

Salivary Glands, Oral Pathology, and Obesity: Review

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ABSTRACT

Consequently, the obesity epidemic has become widespread. The disease affects more and more children and young people, not only adults. Consuming too much food, especially carbohydrates that have undergone extensive processing, is one of the main causes of overweight and obesity. The salivary glands are one of many organs that are altered by obesity, and these changes have an impact on how they function. Researchers are debating the link between obesity and xerostomia, periodontal disease, and tooth decay. More and more academic studies are highlighting how obesity alters the microbiota of the mouth cavity. The morphological and functional changes to the salivary glands are strongly tied to these changes. The opinions that are now held regarding how obesity affects the health of the salivary glands and how changes to their functions affect other tissues in the oral cavity are presented in this article review.

Keywords: Saliva, insulin Resistance, dental Caries, diabetes Mellitus, Type 2, Pathology, oral, obesity, overweight, xerostomia, salivary glands

1. INTRODUCTION

Obesity is a chronic condition that is acknowledged as a worldwide epidemic in both industrialised and developing nations [1-3]. Its frequency has rapidly increased during the past ten years, and in 2015, its comorbidities were responsible for 4 million deaths globally. The most frequent contributor to obesity, albeit having a multifactorial aetiology, is an excessive caloric intake⁵. Its prevalence has increased by more than twofold in children and by fourfold in teenagers over the past 30 years [6], adversely affecting people of all sexes, socioeconomic backgrounds, and ethnicities, as well as their health and life expectancy. A 20% rise in obesity is likely to result in a 20% increase in mortality risk. It is acknowledged as the second leading cause of death in the U.S., behind smoking, when combined with its comorbidities [9-11]. It is generally recognised that the current rise in obesity prevalence is the result of behavioural changes over the past 30 years, such as the widespread availability of dense, highly delicious foods and increasingly sedentary lifestyles [3].

The salivary glands, which are in charge of secreting a number of enzymes and growth factors necessary for the biological balance and protection of the oral cavity, are one of the primary structures impacted by obesity and associated comorbidities. Although its relation to several oral pathologies, such as tooth caries, periodontitis, and xerostomia [20-23], which are closely related to the action of saliva and glandular function, has been reported, the results observed to date vary in the possible effect of obesity on the morphology and function of the salivary glands. This article's objective is to provide a current review of the effects that obesity has on the health of the salivary glands and other oral tissues that are closely associated to salivary function.

Obesity and salivary glands

Studies on obesity in animals have revealed some changes in a number of organs, including the salivary glands. Inoue et al.²⁴ observed that rats with obesity brought on by hypothalamic injury had less salivary gland weight, which was viewed as an abnormality that would result in less sympathetic nerve activity. Additionally, despite there being no changes in the architecture of the glandular tissue, it has been found that genetically produced obesity promotes proinflammatory changes in the submandibular gland and is likewise linked to rampant caries .

Oxidative stress in salivary gland

Recent studies have shown that the development of diseases in the salivary glands can be significantly influenced by an imbalance between the levels of reactive oxygen species (ROS) and antioxidants [19,20]. When rats are exposed to insulin resistance brought on by a fatty diet, the parotid and submandibular glands react differentially, with the parotid gland being the most affected³¹. However, Pannunzio et al.¹² found that children with overweight and obesity had altered levels of phosphate, free sialic acid, proteins, and peroxidase activity, which are all factors that increase the growth of dental caries.

The communication of proinflammatory cytokines, angiogenesis, chronic inflammation, and hormones and adipokines (leptin, insulin, adiponectin, growth factors, oestrogen, and progesterone) may alter cellular metabolism, resulting in tumour development and progression ¹⁵. Additionally, oxidative stress has been linked to obesity and cancer. According to Mod er et al.¹⁶, childhood obesity is linked to a decrease in the flow rate of stimulated total saliva when compared to those of normal weight (1.2 vs. 2.0 mL/min, p 0.001), which is linked to dental caries, further highlighting how bad obesity is for oral health. As a result of the aforementioned low-grade chronic inflammation in the gland, the proinflammatory cytokines produced by adipocytes and macrophages that have accumulated in adipose tissue can severely impact the function of the salivary glands.

There is sufficient evidence to conclude that the saliva of obese and non-obese subjects differs [24]. According to the characteristics of the saliva, obese people present changes in the concentration of sialic acid, phosphorus, and peroxidase activity, as well as a reduced flow of stimulated saliva, which is closely related to tooth caries and periodontal disease. However, salivary alterations such as those in phosphate, sialic acid, proteins, immunoglobulins, and peroxidase activity could help to explain why obese children are more likely to develop dental caries [21].

