Research Article

Retrospective Study of the Relationship between Obesity as BMI and Periodontal Disease

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Abstract

The objective of this research was to determine the relationship between periodontal disease and obesity as calculated by BMI in a retrospective population of patients at the University Of Pittsburgh School Of Dental Medicine.

Background: Obesity is a major global public health problem affecting both developed and developing societies. Obesity is an individual health condition with a societal component and any reduction in the epidemic would have worldwide public health benefits. Obesity is a complex multifactorial chronic disease arising from an interaction of genotype and the environment. Being overweight as an individual is an established predisposing risk factor for many chronic systemic conditions. Our understanding of how and why obesity develops is incomplete, but involves the integration of social, behavioral, cultural, physiological, metabolic, and genetic factors.

Materials and Methods: Data for 3058 patients regarding the relationship between BMI and periodontal condition were extracted from the electronic health record maintained by the University of Pittsburgh School of Dental Medicine. For each patient record, variables including age, gender, BMI, smoking history, diabetes condition, and periodontal condition were extracted and categorized.

Results: Logistic regression was used to control for age, sex, race, diabetes condition, and smoking condition. Patients with Body Mass Index ≥ 30 were 1.22 times more likely to develop periodontal disease. Controlling for all variables except gender and periodontal condition, male patients have a higher chance for periodontal disease than females have. (p< 0.01).

Conclusion: Findings further establish the positive correlation between periodontal disease and obesity as measured by Body Mass Index (BMI). Obese patients, BMI ≥ 30, had a greater chance of developing periodontal disease (p<0.01), with the probability increasing for male patients. The prevalence of periodontal disease in the presence of obesity likewise increased with age.

Introduction

Although there have been no significant changes in the prevalence of obesity since 2004,1 obesity is still an important issue as it affects more than one-third of adults (34.9%) [1]. Obese ranges are determined by Body Mass Index (BMI) which is a measure of body fat based on height and weight. The number of overweight (BMI 25- 30) and obese (BMI over 30) persons worldwide is projected to exceed three billion within 20 years [2], up from current estimates at two billion globally. Obesity rates differ among socioeconomic, age, and racial groups [3]. Men with higher incomes are more likely to be obese than men with low incomes. The opposite trend is observed for females: higher income women are less likely to be obese than low-income women. No correlation exists between obesity and education among men, but college-educated women are less likely to be obese compared to less educated women. Obesity rates are higher in middle-aged adults, 40-59 years old (39.5%), than in both younger adults (30.3%) and older adults (35.4%). Non-Hispanic blacks have the highest age-adjusted rates of obesity (47.8%), which is followed by Hispanics (42.5%) and whites (32.6%), and then followed by non-Hispanic Asians (10.8%).3 Obesity leads to many health problems including heart disease, certain types of cancer, stroke, Type II diabetes, and periodontal disease [4,5]. The relationship between obesity and periodontal disease is not yet clearly defined, but a significant association between obesity and periodontal disease exists [6].

Periodontal disease is a chronic inflammatory condition characterized by a destructive pathological process affecting the supporting tissues of the tooth, causing resorption of alveolar bone and formation of periodontal pockets. Periodontal disease can lead to receding gingiva, bone loss, tooth loss, and increased risk of other health problems such as heart disease and diabetes. According to the Centers for Disease Control and Prevention [7], approximately one in two American adults (47.2%) is affected by periodontal disease, or 64.7 million people. Among adults over the age of 65, the prevalence of periodontal disease increases to 70.1%.

While the epidemiology connecting periodontal disease and systemic disease is indisputable [8-10], the pathophysiological links are still being studied in more depth [11]. Obesity is described as a

Figure 1: Age Distribution.
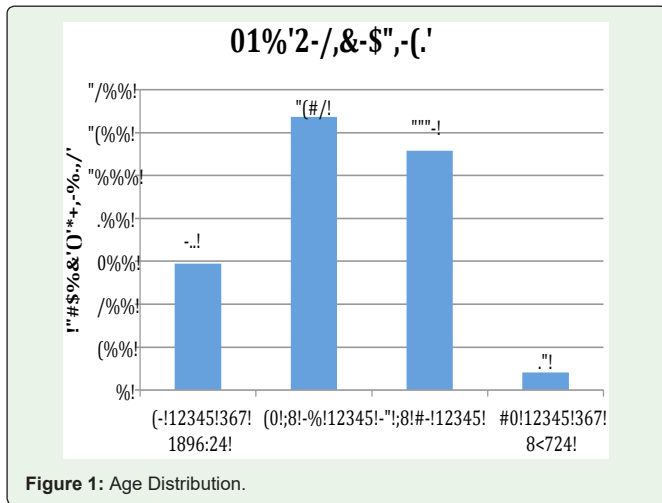
chronic inflammatory state with low-grade sub-clinical inflammation of white adipose tissue exerting systemic influence with possible adverse metabolic outcomes [12]. Adipose tissues are a repository for proinflammatory cytokines that may act on the periodontium directly or systemically by inciting an immune inflammatory response in the host [13]. Periodontal disease and other chronic inflammatory diseases such as obesity are associated through adipocytokines and related hormones [14,15]. Obesity is a direct risk factor to periodontal disease, since secretion of pro-inflammatory agents by adipose tissue modifies the periodontal reaction to the plaque biofilm.16 Periodontitis may stimulate inflammatory change in adipose tissue, creating a triangular self-generating cycle of morbidity linking obesity, diabetes, and periodontal disease [16]. The inflammatory nature of obesity is most likely the precipitating systemic link to chronic disease, including periodontal disease. Historically, the focal infection theory [17] has been used to explain why oral inflammatory lesions have been shown to contribute to elevated systemic inflammatory response and how intensive periodontal therapy can result in significant reductions in bio-markers of inflammation.

