# PERIODONTAL DISEASE; ITS ASSOCIATION WITH SYSTEMIC DISEASES AND PREVENTION

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**Abstract:**
**Background**: Periodontal diseases are prevalent globally, affecting a significant portion of the population. Factors such as inadequate oral hygiene, smoking, diabetes mellitus, and genetic predispositions play crucial roles in their development. These diseases are associated with systemic conditions like cardiovascular disease, diabetes mellitus, chronic kidney disease, and chronic obstructive pulmonary disease, emphasizing the importance of maintaining good oral health. **Objective**: This review aims to examine the relationship between periodontal disease and systemic conditions, explore potential mechanisms linking them, evaluate preventive measures' effectiveness, assess the impact of periodontal disease on health and quality of life, and provide evidence-based recommendations for healthcare providers and patients. **Conclusion**: Periodontal diseases are highly prevalent and linked to various systemic conditions. Inadequate oral hygiene, smoking, diabetes, and genetic factors contribute to their development. The bidirectional relationships underscore the significance of good oral health practices. Preventive measures such as regular dental cleanings, proper oral hygiene, and lifestyle modifications are essential for managing both periodontal diseases and associated systemic conditions. Healthcare providers and patients should collaborate to effectively prevent and manage these conditions, recognizing their impact on overall health and quality of life.

**Keywords:** Periodontal disease, epidemiology, risk factors, systemic disease, preventive strategy.

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**Introduction:**

Periodontal diseases refer to disease processes affecting the periodontium, which encompasses the gingival tissue, alveolar bone, cementum, and periodontal ligament surrounding a tooth [1]. These diseases, particularly the mild and moderate forms, are prevalent among adult populations worldwide, with rates around 50%, while severe cases increase notably between the third and fourth decades of life, with a global prevalence of approximately 10% [1]. Various demographic factors such as age, gender, ethnicity, and socioeconomic status impact the prevalence of periodontitis, along with lifestyle factors like smoking, diabetes mellitus, metabolic syndrome, and obesity [2]. Notably, smoking and diabetes can predispose individuals to advanced periodontal disease even in adolescence and early adulthood, with smoking also linked to tooth loss in young individuals. Severe periodontitis, a leading cause of tooth loss in adults, often leads to tooth mobility and drifting, ultimately affecting an individual's bite function. Additionally, periodontal disease and tooth loss are associated with several chronic diseases and overall health conditions [3].

In a state of periodontal health, immune cells remain present in the gingiva, contributing to the equilibrium between oral biofilms and the host. This ongoing communication sustains an active immune response, characterized by a reciprocal, synergistic, and dynamic interaction. The immune response in the periodontium mirrors that of other body tissues, with non-specific innate responses acting as the initial defense against microbes, and specific adaptive responses triggered by prolonged pathogenic challenges [4].

The accumulation of excessive dental plaque at the gingival margin leads to inflammation and an increase in proteolytic and often obligate anaerobic species. The presence of potentially pathogenic periodontal species in the gingival sulcus triggers an inflammatory reaction in the gingival tissue, which, if chronic, can have severe consequences in susceptible individuals. Interactions between the oral microbiota's components, metabolic activities, and the host can either maintain a balance (homeostasis) or lead to disruption (dysbiosis) within the microbiota [5]. Commensal bacteria associated with periodontal health play a crucial role in preserving this balance by inhibiting the growth of pathogenic bacteria linked to periodontitis. However, qualitative and quantitative changes in subgingival biofilms can disrupt this balance, potentially resulting in various degrees of periodontal tissue destruction and the onset of disease [6].

**Objectives:**

The main objectives of this review are:

1. To examine the relationship between periodontal disease and systemic diseases such as diabetes, heart disease, chronic kidney diseases and COPD.
2. To investigate the potential mechanisms by which periodontal disease may contribute to the development or exacerbation of systemic diseases.
3. To evaluate the effectiveness of preventive measures, such as regular dental cleanings, good oral hygiene practices, and lifestyle modifications
4. To assess the impact of periodontal disease on overall health and quality of life.
5. To provide evidence-based recommendations for healthcare providers and patients on the importance of maintaining good oral health in order to prevent and manage both periodontal disease and systemic diseases.

