

## Effects of long-term alcohol consumption on the risk of periodontitis disease: Literature review

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### Abstract

**Background:** Periodontitis is a proinflammatory oral disease caused by the interaction of pathogenic bacteria and the host response, resulting in loss of attachment, which will lead to tooth loss. Periodontitis is related to a person's bad habits, one of which is excessive alcohol consumption. Long-term alcohol consumption will increase a person's risk of developing periodontitis.

**Objective:** This study aims to assess the relationship between alcohol consumption and periodontal disease.

**Discussion:** Periodontal disease is associated with impaired neutrophil phagocytosis. Alcohol can impair T-cell function and neutrophil chemotaxis, which can alter the immune response and increase the risk of periodontitis. Alcohol intake can cause toxic effects on the periodontium and reduce the production of monocyte inflammatory cytokines that would benefit bacterial proliferation.

**Conclusion:** Long-term alcohol consumption significantly increases the risk of periodontitis. Further studies are needed to examine the relationship between alcohol consumption and the development of periodontitis over time.

**Keywords:** Alcohol; Periodontitis; Oral Disease; Metabolism

### 1 Introduction

Periodontal disease is one of the most common chronic diseases, one of the factors causing periodontal disease is alcohol consumption. Early alcohol consumption can increase the likelihood of developing periodontitis 20 years later. There is a need for further studies including larger populations to investigate alcohol consumption measured at different time points, and long-term alcohol consumption and the development of periodontitis over time. Previous studies have shown that heavy alcohol use can alter host defense mechanisms, including impaired neutrophil, macrophage, and T cell function.

Alcohol consumption can affect the oral cavity and upper gastrointestinal tract leading to morphological, metabolic and functional changes. Increased periodontal damage and tooth loss have been reported in people with severe alcoholism. Long-term excessive alcohol use has been reported to affect bone metabolism and may play a significant role in extensive bone loss. Due to excessive consumption of everything bad, excessive alcohol intake is now a major public health problem worldwide.

Several studies have suggested that the association between periodontitis and alcohol consumption is due to poor oral hygiene. Periodontitis is an inflammatory microbial disease affecting the supporting structures of the teeth.

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Microorganisms present in the subgingival biofilm are the causative agents that trigger the host immune response. Due to this immune response many cytokines are activated, which ultimately cause the destruction of the supporting structures of the teeth and cause periodontal problems along with pocket formation and tooth mobility. Evidence suggests that alcohol consumption has emerged as a major risk indicator correlated with periodontal disease.

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## 2 Material and methods

The literature review was conducted using databases such as ScienceDirect and PubMed with a time span of 2012–2023. The search for relevant literature was conducted using Boolean operators, namely AND/OR/NOT.

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## 3 Review

### 3.1 Alcohol

Alcohol is a psychoactive substance that is widely believed to be the only one with addictive potential that is not controlled at the international level by a legally binding regulatory framework despite its profound implications for population and public health.<sup>1</sup>Alcohol is included in xenobiotic materials that undergo sulfidation, which is the process of conjugating xenobiotics with sulfuric acid with the help of the sulfotransferase enzyme. Alcohol is formed from the fermentation of sugar found in various foods such as wine made from sugar in grapes, beer from sugar in *barley malt* (a type of wheat), *cider* from the sugar in apples, and vodka from sugar in potatoes, beets or other plants.

Alcoholism has been defined by World Health Organization as a term that has long been used and has varied meanings, it is generally used to refer to ongoing or periodic alcohol consumption characterized by loss of control over drinking, frequent drunkenness, and excessive involvement with alcohol and alcohol use despite adverse consequences.<sup>2</sup>Alcohol addiction not only affects the health of the whole body but also the health of one's mouth. Alcoholics are at high risk of developing dental caries to gingival disease.

### 3.2 Periodontitis

Periodontitis is an inflammatory disease caused by plaque bacteria, which results in progressive destruction of the supporting tissues of the teeth, namely the gums, periodontal ligament, dental cement, and alveolar bone. This periodontal disease is characterized by periods of exacerbation alternating with periods of remission, and indicates the presence of a local microbial load that triggers local inflammation and local tissue destruction.<sup>3</sup>

### 3.3 Etiopathology Periodontitis

Periodontitis is an infectious condition caused by certain pathogens, such as *Aggregatibacter actinomycetemcomitans*, *Porphyromonas gingivalis*, *Bacteroides forsythias*, *privately intermedia*, *Campylobacter rectus*, *Treponema denticule*, *Fusobacterium nucleate* and so on. Serine crevicular fluid contains inflammatory mediators and oral pathogens associated with periodontitis. The mechanisms by which this destructive process occurs involve direct tissue damage from plaque bacterial products and indirect damage through bacterial induction of host cell inflammatory and immune responses.