Prior research has concluded that greater BMI exists among periodontal patients and an increasing likelihood of periodontal

disease prevalence coincides with increasing BMI [18]. Probing depth is associated statistically with high BMI and obesity [19]. Analyses of the relationship have shown periodontal treatment is effective in reducing systemic inflammation as measured by serum C-reactive protein levels (Giannoblie 20 in 1999; Lopez et al. [21] in 2012; and Al-Zahrani [22] in 2012). Obesity-related inflammation may also promote periodontitis as well as diabetes and heart disease [10]. In the online journal PLoS ONE, in vitro German research [23]. correlated the decreased serum levels of adiponectin in the obese with the corresponding increased risk for periodontitis in the group by examining the protein synthesis and gene expression of pro- and anti-inflammatory mediators, concluding that the low levels of adiponectin in the obsess may increase the risk for periodontal inflammation. Finally, in a large population retrospective epidemiologic analysis correlating validated self-reported measures of height, weight, and periodontal disease, significant associations and trends were observed between descriptive measures of obesity (BMI, waist circumference, and waist-to-hip ratio) and periodontal disease even after adjusting for a range of confounders including age, smoking, race, physical activity, alcohol consumption and diabetes status [24]. This finding warrants prospective further investigation.

Diabetes and periodontal disease have a well-established, bidirectional relationship. Diabetics exhibit an increased prevalence, extent, and severity of periodontal disease [25]. Patients with diabetes are at increased risk for periodontal disease which can result in the destruction of oral connective tissue and generalized bone loss, ultimately leading to tooth loss [26]. Diabetes and periodontal disease have many similarities in pathobiology with inflammation playing an important role in this relationship [26].

The purpose of this retrospective study was to observe the relationship between periodontal disease and obesity in a large sample of individuals treated at the University Of Pittsburgh School Of Dental Medicine. This is an expansion of the original study performed in 2011 [27].

Materials and Methods

Data for 3058 patients, including the relationship between BMI and periodontal condition, were exported from the electronic health

Figure 2: Gender Distribution.

Figure 3: BMI Distribution.
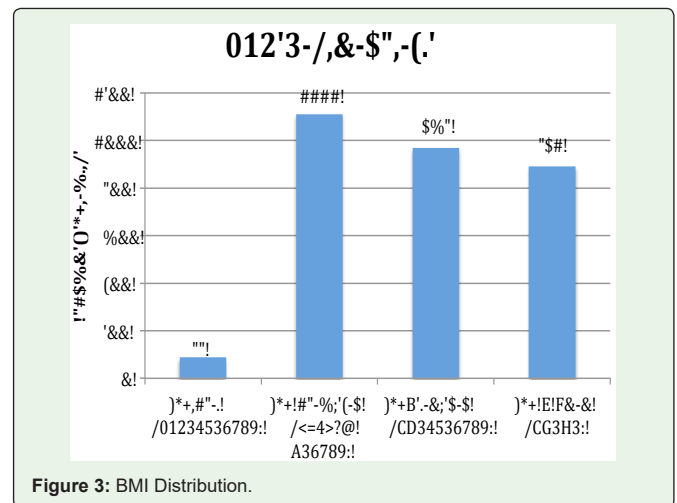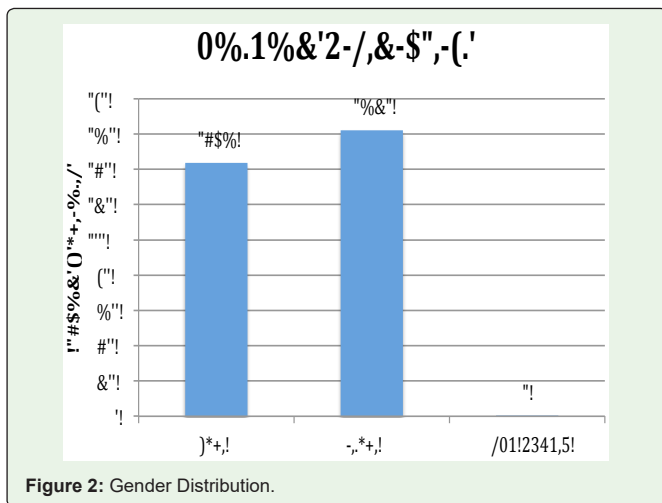
record [axiUm™ dental management software, Exan Group, Las Vegas, Nevada] at the University of Pittsburgh from November 2011 to March 2014, with a focus on demographic information, diabetes and smoking records, medical history, and treatment record.

