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The Association between Periodontal Disease and Obesity among Middle-aged Adults Periodontitis and Obesity

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Abstract

Objective: Obesity is characterized by the abnormal or excessive deposition of fat in the adipose tissue. Besides being a risk factor for cardiovascular diseases, certain cancers and type II diabetes, obesity has been suggested to be a risk factor for periodontitis. A number of epidemiological studies have studied the association between obesity and periodontitis. The aim of this study was to determine the relationship between periodontitis and overweight/ obesity in subjects aged 28-55 years.

Study design: A representative sample of the population, which was enrolled in a study, was examined. A total of 300 chronic periodontitis subjects had a clinical periodontal examination and their weight and height were recorded. Periodontal parameters were: probing pocket depth, clinical attachment level, bleeding on probing, gingival inflammation and presence of visible plaque. In the control group there were 100 periodontal healthy subjects. Moderate periodontitis was identified when teeth had attachment loss of <6 mm and a pocket depth<5 mm, and severe periodontitis with attachment loss ≥ 6 mm and pocket depth ≥ 5 mm. Body weight was measured using body mass index.

Results: Researchers have found a significant association between obesity and prevalence of periodontal disease, among the population aged 28-55. Obesity was associated with periodontitis after adjustment for confounders. Greatest association was found between BMI and severe periodontitis measured by periodontal parameters.

Conclusion: The data suggest that obesity is associated with periodontitis. Obese individuals might be at risk for initiation and progression of periodontitis.

Keywords: BMI; Obesity; Moderate periodontitis; Severe periodontitis; Periodontal parameters

Introduction

Over the past few decades, obesity has become a significant world-wide health problem. The most recent data from the indicated that 32% of adults were obese in 2004 [1]. In the , the prevalence of obesity among adults almost tripled between 1980 and 2002 [2]. The incidence of obesity and elevated body mass index (BMI) has dramatically increased in most industrialized countries. Obesity is now recognized as a chronic disease with a multifactorial etiology that develops from an interaction of genotype and the environment. Obesity has been associated with many serious, life–treating medical conditions. Besides being a risk factor for cardiovascular diseases, type II diabetes [3] and certain cancers [4], obesity has also been suggested to be risk factor for periodontitis. A number of studies have evaluated the relationship between obesity and gum disease. It has become clear that genetic and environmental factors and socioeconomic and behavioral influences leading to excess caloric intake decreased physical activity, and metabolic and endocrine abnormalities are likely important factors [5,6].

The mechanism of how obesity affects the periodontium is currently poorly understood. It is known that obesity has several harmful biological effects that might be related to the pathogenesis of periodontitis. The high prevalence of both obesity and periodontal disease (PD) poses a substantial public health risk [7-10]. Dental providers should anticipate a higher incidence of gum disease among this patient population.

Although obesity is becoming a worldwide problem, in Serbia there is a small number of works devoted to this problem, especially about the relationship between obesity and periodontal disease.

The aim of the current study was to investigate whether there were associations between obesity and periodontal status in population aged 28-55 years.

Materials and Methods

The study population comprised persons aged 28 to 55 years living in . The first group comprised periodontitis free subjects (n=100) or having periodontitis-with evidence of attachment loss (n=300). The subjects were enrolled in the Department of Periodontology at the Dental Clinic in and were selected for study. All subjects provided signed informed consent. The Ethics Committee of the Faculty of

medicine University of Nis, Serbia approved the study protocol (No: 01-2800-5). The data for this research were collected by taking the anamnestic data and clinical oral examinations.

One calibrated dentist performed clinical oral examinations in a dental chair using a headlamp, mouth mirror and a WHO periodontal probe (Michigan 0). The clinical oral examinations included assessment of the condition of periodontium.

Exclusion criteria for all subjects included: periodontal or antibiotic therapy in the previous 6 months; any systemic condition which might have influenced the course of periodontal disease or treatment (e.g. diabetes and cardiovascular disease); any systemic condition which required antibiotic coverage for routine periodontal procedures. Diabetic patients were excluded because interrelations between obesity and diabetes, which depend on the type and the severity of the diabetes, can be complex and prevent accurate control.

Each subject completed a questionnaire, which gathered information on their demographic and socio-economic status (SES). Socio-demographic variables included gender, marital status, years of education, occupational activity and tobacco consumption. The analyses were carried out to all participants. Education was categorized into two categories, <12 years (low) and >12 years (high). Smokers were divided into current smokers or non-smokers. Socio-economic status was categorized as good or bad according to the statements of the respondents. Occupational activity was categorized as moderate or active (once a week or four times a week).

