

# Adverse alcohol use and oral health

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**Objective:** To determine whether different alcohol intake dimensions: average alcohol volume consumed (AVC), binge drinking (BD), and alcohol-related consequences (ARC) are associated with self-rated oral health (SROH). **Methods:** Secondary cross-sectional analysis of The Brazilian National Health Survey of 2019 data. BD was considered when an individual reported a past-month heavy drinking episode. ARC referred to experiences such as past-year blackouts, concerns from others, or failure in routine activities. Adjusted multivariate Poisson regression models with robust variance were employed to calculate the prevalence ratios (PR) and 95% confidence intervals (CI) of SROH across the entire sample and stratified by sex and age. **Results:** The sample comprised 88,531 participants aged 18 years or older. Individuals experiencing at least one past-year ARC had an 11% (95% CI: 1.07, 1.15) higher prevalence of poor SROH than their abstainers' counterparts. Associations were more pronounced among men aged less than 50 (PR = 1.09; 95% CI: 1.03, 1.15) and women aged 50 years or more (PR = 1.15; 95% CI: 1.01, 1.30). **Conclusion:** Alcohol-related consequences predicted poor SROH. Oral health inquiries should include the screening for ARC in addition to traditional measurements of AVC or BD, since such exposures may not fully capture the role of alcohol on oral health impairment.

**Keywords:** epidemiology, oral health, self-assessment, alcohol drinking, alcoholism

## Introduction

Alcohol is the most abused substance worldwide and is recognized as a factor that adversely influences the Sustainable Development Goals. Its consumption accounts for approximately 5.1% of the global burden of diseases, especially behavioural disorders, cancers and major noncommunicable chronic diseases (NCCD) (Griswold *et al.*, 2018), disproportionately affecting people who are disadvantaged. Despite these repercussions, the role of such exposure remains unclear when attention is given to oral NCCD (aside from cancer). For instance, previous studies have shown alcohol intake to be negatively (Medeiros *et al.*, 2022), positively (Wagner *et al.*, 2017), or not associated (Tanner *et al.*, 2015) with dental caries, periodontitis, and tooth loss, all of which focused on the amount or frequency of consumption. Nevertheless, considering the multifaceted nature of alcohol exposure and diversity in biopsychosocial status (Rehm *et al.*, 2017), other measurements, independent of the weekly or monthly amount of intake, such as heavy drinking episodes, also known as binge drinking (BD), and negative physical, mental and social consequences of alcohol misuse (ARC) may play a role in the oral health impairment.

Oral health is multidimensional and normative measurements may not comprehensively capture the functional, psychological, and social impacts of oral NCCD on individuals' lives. In this context, self-rated oral health (SROH) emerges as an important construct of oral health and reflects the individual's subjective perception of his or her own health based on health beliefs and physical and mental well-being, encompassing both biomedical and comprehensive concepts. Self-assessment of health involves a complex set of factors that include not only

individual factors and personal experiences, but also the environment to which people are exposed (Perazzo *et al.*, 2020).

Currently, whether alcohol intake impacts patient-reported oral health remains understudied. Especially regarding to SROH, to the best of our knowledge, the unique study on the theme detected no association between the described factors (Azodo *et al.*, 2014). Moreover, links between SROH and BD or ARC have not been explored. Previous research has focussed only on traditional measures of average alcohol volume consumed (AVC) and may not fully capture the pathway through which alcohol influences oral health.

This study aimed to describe associations between different dimensions of alcohol intake (AVC, BD, and ARC) and SROH using a nationally representative sample of Brazilian adults. Since evidence indicates that both sex and gender interact with alcohol intake in a complex manner (Erol *et al.*, 2015), and that older adults are more vulnerable to alcohol-related harms (Blow *et al.*, 2012), we also performed stratified analyses according to sex and age. We hypothesized that higher AVC, past-month BD, and past-year ARC were associated with poor SROH, and that such associations are stronger in older men.