Obesity and prevalent pathologies of oral cavity

Salivary glands and saliva contribute significantly to the development and maintenance of both soft and hard tissues, which is important for maintaining oral health. Reduced saliva flow can lead to oral health issues like dental cavities and infections. In contrast to patients of normal weight, obese patients had a greater incidence of dental caries, worse gum health, and poorer oral hygiene, according to Lehmann-Kalata et al.[26] Furthermore, the latter group had considerably more stimulated and nonstimulated saliva than the obese individuals, and there was a statistically significant link between the rise in *Lactobacillus* spp. and *Streptococcus mutans*.

González et al.15 demonstrated in their systematic review that the association between dental caries and obesity/overweight can be explained by the weight gain observed being caused by diet, specifically the high frequency of sugar consumption and between-meal snacks, which increases the number of cariogenic microorganisms. However, issues with sample size, a brief follow-up time, and underestimated results that do not record injuries or tooth loss owing to caries may be to blame for the lack of connection between these two factors.

Obesity, oral microbiota and periodontium

The majority of the microorganisms in a healthy human microbiota are microbes 24, and a variety of circumstances, including age, food, antibiotic use, most aspects of modern lifestyle, and certain disorders, can affect the composition of this microbiota.

The host's immune system and the microbiota co-develop from birth and depend on one another 13. As seen between continuous alterations in the intestinal microbiota and its link to obesity 14 and insulin resistance 22, the immune system sets the composition of the microbiota and, in turn, the microbiota shapes the development of the immune system. Other research has described a changed microbiological colonisation in the intestines of obese patients, showing that they had more Firmicutes and substantially fewer Bacteroidetes than participants of normal weight 23.

Mention that obese patients who have had bariatric surgery have different oral bacterial populations. The concentration of circulating adipokines, which can affect both the immune response in the level of mucosa in the oral cavity and in the intestine, can be linked to the changes in the microbiota of obese people.

Obesity, oral microbiota and periodontium

Microorganisms make up a substantial portion of the healthy human microbiota, and a variety of factors, including age, nutrition, antibiotic use, most aspects of modern lifestyles, and certain disorders, can affect its composition. The host's immune system and the microbiota co-develop and are interconnected from birth 23. The immune system, in turn, determines the composition of the microbiota, as seen in the relationship between lasting alterations in the gut microbiota and its association to obesity and insulin resistance 12. Other research have shown that obese people have a different microbiological colonisation in their intestines than people of normal weight, with more Firmicutes and significantly fewer Bacteroidetes.

According to Maciel et al.22's study on periodontal bacteria, obese people with chronic periodontitis had higher concentrations and/or proportions of several periodontal pathogens than people of normal weight. These pathogens included *Aggregatibacter actinomycetemcomitans*, *Eubacterium nodatum*, *Fusobacterium nucleatum* ss *vincentii*, *Parvimonas micra*, *Prevotella intermedia*, and *Prevotella melaninogenica*, *Tannerella forthytia*, and *Treponema socranskii*. In comparison to patients of normal weight, the

proportions of the majority of these pathogens—along with *Campylobacter rectus* and *Eikenella corrodens*—increased at the illness sites in obese patients. In comparison to patients of normal weight, obese patients had statistically significantly higher levels of *Streptococcus mutans* and *Lactobacillus* spp., according to Lehmann-Kalata et al.²³.

Definitely, obesity and the significant inflammatory component it contains help to make periodontal disease more severe and have more side effects. As previously mentioned, numerous studies have shown a positive correlation between overweight or obesity and periodontal disease. This is primarily because of the ongoing action of chemical mediators secreted from fatty tissue in the oral cavity, which fosters an environment that is generally pro-inflammatory and increases the risk of periodontal disease. Additionally, this contributes to the localised decrease in salivary production, which has significant antibacterial and anti-inflammatory effects.

2. CONCLUSION

The main underlying mechanisms surrounding how obesity affects the morphology and function of the salivary glands are discussed in this review, as well as how these changes affect the functionality of other parts of the oral cavity by being linked to pathologies with a high prevalence, like caries and periodontal disease. These are crucial factors to take into account given the rising prevalence of overweight/obesity in the global population. Due to the lack of morphological, ultrastructural, and functional investigations on the alterations brought on by obesity in the structures of the oral cavity, particularly in the salivary glands, further study is required in this area. Designing new pharmacological treatments to help lessen the negative effects of obesity on the oral cavity would be made possible by these morphofunctional investigations in conjunction with research on other factors.

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