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A Review of the Relationship between Obesity and Periodontal Diseases

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Abstract

Aim: To explore the influence of obesity/overweight on development and treatment outcome of periodontal diseases (PD), and to explore possible mechanisms of interaction between obesity and PD.

Method: A literature search was conducted using the PubMed and Go Pubmed databases.

Conclusion: Obesity and PD can exert similar pathogenic effects via common pathways, and can influence each other bidirectionally. Elucidating the relationship between obesity and PD allows for the development of care guidelines and recommendations for clinicians and the public.

Keywords: Periodontal Diseases; Periodontitis; Gingivitis; Obesity

Abbreviations: PD: Periodontal Diseases

Introduction

Obesity and periodontal diseases (PD) are very prevalent among U.S. adults during recent years [1-4]. Since both can lead to severe chronic health conditions and impair people's life quality by exerting similar influences [5-10], a clear understanding of the association between obesity and periodontal diseases is warranted to reduce health and medical costs in the U.S. [5] The objective of this review is to explore the influence of obesity/overweight on development and treatment outcome of PD, and to explore possible mechanisms of interaction between obesity and PD.

Methods

PubMed and Go Pubmed were used to search for related preclinical, observational, clinical studies and meta-analyses that investigated the relationship between obesity and PD. They were reviewed to determine the association and to summarize mechanisms of interaction between the conditions. Combinations of *"obesity" or"overweight" or "fat-induced obesity" or "weight changes" AND"gingivitis" or "periodontitis" or "periodontal diseases"* were used as key terms. Studies conducted in the past six years were included.

Discussion

PD and obesity can cause and/or facilitate the development and progression of similar systemic diseases and conditions, which include metabolic syndrome [9-16], type 2 diabetes mellitus (T2DM) [17,18], cardiovascular diseases (CVD) [19-21], alveolar bone loss [22-24], rheumatic diseases[17,25-34], and a series of cancers [32-38]. Because of the pro-inflammatory cytokines and adipokines released by adipocytes [9-16], obesity has been consistently shown to be significantly associated with increased risk and worsened prognosis of metabolic syndrome, T2DM, CVD, breast cancer and pancreatic cancer. Meanwhile, PD has been found to have similar relationship with these diseases because of the pro-inflammatory effects caused by virulent factors and antigens of periodontal pathogens such as *Fusobacterium* species, *T. denticolaand P.gingivalis [37-41]. Fusobacterium* species have even been detected in pancreatic tissues of patients suffering from pancreatic ductal adenocarcinoma [38]. At the same time, although alveolar bone loss is the hallmark of PD [22], it has been found that each unit increase in BMI is associated with a 5% increase in the risk of alveolar bone loss, and that every 1% increase in waist circumference to height ratio is associated with 3% increase in risk of progression of alveolar bone loss [23,24].

PD and obesity are very likely to interact through their shared inflammatory pathways to influence diseases mentioned above [42]. Although they initiate inflammation via different mechanisms [39,40,43-45], their similar effects on the same set of biomarkers involved in pathogenesis indicate that lots of common inflammatory pathways are involved in subsequent steps [14,40,42]. Among these biomarkers, resistin, TNF-alpha, and

IL-6 are commonly tested for [46,47]. PD elevates levels of these biomarkers mainly through bacterial invasion [39,41,46,48,49]. For instance, lipo polysaccharide of P. *gingivalisis* able to induce the secretion of resistin from neutrophils [46]. Karilysin, a proteolytic enzyme of T. *forsythia*, can induce the release of active TNF-alpha [39,50]. Moreover, PD increases serum IL-6 by lowering the methylation level of IL-6 DNA promotor in patients' gingival tissue and peripheral tissue [48,49]. Increased levels of these biomarkers in obese individuals are mainly due to the excessive amount of adipose tissues [31,51,52].

It is noteworthy that resistin [46,51,53-58], TNF-alpha [50,59-61], and IL-6 [62-69] can participate in many pathogenic pathways. For example, adipose tissue-released TNF-alpha can activate the NF-κB pathway, causing reduced adipocyte insulin sensitivity and increased expression of endothelial cell adhesion proteins, ICAM-1 and VCAM-1, which will lead to endothelial proliferation and increase the risk of atherosclerosis [59,60]. IL-6 can also participate in the NF-κB pathway to promote the transition of human vascular interstitial cells toward an osteoblastic phenotype, inducing aortic valve mineralization and vascular inflammation [66]. Furthermore, IL-6 has been found to participate in mechanisms impairing glycemic control [67-69].

Besides exerting similar pathogenic mechanisms on a set of conditions, PD and obesity can influence each other directly as well [70,71]. Studies have consistently demonstrated that obesity and its various endpoints are positively associated with increased risk and severity, and worse treatment outcome of PD [72-80]. Since visceral adipose tissue releases more pro-inflammatory cytokines than subcutaneous fat, central adiposity tends to induce more severe oral connective tissue breakdown and inflammation in periodontium [75-77]. Moreover, obesity can alter the expression of essential microRNAs of gingival tissues to facilitate PD progression [80]. On the other hand, since PD has been observed to elevate serum level of leptin [81-85], PD may inhibit the progression of obesity [86,87]. Non-surgical treatments of PD can also significantly reduce the serum level of inflammatory biomarkers, and even improve the glycemic control in patients with metabolic syndrome [79,87].

Conclusion

In conclusion, PD and obesity can collectively influence the risk of many chronic systemic diseases, as well as several types of cancers, due to their shared signaling pathways, including adipokine-related pathways and leptin. Furthermore, because of the bidirectional relationship between obesity and PD, well-managed periodontal status is likely to prevent progression of many obesity-induced diseases. Weight loss may also improve the health of periodontium. Last but not the least, elucidating the relationship between obesity and PD allows for the development of care guidelines and recommendations for clinicians and the public.

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