In addition to clinical measurements, subjects were measured for height and weight. The BMI is calculated by dividing the body weight (in kilograms) by the height (in meters) squared (BMI = weight/ height^2). The BMI measured was categorized using the World Health Organization: normal weight (<24.9 kg/m^2), overweight (25-29.9 kg/m^2) and obesity (>30 kg/m^2) [11].

In this study, only baseline clinical periodontal measurements were used and they included: plaque accumulation (PLI), gingival inflammation (GI), bleeding on probing (BOP), periodontal pocket depth (PPD) and clinical attachment loss (CAL) [12,13]. These clinical parameters were measured at six sites per tooth (mesiobuccal, buccal, distobuccal distolingual, lingual and mesiolingual) in all teeth excluding third molars [14].

Periodontal status was determined in all subjects. The proportions of individuals were compared in the periodontal health and periodontitis group according to periodontal status. Periodontal subjects had PPD<5 mm and CAL<6 mm (moderate periodontitis) or PPD ≥ 5 mm and CAL ≥ 6 mm (severe periodontitis). Periodontal pocket depths were measured from the gingival margin to the base of the clinical pocket with the probe tip parallel to the long axis of the tooth. Clinical attachment loss was recorded as the distance from the cement-enamel junction to the base of the clinical pocket.

Statistical Analysis

Tests of general parameters, except the BMI t-test, between the periodontitis patients and control group were done with χ^2 test. Testing of the mean age was done by ANOVA test. Furthermore, 50 respondents were classified by BMI category into 3 groups. This groups and the control group also crafted the χ^2 test to compare the distribution of general parameters. As for clinical parameters, the same tests were applied for all four groups.

Results

A total of 300 individuals 28 to 55 years old, with periodontitis, participated in this study. Of these, 54% were men and 46% women (Table 1). Likewise, significantly more individuals had less than 12 years of education (64%). The number of smokers was also less (38%) in periodontitis group compared to the control group (32% and 40%). The subjects of these two groups differ significantly in education, socioeconomic status, and BMI. The majority of respondents were poorer (66%) in periodontitis group. In the control group there were more affluent people (68%).

Variable	Periodontitis group (n=300)	Control group (n=100)	p value
Gender			
Male	162 (54 %)	28 (28 %)	χ^2=3.64
Female	138 (46%)	72 (72%)	p>0.05
Age (years), mean ± SD	48.76 ± 15.83	42.80 ± 5.76	t=1.799
Age range	28-55	31-51	p>0.05
Years of education, No, %			
<12 year	192 (64%)	32 (32 %)	χ^2=6.86
>12 year	108 (36%)	68 (68 %)	p<0.005
Socioeconomic status, No, %			
Bad	198 (66%)	32 (32%)	χ2=9.67
Good	102 (34%)	68 (68%)	p<0.005
Smoking, No, %			
Yes	114 (38%)	40 (40%)	χ^2=0.03
No	186 (62%)	60 (60%)	p>0.05
Physical activity, No, %			
Active	90 (30%)	24 (24%)	χ^2=0.30
Moderate	210 (70%)	76 (76%)	p>0.05
BMI, kg/cm^2	26 .04 ± 3.38	22.08 ± 4.10	t=4.387
Mean ± SD	19.0-33.5	17.8-35.9	p<0.05

Table 1: Basic characteristics of the study population.

In terms of physical activity, there were more respondents who declared themselves to be moderately physically active (70%) than active (30%). BMI was higher in the periodontitis-affected group (26.04 ± 3.38) compared to the periodontitis-free group (22.08 ± 4.10). Results of BMI compared to the basic characteristics of the study population are shown in Table 2. The number of overweight subjects (24 subjects, 46%) was larger than the number of normal-weight subjects (19 subjects, 40%). A very small number of the subjects was obese (7 subjects, 14%), as they exhibited a mean BMI of ≥30 kg/m^2. In the Serbian population, the number of obese persons was small.

Variable	Normal <24.9 (n=108)	Overweight 25 – 29.9 (n=134)	Obese ≥30 (n=58)	Control (n=100)	p value
Gender					
Male	31 (28.7%)	95 (70.89%)	35 (60.34%)	28 (28%)	χ^2=8.361
Female	77 (71.3%)	39 (29.11%)	23 (39.66%)	72 (72%)	p<0.05
Age(years) mean ± SD	35.37 ± 6.48	56.96 ± 13.05	64.14 ± 12.80	42.80 ± 5.76	F=27.269
Age range	28 - 36	36 - 55	40 - 55	31 - 51	p<0.001
Years of education, No, %					
<12 year	82 (75.93%)	99 (73.88%)	33 (56.9%)	32 (32%)	χ^2=7.063
>12 year	26 (24.07%)	35 (26.12%)	25 (43.1%)	68 (68%)	p>0.05
Socioeconomic status, No, %					
Bad	69 (63.9%)	90 (67.16%)	33 (56.9)%	28 (28%)	χ^2=10.177
Good	39 (36.1%)	44 (32.84%)	25 (43.1)%	72 (72%)	p<0.05
Smoking, No, %					
Yes	73 (67.6%)	40 (29.85%)		40 (40%)	χ^2=10.151
No	35 (32.4%)	94 (70.15%)	58 (100%)	60 (60%)	p<0.05
Physical activity, No, %					
Active	46 (42.6%)	34 (25.37%)	11 (18.97%)	24 (24%)	χ^2=2.834
Moderate	62 (57.4%)	100(74.63%)	47 (81.03%)	76 (76%)	p>0.05

