



REVIEW ARTICLE

Type-2 diabetes mellitus, metabolic control, serum inflammatory factors, lifestyle, and periodontal status



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Abstract Type-2 diabetes mellitus and periodontal disease are complex human diseases. Pathogenesis of both ailments is multifactorial, involving chronic disease courses with varied clinical presentations. It is well established in the scientific literature that both diseases are interrelated; in particular, individuals suffering from diabetes are at a higher risk of developing periodontitis. The present review analyzed, using a hypothetical model, the complex factors that may influence the two diseases indirectly, including lifestyle, obesity, diabetes control, oral health behavior, and serum inflammatory factors, and even quality of life. In this review, special attention was given to exploring plausible theoretical or practical explanations of the interrelations and the contemporary evidence base underpinning these. Since the impact of individual general or oral health quality of life factors are substantial, it is very important for health care professionals to appreciate the influence of these factors as controlling these help assist in management of both type-2 diabetes and periodontal diseases thus reducing the social burden of these two complex disease in various populations.

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Periodontitis and diabetes mellitus as complex diseases

Periodontitis is a complex human disease, clinically expressed as chronic inflammation at tooth-supporting structures resulting from interactions between subgingival plaque biofilms and the susceptible host defense system. Diabetes mellitus (DM) is yet another human complex disease characterized by metabolic disorders leading to various levels of chronic hyperglycemia resulting from insufficient insulin production or ineffective insulin action, or both. Even though possible contributory interactions between diabetes and periodontitis have been established and the support for a bidirectional link appears to be rather clear, one needs to be aware that available scientific evidence supports controversies regarding the association between these two complex diseases. Clinical evidence has been presented in the literature supporting direct, indirect, or no association between DM and clinical periodontal status. The probable reason for these different findings of associations could be due to the complex and multifactorial nature of these two diseases, and hence their diagnosis, classification and/or clinical trials such as level of diabetic control,¹ differences arising from different periodontal disease data collection protocols,² and differing numbers of clinical patients used in the studies.³ Owing to the complex nature of these two diseases other factors, apart from the direct basic science mechanisms linking both diabetes and periodontitis, seem to be associated indirectly. These other factors include general health behaviors, lifestyle, and level of serum inflammatory mediators.⁴

The effect of periodontitis on general health and quality of life remains ill defined, despite several studies. In a study, type-2 DM patients, however, have been reported to experience dry mouth and, in general, have inferior physical, role, and social functioning.⁵ The same study indicated that, in addition to type-2 DM, dry mouth, dissatisfaction with mouth or teeth, and poor financial status were significantly associated with inferior general life quality among the 204 Scandinavians surveyed.

The health-related behaviors and lifestyle factors that play major roles in the development of both type-2 DM and periodontal disease include general health behavior, diet and obesity, oral health behavior, and psychological factors and their associations with serum inflammatory factors such as tumor necrosis factor alpha (TNF- α). The factors, established, theoretical, or conceptual, that may contribute to type-2 diabetes, and periodontitis and their interactions and may potentially modify the corresponding disease(s) outcomes are summarized in Fig. 1.

Taylor and coworkers⁶ recently provided a detailed review on the relationship between glycemic control and periodontal inflammation at molecular and cellular levels. Their group demonstrated a considerable amount of information on the direct impact of poor glycemic control on microbial factors, cytokines, adipokines, immune cell functions, cell stress, and advanced glycation end-products and their receptor and alveolar bone homeostasis, as well as some, but limited, information on the impact of microbial and inflammatory factors of periodontal disease on diabetic control. The aim of this present review is to summarize the clinical evidence available for the associations between the

above mentioned health behaviors and lifestyle factors, and both type-2 DM and poor periodontal health. In addition, current evidence on the impact of periodontal disease on diabetic mellitus and a model of such interaction will be discussed. In particular, the study focuses on the interactions between these two diseases and the aspects that health care professionals should attempt to promote good general and oral health for the affected people.

General health behaviors

The ideal general health behaviors include not smoking, consuming fewer than 10 (if male) or five (if female) alcoholic drinks per week, always wearing a seatbelt while in a car whether as a driver or as a passenger, and participating in an exercise activity such as brisk walking, aerobics, sports, or heavy house-work at least three times a week.⁷ Good health behaviors measured in terms of smoking, alcohol consumption, eating breakfast, hours of sleep, hours of work, physical exercise, nutritional balance, and mental stress are associated with higher natural killer cell activity, which constitutes the first line of immunological defense.⁸ In diabetic males, a healthy lifestyle and fewer micro-vascular complications have been shown to be associated with higher education.⁹ Among diabetic women, however, the more educated perceived themselves as healthier than those with less education, regardless of their medical status.¹⁰ Diabetic patients with poor metabolic control and a lower educational level report more complications, nervous problems, sick leave days, and disability pensions and a lower level of physical activity than patients with good or acceptable metabolic control.¹¹ Diabetic females of a low social class face a higher risk of mortality than both nondiabetic females and diabetic males of low social classes.¹²

Poor general health behaviors, regardless of the DM status, have been shown to be moderately associated with poor periodontal conditions,¹³ whereas those who maintain normal weight, engage in regular exercise, and have a high-quality diet experience improved periodontal conditions.¹⁴

Diet and obesity

Obesity is defined as having excess body weight with an abnormally high proportion of body fat. Body mass index (BMI) is a simple measure of body fat based on body weight and height and is used to identify overweight and obese people. BMI is defined as weight in kilograms divided by height in meters squared. The World Health Organization (WHO) and the National Institute of Health defined overweight as a BMI of 25–29.9 kg/m² and obesity as a BMI of 30 kg/m² or higher. BMI cutoffs are based on data showing that health risks increase with BMI > 25 kg/m².¹⁵ The current increase in the prevalence of obesity has been associated with an increase in the prevalence of type-2 diabetes.¹⁶

Obesity is a known risk factor for type-2 diabetes, heart disease, stroke, hypertension, osteoarthritis, sleep apnea, and some forms of cancer.¹⁷ Overweight or obesity is the single most important predictor of type-2 diabetes.¹⁸ The risk of diabetes increases by approximately 9% with every kilogram increase in the self-reported weight¹⁹ and by 4.5%

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