## Methods

This cross-sectional study used data from the 2019 Brazilian National Health Survey (PNS 2019), a nationally representative household survey conducted by the Brazilian Institute of Geography and Statistics in collaboration with the Brazilian Ministry of Health. The fieldwork was performed between August 2019 and March 2020, with trained examiners using mobile devices pre-programmed for household and individual

interviews. Before participating all participants received a comprehensive explanation of the study's procedures and signed a statement of informed consent. The Brazilian National Ethics Research Committee from the Brazilian Ministry of Health independently reviewed and approved the study protocol (n.3.529.376), and all procedures were in accordance with the Declaration of Helsinki.

The population consisted of residents living in permanent private households in Brazil. Sampling took place in three stages. First, the census tracts were selected; second, the households and finally one resident aged 15 years or more was drawn from each selected household. More information can be found in Stopa *et al.* (2020). This study analysed data from adults aged 18 years or older (N=88,531).

SROH was assessed with the global question "In general, how do you rate your oral health (teeth and gums)?" Participants were categorized as having "poor SROH" if they rated their oral health as fair, bad, or very bad or having "good SROH" if they rated their oral health as very good or good.

Questions about alcohol use asked participants "how often do you consume any alcoholic drink?", "how many days per week do you usually consume any alcoholic drink?" and "during the past month, did you have five or more drinks containing any kind of alcohol on a single occasion?". Participants were defined as "abstainers" if they answered "Never" to the question how often they consume an alcoholic drink.

Average consumption (AVC) was determined using responses to the questions about how many days per week alcohol was usually consumed (possible range 0 to 7) and number of standard drinks usually consumed when drinking. Responses were then categorized in "less than once per month" (in accordance with the first question), "once or more per month but less than once per week", "low-risk drinkers" (those who drink more than once per week but were not classified as heavy drinkers), and "heavy drinkers" [women drinking  $\geq 7$  and men drinking  $\geq 14$  standard drinks per week for those aged less than 65 years (National Institute on Alcohol Abuse and Alcoholism, 2020) and both men and women drinking  $\geq 7$  drinks per week for those aged 65 years or more (National Council on Aging, 2020)].

Binge drinking (BD) was categorised among participants who had had five or more drinks containing any kind of alcohol on a single occasion in the past month (National Institute on Alcohol Abuse and Alcoholism, 2020).

The composite ARC variable was constructed using the questions "during the past year, how often have you failed to do what was normally expected of you because of drinking?"; "during the past year, how often have you been unable to remember what happened the night before because you had been drinking?"; and "has a relative or friend, doctor or other health worker been concerned about your drinking or suggested you cut down?". These questions correspond to the items 5, 8 and 10 of the Alcohol Use Disorders Identification Test (AUDIT) (Saunders *et al.*, 1993). Individuals who answered affirmatively to at least one of these questions were classified as having at least one ARC in the past year (Oliveira *et al.*, 2021).

Covariates included sex; age [dichotomized in  $< 50$  or  $\geq 50$  years in order to enhance comparability with studies that focus on older adults]; skin colour (white

or non-white); marital status; education (incomplete elementary school, incomplete secondary school, incomplete higher education, or complete higher education); per capita household income [collected in Brazilian currency (R\$4.00 was approximately equivalent to US\$1.00 during data collection) and dichotomized in  $< R\$ 1100,00$  or  $\geq R\$ 1100,00$ ]; smoking status (never smokers, former smokers, someday current smokers, or everyday current smokers); toothbrushing frequency ( $< two$  times or  $\geq two$  times); last dental visit (up to or more than a year ago); self-reported diabetes and hypertension; and depression (assessed using the Patient Health Questionnaire-9 and considered present when an individual scored ten or more points). These variables were selected based on the epidemiological literature linking alcohol intake to oral problems (Oliveira *et al.*, 2022; 2023). All covariates were included in the models, irrespective of the p-values.