**Epidemiology:**

Periodontal diseases are prevalent worldwide, affecting a significant portion of the population, with estimates suggesting up to 90% of individuals are impacted by this condition, making it the most prevalent oral disease globally. In the United States, recent cross-sectional studies indicate that around 50% of adults currently exhibit symptoms of gingivitis, while up to 80% have encountered some form of periodontal disease during their lifetime. Certain demographics, such as older individuals, males, and African-Americans, have been identified as having a higher susceptibility to periodontal diseases. Additionally, individuals with lower income and education levels are more likely to experience severe cases of periodontitis [7].

**Etiology:**

Periodontal diseases emerge due to a variety of factors, encompassing patient-specific risk elements and insufficient oral hygiene practices. These risk factors can be categorized into modifiable factors, such as smoking tobacco, inadequate oral hygiene, diabetes mellitus, and pregnancy, as well as non-modifiable factors like age and heredity, which includes genetic predispositions [8].

Inadequate oral hygiene habits play a pivotal role in the onset and progression of periodontal diseases. Incorrect oral hygiene methods can result in the accumulation of bacteria and plaque on the teeth, initiating gingivitis and potentially advancing to periodontitis. Research has established a direct

correlation between the increasing buildup of dental plaque and the heightened severity and prevalence of periodontal diseases [9].

Insufficient oral hygiene allows anaerobic organisms responsible for the advancement of periodontal diseases to inhabit deeper regions of the periodontium, where they can instigate their detrimental effects. The primary bacteria implicated in periodontitis comprise Aggregatibacter actinomycetemcomitans, Porphyromonas gingivalis, Treponema denticola, and Tannerella forsythia. These organisms, when able to penetrate deeply into the periodontium, induce inflammation by stimulating the release of inflammatory mediators and other defensive substances from the host [10,11].

One of the most significant modifiable risk factors for periodontal diseases is tobacco smoking, which can elevate the risk by 5-20 times, with an odds ratio of 5.4 between smoking and chronic periodontitis. Moreover, smokers exhibit increased levels of bone loss, attachment loss, deep periodontal pockets, and tooth loss compared to non-smokers. Tobacco smoking is also linked to reduced treatment efficacy [12].

Diabetes mellitus is another major contributor to periodontal diseases, as it is associated with pathological processes that exacerbate periodontal breakdown, such as impaired wound healing. Patients with diabetes mellitus and severe periodontal disease face a higher mortality risk compared to those with mild or absent disease [13].

Pregnancy induces hormonal fluctuations that promote an inflammatory response associated with gingivitis and periodontitis. Maternal hormones have been positively correlated with Porphyromonas gingivalis levels, a crucial microbe in periodontal disease progression. Both hypoestrogenism and hyperestrogenism have been implicated in gingivitis development [14,15].

Age, a non-modifiable risk factor extensively discussed in the literature, is associated with a more severe inflammatory response to plaque deposition in older individuals. This heightened response, characterized by an increased number of inflammatory cells, predisposes older individuals to periodontal tissue destruction. Additionally, age-related decline in dexterity leads to less effective oral hygiene practices, resulting in elevated plaque levels, a known risk factor for periodontal disease development. Research indicates greater clinical attachment loss in individuals aged 60 to 90 compared to those under 50 [16,17].

Finally, certain genetically linked systemic disorders, such as Down syndrome, Ehlers-Danlos syndrome (types IV and VIII), and Crohn's disease, have been shown to present as periodontal diseases. The literature also documents the etiology of periodontal disease development within these systemic conditions [18,19].

**Pathophysiology:**

The commensal bacteria found in the oral cavity play a crucial role in the development and progression of periodontal disease through a phenomenon known as dysbiosis, which refers to an imbalance in the microbial community [20]. This disease typically follows a cyclic pattern, alternating between periods of activity and quiescence, until intervention is sought or irreversible damage occurs, potentially leading to tooth loss [20].

As periodontal disease advances from gingivitis to periodontitis, an increasing number of anaerobic bacteria, such as Aggregatibacter actinomycetemcomitans and Porphyromonas gingivalis, colonize the deeper pockets around the teeth, triggering an inflammatory response from the host [20]. This response involves the release of inflammatory biomarkers like C-reactive protein (CRP), as well as various compounds from neutrophils and macrophages, including tumor necrosis factor-alpha (TNF-a), matrix metalloproteinases (MMPs), and interleukins (IL-1 and IL-8) [20].