Table 2: BMI according to the basic characteristics of the study population

Among the overweight and obese subjects there were more males non-smokers. Overweight and obese individuals were older, less educated, and with bad SES. Physical activity was more moderate in overweight and obese subjects. The mean clinical periodontal parameters were compared in subjects according to BMI categories (Table 3). There was a strong association between BMI and periodontal status. Clinical periodontal parameters were compared among subjects according to BMI. There were a larger number of overweight and obese subjects in the group with severe periodontitis compared to the group with moderate periodontitis.

The subjects with periodontitis exhibited significant differences in clinical parameters among BMI categories. The values of periodontal parameters increased along with the increase in body weight of respondents. The highest values for all parameters were reported in the group of obese persons. Table 3 also shows that the severity of periodontal attachment loss and pocket depth increased proportionally with increasing BMI. Plaque index was 1.52, 1.70, and 1.71 to BMI status. Gingival inflammation was 1.68, 170, and 1.85. Bleeding on probing was 1.73, 1.75, and 1.85.

Subjects who had the highest BMI had a deeper pocket (6.92 mm) than those with the lowest BMI (5.13 mm). Individuals who were overweight or obese were more likely to have severe periodontitis than subjects with normal BMI. Similar results were obtained with respect to the values for the attachment level. In obese subjects CAL was 8.05 mm, and in subjects with normal weight CAL was 6.15 mm. The analysis indicated that BMI was significantly associated with periodontal status even after adjusting for gender, age, socioeconomic status and smoking.

Discussion

The main finding of this study was that obesity in Serbian population was associated with a significantly increased prevalence of periodontitis but much lower than overweight, too. The relationship was much stronger in individuals with severe periodontitis than in the subjects with moderate periodontitis. This was in keeping with a number of studies which have suggested that obesity is associated with oral diseases, particularly periodontitis [15,16]. The first report on the relationship between obesity and periodontal disease was written in 1977, when Perlstein et al. [15] observed histopathological changes in the periodontium in hereditary obese Zucker rats. Also, it seemed that under healthy oral conditions, obesity *per se* does not promote pathological periodontal alterations; however, in response to bacterial plaque accumulation, periodontal inflammation and destruction were more severe in obese animals.

Periodontal variable	Normal <24.9 (n=108)	Overweight 25 – 29.9 (n=134)	Obese ≥30 (n=58)	Control (n=100)	p value
Plaque index (PLI)	1.526 ± 0.612	1.708 ± 0.464	1.714 ± 0.488	0.520 ± 0.420	F=29.036 p<0.0001
Gingival inflammation (GI)	1.684 ± 0.478	1.708 ± 0.464	1.857 ± 0.378	0.400 ± 0.382	F=51.491 p<0.0001
Bleeding on probing (BOP)	1.737 ± 0.452	1.750 ± 0.442	1.857 ± 0.378	0.400 ± 0.382	F=58.321 p<0.0001
Periodontal pocket depth (PPD) - mm, mean ± SD	4.24 ± 0.83	4.79 ± 0.98	5.48 ± 1.68	1.90 ± 0.55	F=55.280 p<0.001
PPD > 5 mm	29 (26.85%)	46 (33.3%)	34 (58.62%)		χ^2=13.776
PPD ≤ 5 mm	79 (73.15%)	92 (66.7%)	24 (41.38%)	100 (100%)	p<0.005
Clinical attachment level (CAL) - mm, mean ± SD	5,38 ± 0.83	5.91 ± 0.97	5.95 ± 1.13	1.90 ± 0.55	F=119.073 p<0.0001
CAL>6 mm	29 (26.85%)	44 (33.3%)	34 (58.62%)		χ^2=13.776
CAL ≤ 6 mm	79 (73.15%)	92 (66.7%)	24 (41.38%)	100 (100%)	p<0.005

Table 3: Presents BMI (normal, overweight or obese) according to periodontal parameters.

Later on, the hypothesis of obesity as a risk factor for periodontal disease was supported by epidemiological study [17]. There are studies in which obesity is not significantly associated with severe periodontitis [18].

