

Is periodontitis a risk factor for severe Covid-19 illness?

A number of studies have reported an association between periodontitis and Covid-19 outcomes.

Learning outcomes:

After reading this article the reader should be able to:

1. Describe the association between the presence of periodontitis and adverse Covid-19 outcomes during the recent pandemic.
2. Outline potential systemic biological mechanisms underlying the association between periodontitis and Covid-19 outcomes, alongside local factors relating to the periodontal pocket, viral carriage in the oral cavity, and the role of specific periodontal pathogens.

Introduction

In 2019, the World Health Organization (WHO) published the name 'severe acute respiratory syndrome coronavirus 2', or SARS-CoV-2, for the virus responsible for the disease referred to as Covid-19. The virus was first identified in Wuhan, China, in December 2019, with Covid-19 being declared a global pandemic in March 2020. By the end of April 2025, the WHO had reported 778 million cases of Covid-19 worldwide, with 7.1 million deaths. In Ireland, 1.8 million cases have been reported, with approximately 9,800 associated deaths.

Most patients with Covid-19 infection develop mild symptoms such as low-grade fever, fatigue and dry cough. However, in some cases symptoms can be severe, leading to hospitalisation due to shortness of breath, chest pain, low blood oxygen, and respiratory distress. The risk factors associated with this severe systemic presentation include advanced age, male gender, obesity, cardiovascular disease, and diabetes. This narrative review will evaluate the evidence of a possible association between periodontitis and an increased risk of serious adverse outcomes of Covid-19.

Periodontitis and systemic disease

Over recent years, periodontitis has been linked to the pathogenesis of numerous systemic conditions (Figure 1). Of these, most studies have centred on cardiovascular disease and diabetes. Periodontitis is now considered an independent risk factor for cardiovascular disease.¹ Similarly, periodontitis has been shown to increase the risk of diabetes onset and the subsequent development of complications, while successful treatment of periodontitis has been shown to improve diabetic status, significantly reducing glycosylated haemoglobin levels.² Proposed biological mechanisms underlying these links include:

- bacteraemia: the ingress of periodontal pathogens to the bloodstream and subsequent translocation around the body; and,

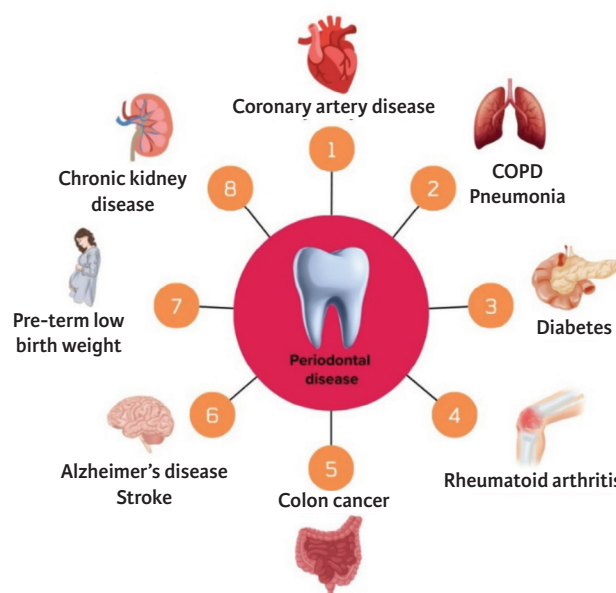


FIGURE 1: Proposed links between periodontal disease and a range of systemic conditions.

- increased systemic inflammation: due to the overflow of inflammatory mediators produced at sites of periodontitis into the systemic circulation, and release by the liver and other tissues on stimulation by periodontal pathogens through bacteraemia.

While studies on a possible link between periodontitis and respiratory disease are more limited, available evidence also supports an association between

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periodontitis and chronic obstructive pulmonary disease (COPD), specifically the frequency of exacerbations and hospitalisation, and quality of life in COPD patients.³ In addition, early intervention studies suggest a positive impact of periodontal treatment on COPD and pneumonia.⁴ An additional suggested mechanism linking these two conditions is the aspiration of periodontal pathogens. Elevated levels of *Fusobacterium nucleatum* and *Prevotella intermedia* have been found in the sputum of patients with an acute exacerbation of COPD.⁵

Association between periodontitis and Covid-19 outcomes

A small number of studies have investigated a potential association between periodontitis and Covid-19 outcome severity, with the majority reporting associations between the two conditions. Severe periodontitis, elevated plaque score and gingival bleeding have been more frequently observed in Covid-19 patients⁶ and, while not reported in all studies, analysis of data from a range of studies has indicated that patients with periodontitis had a 54% greater chance of getting Covid-19 infection compared to those with healthy periodontal tissues.