Elevated levels of CRP in the bloodstream have been linked to the inflammation associated with periodontitis, suggesting a potential correlation with cardiovascular diseases [20]. Furthermore, smoking has been shown to create a more favorable environment for the growth of periodontal pathogens, exacerbating the progression of the disease [21].

**Association of Periodontal Disease with other Medical Conditions:**

**Cardiovascular disease:** A substantial body of evidence elucidates the correlation between cardiovascular diseases and periodontal diseases. According to a systematic review, it was revealed that periodontitis represents a significant risk factor for coronary heart disease, with the association remaining independent of other risk factors like diabetes, smoking, and socioeconomic status [22]. Furthermore, a meta-analysis encompassing eight prospective and one retrospective studies indicated

that periodontal disease could potentially elevate the risk of cardiovascular disease by 19%, a figure that escalates to 44% among individuals aged 65 years and older [23]. Moreover, an additional systematic review and meta-analysis involving 11 studies (comprising five cohort and six cross-sectional studies) demonstrated that periodontal disease, coupled with heightened levels of systemic bacterial markers, was linked to an increased risk of coronary heart disease [24].

Likewise, a meta-analysis amalgamating findings from 29 studies (including 22 case-control and cross-sectional studies, as well as seven cohort studies) reported a pooled odds ratio of 2.35 and a pooled relative risk of 1.34, indicating that individuals afflicted with periodontal disease faced a substantially greater risk and higher odds of developing heart disease compared to those without periodontal disease [25]. Furthermore, the association between periodontal disease and stroke, as well as peripheral artery disease, appears to be even more robust than that with coronary heart disease.

**Diabetes mellitus:** The intricate interplay and mutual influence between diabetes and periodontal disease have been extensively documented in the literature [26]. A longitudinal study involving 628 participants aged 35 years and above, spanning an 11-year period, revealed that individuals with type 2 diabetes and severe periodontal disease faced a significantly elevated risk of mortality from ischemic heart disease, with a risk 3.2 times higher than those with little to no periodontal issues [27]. Furthermore, a comprehensive meta-analysis indicated that interventions targeting periodontal health can lead to improved glycemic control in individuals with type 2 diabetes for a duration of at least 3 months [28]. Supporting this, a systematic review highlighted the contributory role of periodontal disease in the onset and progression of type 2 diabetes and its associated complications [29].

Numerous scientific studies consistently underscore the association between periodontitis and insulin resistance, positing that the former may exacerbate the latter, a chronic condition intricately linked to the development of metabolic disorders and type 2 diabetes mellitus [30]. Notably, a study by Lim et al. scrutinizing data from a national survey involving 16,720 subjects identified a significant correlation between insulin resistance and periodontitis, particularly among postmenopausal Korean women [31]. Moreover, interventions targeting periodontal health have been proposed as a potential strategy to ameliorate insulin resistance in diabetic patients [32].

Several systematic reviews have also pointed towards a significant relationship between obesity and periodontal disease, with obesity emerging as a notable risk factor for the onset and progression of periodontitis [33,34]. Recent research has shed light on how obesity can heighten oxidative stress within periodontal tissues, leading to their deterioration [35,36]. Given the escalating global prevalence of obesity and its established association with periodontitis, it is imperative for healthcare providers to prioritize preventive measures to address these burgeoning public health challenges [37].

**Respiratory diseases:** The significance of maintaining optimal oral hygiene in individuals suffering from chronic obstructive pulmonary disease (COPD) has been underscored in light of its correlation with periodontitis. According to Chung et al., who analyzed data from a Korean national survey involving 5,878 adults, COPD patients exhibited a notably higher prevalence of periodontitis in comparison to their healthy counterparts [38]. Furthermore, a substantial cohort study involving 22,332 COPD patients compared to non-COPD individuals indicated that those with COPD faced an elevated risk of developing periodontal disease [39]. Moreover, a meta-analysis encompassing 14 epidemiological studies highlighted a significant link between periodontal disease and COPD, establishing periodontal disease as an independent risk factor for COPD [40]. Additionally, there is a suggestion that oral and periodontal microorganisms play a role in bacterial pneumonia.

