lower access to health services of people in a lower socioeconomic conditions are detrimental to the oral health and OHRQoL of individuals.<sup>26</sup>

It is recognized that oral disorders can cause symptoms that affect the perception of oral health and cause a series of daily limitations capable of compromising OHRQoL.<sup>12</sup> This effect can be

**Table 2.** Unadjusted and adjusted association between individual variables at T2 and regular alcohol consumption at T3 determined using multilevel Poisson regression.

Variables	IRR <sup>a</sup> Unadjusted (95% CI) <sup>b</sup>	p-value	IRR <sup>a</sup> Adjusted (95% CI) <sup>b</sup>	p-value
Demographic variables				
Sex				
Girls	1	0.019	1	< 0.01
Boys	1.13 (1.02-1.25)		1.21 (1.07-1.37)	
Race				
White	1	< 0.001	1	< 0.001
Non-white	1.32 (1.17-1.49)		1.46 (1.27-1.68)	
Socioeconomic variables				
Household income in R\$ <sup>c</sup>				
Highest (3 <sup>rd</sup> tercil)	1	< 0.001	1	< 0.001
Medium (2 <sup>nd</sup> tercil)	1.38 (1.17-1.62)		1.38 (1.17-1.63)	
Lowest (1 <sup>st</sup> tercil)	1.72 (1.48-2.01)		1.71 (1.46-2.02)	
Oral health measures				
Dental visits (last 6 months)				
Yes	1	< 0.001	1	< 0.001
No	1.24 (1.12-1.39)		1.34 (1.19-1.52)	
Self-perception of gingival bleeding				
Yes	1	< 0.001	1	0.01
No	0.80 (0.72-0.90)		0.84 (0.73-0.95)	
OHRQoL (CPQ overall score)				
Untreated dental caries	1.01 (1.01-1.02)	< 0.001	1.01 (1.01-1.02)	< 0.01
Without	1	0.953	-	-
With	1.01 (0.90-1.11)		-	

<sup>a</sup>IRR: incidence rate ratio; <sup>b</sup>CI: confidence interval; <sup>c</sup>R\$, Real (at the time, R\$4.04 was equivalent to US\$1.00 approximately).

cumulative over the years, confirming the fact that a negative impact on OHRQoL in a transitional and self-acceptance phase would not disappear in the period considered in this study.<sup>27,28</sup> This scenario can affect not only the current quality of life, but also long-term physical, psychological, and social development, promoting worse well-being associated with negative feelings.<sup>11</sup> Furthermore, these feelings may justify the adoption of risky behaviors, such as substances use, since many people find in this habit an escape from the stressful reality they experience.<sup>13</sup> In this way, although no study has directly explored this relationship, the literature supports the connection between psychosocial variables and the use of harmful substances.<sup>4,13</sup>

The regular consumption of both substances was higher among boys, as previously observed.<sup>29</sup> During adolescence, males are more prone to substance use, which is closely related to the transmission of family

customs and the need to value their self-image.<sup>30</sup> However, there is no consensus regarding this finding, since other results did not show gender differences or even reported higher use in women.<sup>31</sup> Non-white adolescents also showed higher cigarette consumption when compared to their counterparts. This is probably related to the fact that non-white individuals still constitute a social minority, have lower socioeconomic and educational conditions, and limited access to health information.<sup>32</sup>

Our findings demonstrated that regular alcohol drinking and cigarette smoking was higher among adolescents belonging to families with lower income. It has been reported that adolescents with a lower socioeconomic status have higher risk for substance use.<sup>33</sup> Notwithstanding, the risk of starting and persisting in smoking is higher in individuals with low socioeconomic status. Also, socioeconomic barriers limit access to knowledge and facilitate the adoption

**Table 3.** Unadjusted and adjusted association between individual variables at T2 and regular cigarette consumption at T3 determined using multilevel Poisson regression.

Variables	IRR <sup>a</sup> Unadjusted (95% CI) <sup>b</sup>	p-value	IRR <sup>a</sup> Adjusted (95% CI) <sup>b</sup>	p-value
Demographic variables				
Sex				
Girls	1	< 0.001	1	0.003
Boys	1.56 (1.38–1.76)		1.25 (1.07–1.45)	
Race				
White	1	0.327	-	-
Non-white	0.92 (0.80–1.07)		-	
Socioeconomic variables				
Household income in R\$ <sup>c</sup>				
Highest (3 <sup>rd</sup> tercil)	1	< 0.001	1	< 0.001
Medium (2 <sup>nd</sup> tercil)	2.05 (1.67–2.52)		1.82 (1.48–2.25)	
Lowest (1 <sup>st</sup> tercil)	2.94 (2.40–3.60)		2.31 (1.88–2.86)	
Oral health measures				
Dental visits (last 6 months)				
Yes	1	< 0.001	1	< 0.001
No	1.88 (1.64–2.17)		1.76 (1.51–2.05)	
Self-perception of gingival bleeding				
Yes	1	0.223	1	0.052
No	1.07 (0.95–1.21)		1.16 (0.99–1.36)	
OHRQoL (CPQ overall score)				
Untreated dental caries	1.01 (1.01–1.02)	< 0.001	1.03 (1.02–1.04)	< 0.001
Without	1	< 0.001	1	0.008
With	1.37 (1.21–1.54)		1.21 (1.05–1.40)	