Age, gender, and periodontal condition were extracted and categorized for each patient entry. Periodontal condition was determined by probing depths. Probing depths in excess of 4mm were categorized as periodontal disease present and probing depths less than 4mm were categorized as periodontal disease absent. Smoking habits, health status, and existing diagnosis of diabetes were obtained from the medical record and noted. The weight and height measurements were extracted, then BMI was calculated by the standard calculation using the non-metric conversion formula [(weight (pounds)/height (inches) 2) x 703] [28]. Our definition of obesity is based on Body Mass Index (BMI). BMI values were arranged in four categories: underweight with BMI 18.5 and smaller, normal weight with BMI 18.5-24.9, overweight with BMI 25-29.9, and obese with BMI ≥ 30 [28].

Results

Logistic regressions determined the statistical relationship between BMI and periodontal disease, while controlling for age, sex, race, diabetes condition, and smoking condition.

Summary of Results:

- Controlling for age, sex, race, diabetes condition, and smoking condition, patients with Body Mass Index ≥30 were 1.22 times more likely to develop periodontal disease (p < 0.01).

- Controlling for BMI and diabetes, male patients have a larger risk for developing periodontal disease than female patients have (p <0.01).

The data are represented in (Figures 1,2, and 3).

Discussion

This study showed a significant relationship between periodontal disease and obesity [OR= 1.22] (p < 0.01).

Several studies have observed the positive relationship between obesity represented as the incidence of periodontal disease and increased BMI. One study [29] conducted a survey with 13,665 patients and found a significant association of overall and abdominal obesity with increased prevalence of periodontal disease, and underweight BMI associated with decreased prevalence. The author of this study, Al-Zahrari, [29] noted an especially strong association between BMI and periodontal disease among younger individuals. In a French study [30]. In 2012, dental examinations were performed on 186 patients to assess their periodontal conditions. The study revealed probing depth, closely linked with periodontal inflammation and infection, are statistically associated with high BMI and obesity, independent of dietary patterns and insulin resistance. Our study is consistent with both studies, which examined the relationship between obesity and periodontal disease in a representative sample.

In our findings, obesity measured by BMI was related to periodontal disease. This supports previous results which established a positive correlation between BMI above normal and periodontal disease [29,30]. Research that attempts to establish a relationship

between periodontal disease and systemic disease is confronted with the issue that periodontal disease increases with age, as shown here. Most systemic diseases like diabetes and heart disease also increase in prevalence with age. Therefore, our investigation adjusted for age, diabetes, smoking condition, and gender.

This research had the advantage of examining the relationship between periodontal disease and obesity as measured by BMI, while controlling for diabetes. Periodontal disease may exist through the casualty of accumulated effects of health-related behaviors adopted by individuals with large BMI. Limitations of this research include necessary reliance upon previous health history information by individual reports stored in the electronic record, along with inherent confidence in others for accurate record-keeping. At least one systemic review in obesity literature has documented that human nature shows trends of under-reporting weight and over-reporting height and a great deal of individual variability in self-reporting generally [31]. Another limitation of the research at hand could be the postulation of BMI as a sole measure of obesity, since that calculation can admittedly be flawed for failing to take into account body fat percentages. BMI has been shown to be the least valid predictor of mortality risk, when considered together with the waist-to-height and waist circumference predictor indices [32].

Conclusion

Many previous studies have attempted to determine the relationship between increased BMI and incidence of periodontal disease. These results restate similar findings, establishing a positive correlation between BMI above normal and periodontal disease, while controlling for diabetes condition. The research is limited by its assumption that postulates BMI as the sole measure of obesity. Furthermore, data were dependent upon self-reported health information stored in the Electronic Health Record (EHR), with inherent reliance on others for accurate record keeping. Nevertheless, the findings establish a positive correlation between periodontal disease and obesity. Obese patients, with BMI ≥30, have a greater chance of developing periodontal disease.

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