**Chronic kidney disease (CKD):** According to Fisher and Taylor's epidemiological study involving 11,955 adults in the U.S, it was discovered that periodontitis is a significant risk factor for chronic kidney disease (CKD) [41]. Subsequent research, comprising a systematic review of four observational and three interventional studies, highlighted that individuals with periodontitis face an elevated risk of developing CKD, with positive outcomes observed in CKD patients following periodontal treatment [42]. Furthermore, Ioannidou and Swede's investigation revealed a dose-response relationship between periodontal disease and various stages of CKD, indicating that individuals with CKD are 30-60% more likely to develop moderate periodontitis [43]. In a separate study by Ioannidou et al., it was demonstrated that Mexican Americans with reduced kidney functions were twice as likely to have periodontal disease compared to those with normal kidney functions [44]. Similarly, Iwasaki et al. established a correlation between periodontitis and diminished kidney functions in elderly

Japanese individuals [45]. More recently, Ricardo et al.'s prospective cohort study, spanning 14 years, found that CKD patients with periodontitis faced a 35% higher risk of mortality compared to those without periodontal disease [46].

**Prevention and treatment of periodontal diseases:**

The management of periodontal disease involves a systematic approach that commences with more conservative measures. The initial phase of treatment for all types of periodontitis typically entails a professional dental cleaning, encompassing the scaling of teeth and root planning to eliminate dental plaque and calculus located both above and below the gum line. An integral component of this dental cleaning process involves the provision of oral hygiene instructions by the dental practitioner to the patient, aimed at enhancing their at-home oral hygiene regimen. Subsequent to the completion of the cleaning session, it is advisable for the patient to revisit the dentist for a reevaluation of the periodontal status, involving an assessment of the condition of the periodontium and the measurement of probing depths to ascertain if the disease progression has been halted. Upon confirmation of the resolution of the condition, regular follow-up cleanings are recommended, given that periodontitis is a chronic ailment that can recur if conducive conditions persist [47].

The primary focus of managing periodontal disease lies in addressing risk factors. Inadequate oral hygiene stands out as one of the principal triggers of periodontal disease. Preventing poor oral hygiene practices entails advocating for appropriate self-administered oral hygiene routines as well as professional upkeep at specified intervals based on the individual patient's risk profile. The recommended self-care regimen involves a three-step daily protocol comprising brushing, flossing, and rinsing. It is also advised to refer patients to a dentist for professional cleanings and scheduled monitoring to track disease progression [48].

Another crucial modifiable risk factor that necessitates attention is tobacco smoking. Research indicates that tobacco smoking not only escalates the likelihood of developing periodontal disease but also correlates with a more aggressive disease course and a diminished response to periodontal treatments. The association between smoking and periodontal disease weakens upon smoking cessation [49].

The well-documented connection between diabetes mellitus and periodontal disease highlights the potential exacerbation of periodontitis as a result of diabetes. Moreover, inadequate glycemic control is linked to accelerated disease advancement. Poorly regulated glucose levels are associated with heightened mortality rates in cases of severe periodontal disease. Hence, optimizing the management of diabetes mellitus and prediabetes may be imperative to enhance the outcomes of periodontal therapy [50].

**Conclusion:**

In conclusion, periodontal diseases are prevalent worldwide, affecting a significant portion of the global population. Factors such as inadequate oral hygiene, smoking, diabetes mellitus, and genetic predispositions play key roles in the development and progression of periodontal diseases. These diseases have been linked to various systemic conditions, including cardiovascular disease, diabetes mellitus, chronic kidney disease, and chronic obstructive pulmonary disease. The bidirectional relationships between periodontal diseases and these systemic conditions highlight the importance of maintaining good oral health. Preventive measures such as regular dental cleanings, good oral hygiene practices, and lifestyle modifications are crucial in managing both periodontal diseases and their associated systemic conditions. Healthcare providers and patients should be aware of the impact of periodontal diseases on overall health and quality of life, and work together to prevent and manage these conditions effectively.

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