### 3.4 Factors Causing Periodontitis

Periodontitis is a multifactorial disease that causes inflammation of the periodontal tissue. In general, periodontal disease is caused by plaque bacteria on the tooth surface, where plaque is a thin layer of biofilm containing a collection of pathogenic microorganisms such as *Porphyromonas gingivalis*, *Actinobacillus actinomycetemcomitans*, *privately intermedia*, *Annarella forsythia* as well as *Fusobacterium nucleate* which is a soft deposit. Some things that are risk factors for periodontitis include stress, aging, depression, environmental exposure (e.g. smoking), a number of systemic conditions such as diabetes mellitus, and alcohol consumption.<sup>3</sup>

Some of the literature that we have studied contains a lot about the influence of alcohol on periodontitis, among which is the following table.

**Table 1** Article Search Synthesis Results

Author	Title	Method	Results
Gay et al. (2018) <sup>4</sup>	Alcohol intake and periodontitis in adults aged $\geq 30$ years: NHANES 2009-2012	Using National Health and Nutrition Examination Survey (NHANES) data and the computer-Assisted Personal Interviewing (CAPI) system. Sample: 9402 participants 30 years or older in US adults.	A total of 3884 participants $\geq 30$ years, representing 45.9% of the US population, had periodontitis. Severe periodontitis was seen in participants who consumed $\geq 8$ alcohol per week.
Hach et al. (2015) <sup>5</sup>	The effect of alcohol consumption on periodontitis in older Danes	Use cross-sectional data from the Copenhagen Oral Health Senior Study (COHSS). Alcohol consumption Sample: Participants aged 65 years or older in 2003.	Heavy drinkers of alcohol in 1981-1983 had odds ratio who are more likely to experience periodontitis compared to light drinkers
Susin et al. (2014) <sup>6</sup>	The association between alcohol consumption and periodontitis in southern Brazilian adults	Data was collected from participants who took part clinical examination and structured interviews. Sample: 1115 subjects aged 18-65 years.	The prevalence of periodontitis was significantly higher among alcohol drinkers $>1$ drink/day than among non-drinkers.
Singh et al. (2018) <sup>7</sup>	Assessment of Alcohol Consumption as a Potential Risk Factor on Periodontal Attachment Loss: A Longitudinal Study	A population-based cohort study conducted over 4 years. Sample: 1,385 people were involved in the study and only 730 people remained for follow-up after 4 years.	There is a positive linear relationship between alcohol consumption and periodontal attachment loss. This proves that alcohol is a potential risk factor in the development of periodontitis at high and chronic alcohol doses.
Oliveira et al. (2021) <sup>8</sup>	Alcohol use disorders are associated with higher prevalence of periodontitis in a rural area of Brazil	Using a population-based cross-sectional study conducted between March 2015 and May 2016. Sample: 688 individuals aged 15 years or older living in rural Rosário do Sul.	These findings indicate that alcohol use disorder impacting the prevalence of severe and widespread periodontitis cases in rural populations.
Lages et al. (2015) <sup>9</sup>	Alcohol Consumption and Periodontitis: Quantification of Periodontal Pathogens and Cytokines	Using observational analytical studies. Sample: 88 volunteers	Dependent alcohol users showed the worst periodontal status and level of <i>P. intermedia</i> , <i>E. corrodens</i> e <i>F. nucleatum</i> , and higher IL-1 $\beta$ .
Park et al. (2014) <sup>10</sup>	Association Between Alcohol Consumption and Periodontal Disease: The 2008 to 2010 Korea National Health and Nutrition Examination Survey	Use data from KHANES and Welfare multivariate logistic regression analyses. Sample: population and housing consensus from the 2005 National Census Registry in Korea has a total of 20,229 individuals.	Men with high alcohol intake are more likely to have periodontal treatment needs regardless of their age, socioeconomic factors, systemic conditions.
Pulikkotil et al. (2020) <sup>11</sup>	Alcohol consumption is associated with	This analysis was conducted using Stata, where the meta-analysis used the DerSimonian and Laird's random effects	It was found that alcohol consumption in men can cause periodontitis disease, alcohol consumption is a common risk