Statistical analyses were conducted on the software Stata, version 14.0. Descriptive analysis adopted sample weights for primary sampling units, households, and the selected resident, in accordance with the complex survey sampling. Estimates were presented as overall relative frequencies along with their corresponding 95% confidence intervals (CI). Subsequently, the associations were evaluated using crude and adjusted Poisson regression models with robust variance to estimate prevalence ratios (PR) and their respective 95% CI. Regression models were fitted separately for each exposure using abstainers as the reference category in each case. Lastly, stratified analyses according to sex and age were conducted.

This manuscript was prepared according to the reporting recommendations found in the STROBE (STrengthening the Reporting of OBservational studies in Epidemiology) Statement.

## Results

Most participants rated their oral health as good (Table 1). Most (57.8%) were alcohol abstainers, 8.3% were heavy drinkers, 25.1% were binge drinkers, and 9.6% reported at least one ARC during the past year. Individuals who consumed alcohol less than once per month or were low-risk drinkers, current drinkers who were not binge drinkers and who did not report ARC, were less likely to have poor SROH than abstainers (Table 2). In contrast, individuals who had experienced at least one ARC in the past year had 11% (95% CI: 1.07, 1.15) higher prevalence of poor SROH.

In stratified analyses, protective associations were noted within intermediate categories for both sexes among individuals aged less than 50 years. In this age group, only men who reported ARC had a higher prevalence of poor SROH (PR = 1.09; 95% CI: 1.03, 1.15). Among those aged 50 years or more, no protective associations were found. Both men (PR = 1.12; 95% CI: 1.06, 1.20) and women (PR = 1.15; 95% CI: 1.01, 1.30) who reported experiencing a past-year ARC presented higher prevalence of poor SROH when compared to abstainers.

## Discussion

Our findings reveal distinct associations between different dimensions of alcohol intake and SROH, related

**Table 1.** Characteristics of 88,531 participants in the 2019 Brazilian National Health Survey.

<i>Variables</i>	<i>Weighted % (95% CI)</i>
Women	53.2 (52.6, 53.8)
Non-white	56.7 (56.0, 57.5)
Age	
< 50 years	61.3 (60.7, 61.9)
≥ 50 years	38.7 (38.1, 39.3)
Marital status	
Married	43.9 (43.2, 44.6)
Divorced	7.1 (6.8, 7.4)
Widower	6.9 (6.6, 7.1)
Single	42.2 (41.5, 42.8)
Per capita household income	
≥ R\$ 1100,00	43.0 (42.4, 43.6)
< R\$ 1100,00	57.0 (56.4, 57.6)
Education	
Complete higher education	15.8 (15.2, 16.5)
Incomplete higher education	34.9 (34.3, 35.6)
Incomplete secondary school	14.5 (14.1, 14.9)
Incomplete elementary school	34.8 (34.1, 35.4)
Smoking status	
Never smokers	60.8 (60.2, 61.4)
Former smokers	26.6 (26.1, 27.2)
Someday current smokers	1.2 (1.1, 1.3)
Everyday current smokers	11.4 (11.0, 11.8)
Toothbrushing frequency	
≥ Two times	93.6 (93.3, 93.9)
< Two times	6.4 (6.1, 6.7)
Last dental visit	
Up to a year ago	49.1 (48.5, 49.8)
More than a year ago	50.9 (50.2, 51.5)
Diabetes	7.7 (7.4, 8.0)
Hypertension	23.9 (23.4, 24.4)
Depression	10.8 (10.4, 11.2)
Abstainers	57.8 (57.2, 58.5)
Average alcohol volume consumed	
Less than once a month	12.2 (11.8, 12.5)
Once or more a month but less than once a week	3.6 (3.4, 3.9)
Low-risk drinkers	18.0 (17.5, 18.6)
Heavy drinkers	8.3 (8.0, 8.7)
Binge drinking	
Not binge drinkers	17.1 (16.6, 17.5)
Binge drinkers	25.1 (24.5, 25.7)
Alcohol-related consequences	
None in the past year	32.6 (32.0, 33.3)
At least one in the past year	9.6 (9.1, 10.0)
Self-rated oral health	
Good	69.7 (69.1, 70.3)
Poor	30.3 (29.7, 30.9)

to the sex and age of the participants. While J-shaped relationships were observed for all exposures among those under 50 years, no negative association was noted for the older group. More individuals who reported at

least one ARC during the past year had poor SROH than their counterparts. This association was stronger for women among the older age group and for men among the younger group. Thus, the study hypothesis was only partially accepted.