Pooled data from studies also showed a significant positive association between periodontitis and Covid-19 severity. In one case-control study from Qatar,⁷ where radiographs were available to determine periodontal status, after adjusting for potential confounders the presence of significant periodontal disease (Stage II-IV) was found to be associated with poor Covid-19 outcomes:

- need for assisted ventilation (OR=4.57, 95% CI 1.19-1.74);
- ICU admission (OR=3.54, 95% CI 1.39-9.05); and,
- death (OR=8.81, 95% CI 1.00-77.7).

Interestingly, in this study, Covid-19 cases with periodontitis also had significantly elevated markers of systemic inflammation, including white blood cell counts and C-reactive protein (CRP) levels.⁷

In a separate case-control study, where the level of periodontal disease was assessed clinically, higher severity of periodontitis was again related to poorer Covid-19-related outcomes, namely: the need for assisted ventilation (OR=7.45, 95% CI 2.00-25.82); hospital admission (OR=36.52, 95% CI 4.62-288.64); Covid-19-related pneumonia (OR=4.42, 95% CI 1.57-12.45); and, death (OR=14.58, 95% CI 0.69-125.33).⁸

Obesity is known to be a significant risk factor for poor Covid-19 outcomes. A recent study has shown an additive effect of periodontitis and obesity on Covid-19 outcomes. For patients with obesity, both hospital admission rates and mortality rates were significantly higher in those participants with periodontitis than those without.⁹

Given the acute nature of the condition, no intervention studies on the impact of periodontal treatment on Covid-19 outcomes have been undertaken. However, using the same database as used in the previously mentioned study in Qatar, researchers were able to compare infection outcomes between periodontal patients who had previously received treatment and those who had not. No statistically significant differences were found between participants who were periodontally healthy and those previously treated for periodontitis. In contrast, untreated periodontal patients had a significantly greater risk of requiring mechanical ventilation compared to healthy cases (OR=3.91, 95% CI 1.21-12.57).¹⁰

Table 1: Risk factors for periodontitis and adverse Covid-19 outcomes. Factors in bold are shared by both conditions.

Periodontal disease	Adverse Covid-19 outcomes
Smoking	Smoking
Diabetes	Diabetes
Obesity	Obesity
Older age	Older age
Male gender	Male gender
Genetic	COPD
Stress	Cardiovascular disease
Dysbiotic plaque	Hypertension
	Chronic kidney disease

A direct effect or simply shared risk factors?

Taken as a whole, data from these studies indicate that periodontitis shows an association with increased severity of Covid-19 infection and poorer outcomes. Periodontitis and severe Covid-19 complications have common risk factors, including smoking, diabetes, obesity, older age and male gender (**Table 1**). Any association between the two conditions may thus simply be a result of these shared risk factors.

In contrast, several hypotheses have been put forward to provide biological plausibility underlying an association between the two conditions. Patients with severe Covid-19 outcomes show an exacerbated immune and inflammatory response to infection by the virus, characterised by excessive levels of pro-inflammatory cytokines and multi-organ damage – the so-called cytokine storm syndrome,¹¹ many of the components of which are common to the cytokine expression profile of periodontitis. Covid-19 mortality has been associated with elevated levels of serum IL-6 and CRP,¹² indicating a clear link between systemic hyperinflammation and disease severity. In 1986 a seminal paper in the periodontal literature was published on periodontal disease progression in a group of male Tamil tea labourers with no exposure to dental treatment or disease prevention.¹³ This study found a subset of approximately 8% of participants who showed rapid progression of periodontal disease. The term 'hyperinflammatory phenotype' was conceived to define those patients deemed at higher risk of developing progressive periodontitis, a term resonating with the excessive levels of systemic inflammation seen in patients with severe Covid-19 outcomes and raising the possibility of hyperresponsiveness to bacterial/viral insult, based in genetics, underlying both conditions.

Knowledge of the association between periodontal disease and other systemic conditions also provides a basis for a biological link between periodontitis and Covid-19 outcomes. As detailed above, bacteraemia, systemic inflammation and, in the specific case of respiratory disease, micro-aspiration of periodontal pathogens, all play a role in these associations and could equally be applied to Covid-19 outcomes. Thus, the presence of untreated periodontitis could add to the burden of systemic inflammation in Covid-19 patients.

Periodontal pockets and bacterial pathogens may also influence the response to Covid-19 infection. SARS-CoV-2 has been detected in periodontal pockets and gingival crevicular fluid.¹⁴ Micro-ulceration of the diseased periodontal pocket wall is thought to aid ingress of the virus into the local tissues and systemic circulation. Angiotensin-converting enzyme