	periodontitis. A systematic review and meta-analysis of observational studies	model. In addition, literature searches and literature search strategies were conducted in the PubMed and Scopus databases. Sample: Women and men who refer to the alcohol consumption group with a range of <40 years or >40 years.	factor for various chronic diseases and the positive association revealed in this review is in addition to the role of alcohol in oral carcinogenesis.
Alsharief and Elizabeth (2017)12	Alcohol Consumption May Increase The Risk For Periodontal Disease In Some Adult Populations	Using data from PubMed, Web of Science, recent studies and Embase	11 of 18 studies showed a statistically significant association between alcohol intake and periodontitis. When stratified by sex, the risk of periodontitis with high alcohol use was doubled among women but only 25% higher in men.
Oliveira Tal. (2023)13	Differences in the subgingival microbial composition associated with alcohol intake.	Using Preferred Reporting Items for Systematic Reviews and Meta Analyses (PRISMA) data and the Cochrane Handbook for Systematic Reviews of Interventions with modifications for exposure reviews sample: 4636 individuals with an age range of 16 to 83 years	The subgingival microbiota of individuals exposed to alcohol intake had significantly higher overall abundances of both <i>P. gingivalis</i> and orange-complex bacteria (i.e., <i>F. nucleatum</i> ) when compared to those not exposed.
Sankaranarayanan et al. (2019)14	Association between alcohol use and periodontal pockets in Finnish adult population	This study is based on the Health Survey 2000, a nationally representative survey conducted in 2000–2001 by the National Institute for Health and Welfare (THL) (formerly the National Institute of Public Health [KTL] of Finland). Sample: 8028 adults aged 30 years	An association with poor periodontal health was found in males or older participants who were in the primary or secondary education group, whereas this association was not found in participants who were in the higher education group.
Hamdi et al. (2021)15	Alcoholic beverage consumption, smoking habits, and periodontitis: A cross-sectional investigation of the NutriNet-Santé study	Data on type and frequency of alcohol consumption were obtained from a semi-quantitative self-reported alcohol frequency questionnaire; daily amounts (g/day) were estimated from 24-hour dietary records. sample: 35,390 adults (mean age: 49.04 ± 13.94 years)	A stronger association with self-reported severe periodontitis was noted when alcohol consumption exceeded >20 g/day for women and >30 g/day for men combined with smoking habits.
Lages et al. (2012)16	Risk variables in the association between frequency of alcohol consumption and periodontitis	Undergoing a complete periodontal examination, and divided into four groups based on the frequency of alcohol use, based on the alcohol use disorder identification test and the Cut-down, Annoyed, Guilty, Eye-opener (CAGE) instrument.	Periodontitis among alcohol users is quite high and the frequency of alcohol consumption increases the likelihood of developing periodontitis, especially in smokers.

Wang et al. (2016) <sup>17</sup>	Alcohol consumption and risk of periodontitis: a meta-analysis	A comprehensive literature search in PubMed, Web of Science, and Embase databases was performed to identify eligible studies published in English. Pooled relative risk (RR) with 95% confidence interval (CI) was calculated using a random effects model.	A significant association was found in the analysis by gender [male: (1.25, 95% CI: 1.11-1.41), female (2.15, 95% CI: 1.36-3.41)]. A linear dose-response relationship was found between alcohol consumption and the risk of periodontitis, and the risk of periodontitis increased by 0.4% for every 1 g/day increase in alcohol consumption.
Baumeister et al. (2021) <sup>18</sup>	Testing the association between tobacco smoking, alcohol consumption, and risk of periodontitis: A Mendelian randomization study	Using 17 single nucleotide polymorphisms (SNPs) as instrumental variables (IVs) for number of cigarettes per day from a genome-wide association study (GWAS) of 337,334 individuals, 109 SNPs for lifetime smoking index from a GWAS of 462,690 participants, and 33 SNPs for number of drinks per week from a GWAS of 941,280 individuals. The periodontitis GWAS included 12,289 cases and 22,326 controls. The Wald ratio was obtained by dividing the periodontitis SNP effect by the exposure SNP effect and combined using an inverse-variance weighted model.	Number of drinks consumed per week was genetically positively associated with periodontitis (IVW OR = 1.41; 95% CI: 1.04-1.90; p-value = 0.0265; Q-value = 0.0265), there was little heterogeneity (in terms of IGX2) among Waldroni, and MR-Egger intercept analysis did not indicate any directional pleiotropy). In multivariable IVW analysis, assessing genetic liability for cigarettes per day and drinks per week simultaneously, both exposures maintained a direct association with periodontitis.