This study had certain limitations. The findings do not permit the attribution of causality, and all associations, especially those with BD, since this exposure related to the previous 30 days are subject to reverse causation. We were also unable to eliminate unmeasured and residual confounding. For instance, underreporting of diabetes, an important risk factor of oral health impairment, may have led to an overestimation of the magnitude of the associations being assessed in self-reported data. Conversely, there may have been underestimation of the relationships due to recall and social desirability biases associated with self-reported alcohol intake, particularly among those in the high-risk categories. In this respect, we assumed that participants had maintained consistent drinking habits over time; however, individuals often change their drinking behaviour throughout their lives. Additionally, individuals who had previously quit drinking due to physical or sociopsychological consequences may have reported themselves as abstaining, thus introducing sick-quitters bias. Sick-quitters may still be susceptible to oral health impairment, so masking the impact of alcohol intake.

Among the three dimensions of alcohol intake that we examined, only past-year ARC was associated with poor SROH. This association can be explained by the broader time frame of such an exposure (covering the past 12 months), considering the chronic nature of oral diseases, and greater stability when compared to other dimensions. In addition, ARC is linked to alcohol dependence, not merely to its use. The connection between ARC and poor oral health may stem from the stressful life circumstances resulting from problematic alcohol use, which can include family, social, financial or legal challenges. In line with cognitive-behavioural theories of substance use, experiencing ARC may lead to thoughts, emotions, and attitudes that contribute to or worsen oral health symptoms. That is, although biological paths have been proposed in the association between alcohol use and oral disease, there may be broader impact via a psychosocial pathway. This finding aligns with an association between the presence of ARC and higher rates of periodontitis (Oliveira *et al.*, 2021). Importantly, this association was stronger than that related to the volume of alcohol consumed.

The differences observed across sex and age can be attributed to biological and sociocultural factors. Older adults are considered at high-risk for adverse health effects of alcohol intake due to their reduced ability to metabolize alcohol, greater prevalence of comorbidities (Blow *et al.*, 2012) and limited access to oral and general healthcare than their younger counterparts (Xu *et al.*, 2020). This age-related effect synergistically interacts with the stigma and sexism that women often encounter in relation to alcohol use, creating complex systems of oppression that intersect with alcohol-related harms. These elements are temporal and culturally specific and interact with sex-related factors to produce varying effects and impacts (Erol *et al.*, 2015). Consequently, their influence may differ across countries or societies. The stronger

**Table 2.** Poisson regression for associations between alcohol intake dimensions and poor self-rated oral health among 88,531 Brazilian adults.

	<i>Unadjusted</i>	<i>Adjusted</i>
	<i>Prevalence Ratio (95% CI)</i>	
Average alcohol volume consumed		
Less than once a month	0.91 (0.88, 0.94)	0.96 (0.93, 0.99)
Once or more a month but less than once a week	0.91 (0.86, 0.96)	0.99 (0.93, 1.05)
Low-risk drinkers	0.86 (0.83, 0.88)	0.94 (0.91, 0.97)
Heavy drinkers	1.03 (0.99, 1.06)	1.01 (0.98, 1.05)
Binge drinking		
Not binge drinkers	0.85 (0.83, 0.87)	0.93 (0.90, 0.95)
Binge drinkers	0.99 (0.97, 1.02)	1.03 (1.00, 1.06)
Alcohol-related consequences		
None in the past year	0.83 (0.81, 0.85)	0.92 (0.90, 0.95)
At least one in the past year	1.17 (1.13, 1.20)	1.11 (1.07, 1.15)

Reference category = abstainers

Estimates adjusted for sex, age, skin colour, marital status, education, per capita household income, smoking status, toothbrushing frequency, last dental visit, diabetes, hypertension, and depression.