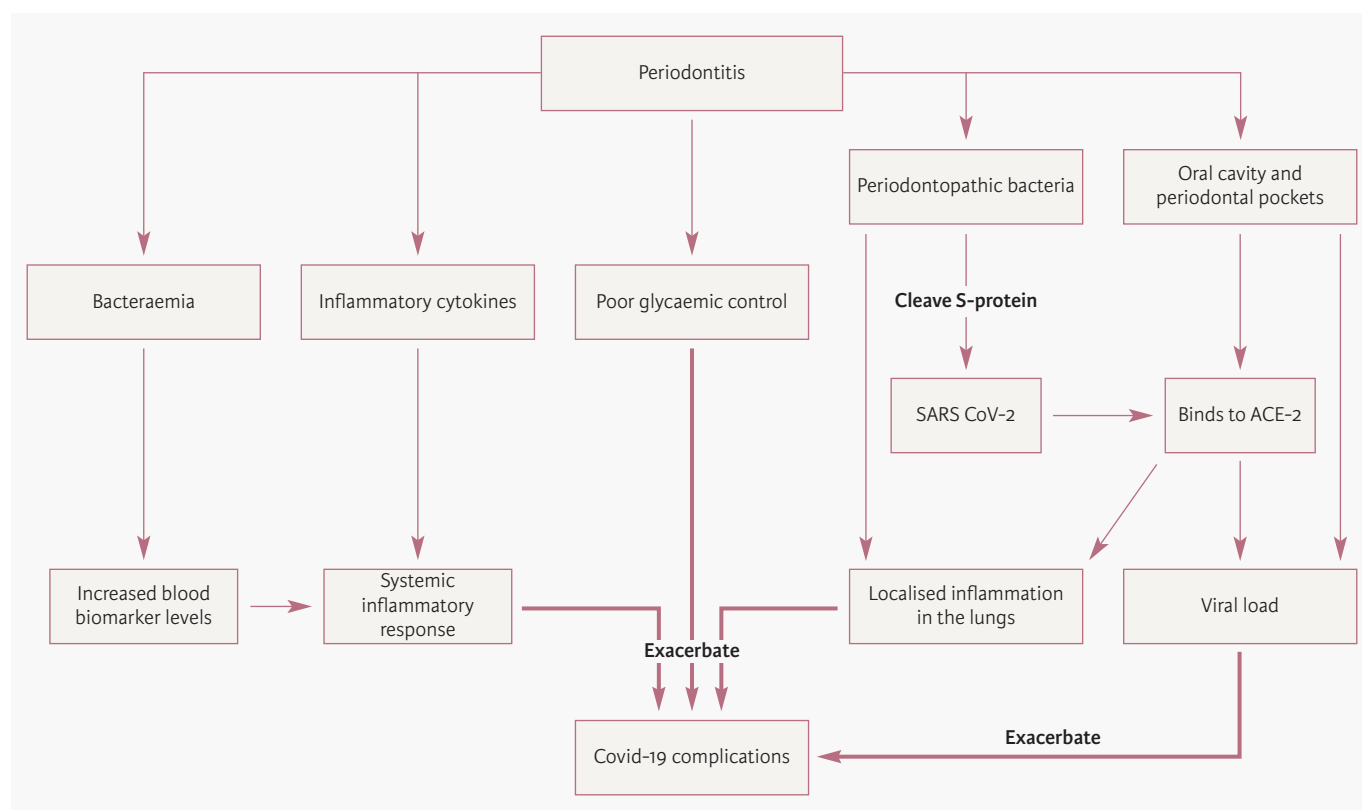


FIGURE 2: Potential mechanisms underlying the association between periodontal disease and Covid-19 outcomes.

2 (ACE2), the main receptor for SARS-CoV-2 promoting entry into host cells and tissues, is highly expressed in inflamed periodontal tissues. Moreover, periodontal pathogens can enhance the virus's ingress and virulence by cleaving its S-glycoprotein, while aspiration of periodontopathic bacteria, and specifically *Fusobacterium nucleatum*, induces the expression of ACE2 in the lower respiratory tract.¹⁵ **Figure 2** summarises proposed local and systemic biological mechanisms that could explain the association between periodontitis and Covid-19 outcomes.

Clinical implications

The Covid-19 pandemic had a worldwide impact on all aspects of our lives. While current infection levels have diminished greatly – 515 Covid-19 cases in Ireland, and >25,000 cases worldwide were reported to the WHO in April 2025 – our understanding of the association between periodontitis and Covid-19 outcomes, alongside links to a range of systemic diseases, highlights the importance of the maintenance of periodontal health to our

general health. Despite the lack of intervention studies on periodontal treatment of Covid-19-infected patients, data reported in this review strongly suggest that the concomitant presence of periodontitis leads to significantly increased risk of adverse Covid-19 outcomes. Prevention or successful treatment of periodontitis will not only reduce the direct impact of periodontal pathogens on respiratory tissues, but has also been shown to reduce markers of systemic inflammation, including IL-6 and CRP. Moreover, treatment of periodontitis has also been shown to have a direct impact on a systemic condition, namely diabetes, itself a risk factor for Covid-19 outcomes. Analysis of data from intervention studies showed that successful non-surgical periodontal therapy led to a reduction in glycated haemoglobin levels of 0.43% in type 2 diabetic patients, equivalent to taking glucose-reducing medication.² Data on the association between periodontitis and Covid-19 outcomes further strengthen our understanding of the importance of maintaining periodontal health, not just in relation to oral health, but also regarding overall systemic health.

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