#### 4 Discussion

Alcohol is included in xenobiotic materials that undergo sulfation, which is the process of conjugating xenobiotics with sulfuric acid with the help of the sulfotransferase enzyme. Alcohol is a common risk factor for several chronic diseases, such as periodontitis. Periodontitis among alcohol users is quite high and the frequency of alcohol consumption increases the possibility of increasing periodontitis, especially in smokers.<sup>16</sup> The number of drinks consumed per week was positively associated with periodontitis.<sup>18</sup> Based on the literature review that has been conducted, there is a relationship between long-term alcohol consumption and the risk of periodontitis. Consuming alcohol in large doses and over a long period of time has the potential to experience severe periodontitis. Alcohol use disorder impacts on the prevalence of severe and widespread periodontitis cases, especially in rural populations. A total of 3884 participants  $\geq 30$  years, representing 45.9% of the US population, had periodontitis. Severe periodontitis was seen in participants who consumed  $\geq 8$  alcohol per week.<sup>4</sup> Dependent alcohol users showed the worst periodontal status and level of *P. intermedia*, *E. corrodens*, *F. nucleatum*, and higher IL-1 $\beta$ .<sup>9</sup> Long-term heavy drinkers have odds ratio who are more likely to develop periodontitis than long-term light drinkers.<sup>5</sup> Odds ratio is a measure of the association of exposure (risk factors) with the occurrence of a disease. The prevalence of periodontitis or gingivitis is significantly higher in individuals who consume the equivalent of more than 1 glass of alcohol per day compared to those who do not drink alcohol at all.<sup>6</sup>

It is widely believed that excessive alcohol consumption can be harmful to human health. When stratified by gender, the risk of periodontitis with high alcohol use is doubled among women but only 25% higher in men.<sup>12</sup> A significant association was found in the analysis by gender [male: (1.25, 95% CI: 1.11-1.41), female (2.15, 95% CI: 1.36-3.41)]. A linear dose-response relationship was found between alcohol consumption and the risk of periodontitis, and the risk of periodontitis increased by 0.4% for every 1 g/day increase in alcohol consumption.<sup>17</sup> A stronger association with self-reported severe periodontitis was noted when alcohol consumption exceeded  $> 20$  g/day for women and  $> 30$  g/day for men combined with smoking habits.<sup>15</sup>

Alcohol can interfere with the function of T cells and neutrophils, which can increase the possibility of infection, and then increase the risk of periodontitis. There is a positive linear relationship between alcohol consumption and periodontal attachment loss. This proves that alcohol is a potential risk factor for the development of periodontitis at high and chronic alcohol doses. Alcohol intake can cause toxic effects on the periodontium and can reduce the production of inflammatory cytokines by monocytes that potentially help microbial proliferation. Alcohol can also affect the host cell response to bacterial infection, thereby increasing the vulnerability of the host cells. Bacteria are able to increase the production of pro-inflammatory cytokines, and this increase is associated with the severity of periodontitis. Alcohol consumption will trigger significant induction of TNF- $\alpha$  and IL-6, which affect changes in immune function, which can contribute to immunosuppression and decreased immune-mediated host defense against periodontal pathogens. Two cytokines, namely TNF- $\alpha$  and IL-6, are key in the initiation and maintenance of systemic inflammation that has been implicated in the development and severity of periodontitis.

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## 5 Conclusion

Overall, it can be concluded that the reviewed literature shows similar results, namely that excessive and long-term alcohol consumption can act as a risk factor for the development of periodontitis. The prevalence of periodontitis tends to be higher in heavy drinkers and drinkers who consume alcohol in high doses chronically. In addition, alcohol dependence can also negatively affect periodontal conditions, including the levels of certain bacteria and the extent of periodontitis. This study also highlights the need for more intensive periodontal treatment in individuals with high alcohol consumption.

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## Compliance with ethical standards

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### *Disclosure of conflict of interest*

The authors declare no conflict of interest.

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