**Table 3.** Poisson regression stratified by age and sex for associations between alcohol intake dimensions and poor self-rated oral health.

	<i>&lt; 50 years</i>		<i>≥ 50 years</i>	
	Only men (n=20,476)	Only women (n=24,353)	Only men (n=15,884)	Only women (n=19,840)
	<i>Prevalence ratio (95% CI)</i>			
Average alcohol volume consumed				
Less than once a month	0.88 (0.83, 0.94)	0.94 (0.89, 1.00)	1.04 (0.97, 1.11)	0.97 (0.90, 1.05)
Once or more a month but less than once a week	1.02 (0.92, 1.12)	0.96 (0.87, 1.07)	0.98 (0.87, 1.11)	0.93 (0.80, 1.08)
Low-risk drinkers	0.95 (0.90, 1.01)	0.86 (0.80, 0.93)	0.96 (0.90, 1.01)	0.95 (0.87, 1.04)
Heavy drinkers	1.01 (0.95, 1.08)	0.95 (0.88, 1.02)	1.00 (0.93, 1.08)	1.03 (0.91, 1.16)
Binge drinking				
Not binge drinkers	0.90 (0.85, 0.95)	0.88 (0.84, 0.93)	0.95 (0.91, 1.00)	0.95 (0.89, 1.01)
Binge drinkers	1.00 (0.95, 1.05)	0.99 (0.93, 1.05)	1.06 (1.00, 1.12)	1.06 (0.96, 1.17)
Alcohol-related consequences				
None in the past year	0.88 (0.84, 0.93)	0.89 (0.85, 0.94)	0.95 (0.91, 1.00)	0.95 (0.89, 1.01)
At least one in the past year	1.09 (1.03, 1.15)	1.04 (0.96, 1.11)	1.12 (1.06, 1.20)	1.15 (1.01, 1.30)

Reference category = Abstainers

Estimates adjusted for sex, age, skin colour, marital status, education, per capita household income, smoking status, toothbrushing frequency, last dental visit, diabetes, hypertension, and depression.

associations detected in men under 50 years old could be linked to social pressures and conformity with gender norms of adhering to risk behaviours, such as delay seeking treatment for alcohol use disorders and lack of proper oral preventative behaviours (Genco *et al.*, 2013).

Potential negative associations among individuals aged less than 50 years should be viewed with caution, especially considering the cross-sectional design and omission of other health domains (Griswold *et al.*, 2018). The beneficial effects of light-to-moderate alcohol consumption have been a matter of debate, and traditional J-shaped curves have been observed between alcohol and many health outcomes, including periodontitis (Wagner *et al.*, 2017). One plausible explanation for these findings could arise from the greater social participation often seen among current drinkers compared to abstainers

(Vogelsang *et al.*, 2020). Social participation may have a positive impact on physical and mental health achieved by bolstering self-esteem, cultivating a sense of purpose and buffering against stress. Additionally, there may be a bidirectional association between social participation and tooth loss, with more natural teeth being associated with greater social participation (Cooray *et al.*, 2023), which may explain the better SROH among individuals who are not at-risk drinkers when compared to abstainers.

The primary implication of our findings is that individuals who reported one or more ARCs might benefit from preventative efforts such as education on general and oral wellbeing. Oral health inquiries could include screening for ARC as well as traditional measures of AVC or BD, which may not fully capture the role of alcohol on oral health. Likewise, alcohol-related public health

policies or interventions should be gendered-informed, and dental professionals can play a role in these efforts by providing brief advice to encourage longer periods of abstinence. Given that the effects of alcohol consumption exhibit socioeconomic patterns, further research is warranted to better understand the role of ARC within the “alcohol harm paradox” (Oliveira *et al.*, 2022, 2023).

In conclusion, individuals experiencing at least one past-year ARC have a higher prevalence of poor SROH than abstainers. Such an association was stronger among men under 50 years and among women over 50 years.

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### Data availability statement

The data used in this study are available at: <https://www.ibge.gov.br/estatisticas/sociais/saude/9160-pesquisa-nacional-de-saude.html?=&t=downloads>

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