<sup>a</sup>IRR: incidence rate ratio; <sup>b</sup>CI: confidence interval; <sup>c</sup>R\$, Real (at the time, R\$4.04 was equivalent to US\$1.00 approximately).

of unhealthy habits.<sup>34</sup> However, such findings have not been consistent across studies, probably due to differences in the methodology employed, cultural factors, geographic characteristics, and socioeconomic indicators, which limit the comparison of findings.

Clinical oral measures were also associated with outcomes. Adolescents with higher perception of gingival bleeding presented a higher consumption of alcohol. On the other hand, those with dental caries had a higher consumption of cigarettes. Previous authors have reported the association of clinical status and OHRQoL in adolescents,<sup>12</sup> justified by the physical and psychological impact of these conditions on this age group. The presence of pain/discomfort and food impaction in teeth, as well as aesthetic impairment due to bleeding gums, lead to experience a worse perception of oral health and self-esteem in affected individuals. Furthermore, previous results have shown that adolescents with gingival bleeding were

more likely to be verbally bullied than their peers, showing another psychosocial face that contributes to feelings of inferiority,<sup>35</sup> which favors the adoption of habits that are detrimental to health.<sup>10</sup> Individuals with worse oral health conditions are also more likely to have poorer overall health and harmful health behaviors, since an unfavorable socioeconomic environment with fewer biological resources reduces the chances of adopting healthy habits, which in turn can increase the risk of oral diseases and facilitate the use of alcohol and cigarettes.<sup>36</sup>

Although we investigated two outcomes that are considered legal substances in society, the motivation for their use is not the same across different subpopulations, leading to the different prevalence of use of the two substances. The likely explanation for high alcohol consumption is that drinking is seen as a ritual of sociability that represents the introduction of the adolescent in a friendship group.<sup>37</sup>



Besides, drinking is also associated with a moment of relaxation and pleasure.<sup>37</sup> On the other hand, one of the main reasons why adolescents start smoking is curiosity about cigarette. However, there are common determinants of consumption, such as the demographic, socioeconomic, and clinical variables verified in this study. Questions related to substance use among family and friends, school performance, family conflicts, and physical and/or sexual abuse have also been shown to be influential in alcohol and cigarette consumption.<sup>3,29</sup> The mutual consumption is justified by the fact that individuals develop a greater desire for cigarette smoking when they drink.

The main limitation of this study was that alcohol and cigarette consumption were measured by self-report. This can underestimate the levels of consumption since adolescents may be ashamed or afraid about reporting the truth. However, adolescents were told that their responses would be kept confidential, as they answered these questions individually. Another limitation concerns possible memory bias. However, the prevalence of consumption was consistent with other studies carried out in Brazil, which provide validity to our measurements.<sup>2</sup> Furthermore, alcohol and cigarette consumption were not measured at study baseline to allow for longitudinal analysis with repeated measures, making it impossible to evaluate whether these values changed over time. In addition, only a few variables were selected and included in the analytical model. Thus, other factors that were not included in the analysis may act as confounding variables between the observed associations. However, variables were selected based on a previously consolidated theoretical model.<sup>21</sup>

Despite these limitations, this study is a prospective cohort with a high retention rate after 4 years of follow-up. This longitudinal assessment provided important information about the influence of OHRQoL on adolescent behavior in a period of transition from

adolescence to adulthood. This transitional period contributes to adolescents' susceptibility to adopting health risk behaviors, which can cause current harm, such as disease development, violence, accidents, and poisonings, which can persist into adulthood.<sup>1</sup> This knowledge has implications for oral health professionals, as it indicates the fundamental role of OHRQoL on adolescent risk behaviors and the importance of providing adequate oral health and OHRQoL. Moreover, this information is also useful in providing additional evidence for planning public health strategies to improve adolescent OHRQoL and reduce use of these substances. Future intervention studies should test the evidence generated in this research, with the aim of improving adolescent behavior through OHRQoL.

## Conclusion

In conclusion, our findings indicated that OHRQoL affects regular consumption of alcohol and cigarette among adolescents. Adolescents with worse OHRQoL presented a higher consumption of both substances. Moreover, demographic, socioeconomic, and clinical conditions were also important predictors of their consumption.

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