Obesity is a complex disease, and its relationship with oral status has been realized by the scientific community in the recent years. Various cross-sectional and case-control studies found a strong association between obesity and periodontal disease. Body mass index (BMI) was calculated as the body weight/height^2 (kg/h^2). The BMI measured was categorized using the World Health Organization (2000) classification: normal weight equated to BMI<25 kg/m^2, overweight 25 – 29.9 kg/m^2 and obese ≥ 30 kg/m^2.

In this study, obesity measured by BMI, was related to periodontal status in terms of health versus periodontitis after adjusting for age, gender, smoking and socioeconomic status. Clinical parameters, including the presence of plaque, gingival inflammation, BOP, mean PPD and mean CAL were also related to BMI status. These data are in accord with the findings of other studies [19,20].

They found that total body weight was associated with an increased risk for periodontitis in the older subjects (17-21 years), but not in the younger subjects (13-16 years). Gender also had an impact on the relationship between obesity and periodontitis. In this study, there were significantly higher proportions of normal BMI subjects in both normal and overgrowth females compared with male subjects in the same clinical groups (Table 4).

Statistical analysis shows that there was an association between BMI and periodontitis. Obese people with BMI ≥ 30 had an adjusted odds ratio of 7.659 for having periodontitis. In the study in Japanese subjects indicated that both smoking and obesity were independent risk factors for periodontitis. One of the most important confounders in this context is smoking, which is considered to be a risk factor for periodontitis. Smoking most probably confounds the association between body weight and periodontal infection [21].

In our study, there were fewer smokers in all groups. Thus, smoking had smaller impact on the results. In our study, overweight and obese patients are characterized by worse periodontal status when compared to the subjects with normal BMI. Variations in the strength of the association between obesity and periodontitis reported in studies on different populations may reflect a lack of uniformity in the case definitions used for periodontal disease. The average PPD was significantly higher in obese subjects (p<0.001) when compared with that among participants with BMI<25 kg/m^2. The average CAL was significantly higher (p<0.001) in both overweight and obese participants when compared to normal weight participants. This finding was consistent with the findings of the study conducted by Khader et al. [20] who reported that CAL and PPD, as indicators of periodontal disease, were correlated with increased BMI.

In case of periodontitis with periodontal pockets of 5 mm or deeper BMI increases. This analysis showed a positive association between BMI and periodontal pockets (5 mm or more). This finding could be interpreted that body weight has an effect on the extent of periodontal infection among subjects with periodontal infection. In our study, moderate periodontitis was relatively common affecting 90% of the population with normal weight, which is similar to periodontitis-free group. Severe periodontitis was identified only in 10% of the population examined in the group with normal weight, in 60% in group with overgrowth subjects and in 86% in the obese subjects.

In general, the obese subjects had different risk factors, such as lower SES, fewer years of education. All three factors have been associated with an increased risk of periodontitis; however, it is

possible that there are other confounders that were not controlled in the analysis. The mechanisms how obesity has effects on periodontium are not known, but there are several possible biological explanations.

Plum	Mean ± SD	Wald	Significance
Level – 0[a]:1[b]	4.55 ± 2.55	3.179	0.075
Level - 1[b]:2[c]	7.309 ± 2.641	7.659	0.006
Gender	-0.16 ± 0.52	0.090	0.764
Age (years)	-0.002 ± 0.02	0.738	0.390
Education	-0.38 ± 0.51	0.546	0.460
Social status	-1.62 ± 0.55	8.572	0.003
Smoking	-0.29 ± 0.53	0.297	0.586
Physical activity	0.87 ± 0.56	2.444	0.118
BMI	0.35 ± 0.08	16.597	0.000
Level - 0[a]:1[b]	25.96 ± 8.27	9.858	0.002
Level - 1[b]:2[c]	49.74 ± 15.58	10.196	0.001
PLI[d]	-0.13 ± 2.27	0.003	0.954
GI[e]	9.94 ± 49.86	0.040	0.842
BOP[f]	-12.48 ± 50.11	0.062	0.803
PPD[g]	2.18 ± 2.77	0.619	0.431
CAL[h]	7.22 ± 3.21	5.056	0.025

Table 4: PLUM-ordinal regression analysis for periodontal healthy.

Obesity is a risk factor for several chronic diseases, most notably hypertension, type 2 diabetes dyslipidemia and coronary heart disease [22,23]. According to the current knowledge, the adverse effects of obesity on the periodontium might be mediated through impaired glucose tolerance, dyslipidemia or through increased levels of various bioactive substances secreted by adipose tissue. Its consequences go far beyond adverse metabolic effects on health, causing an increase in oxidative stress, which leads not only to endothelial dysfunction but also to negative effects in relation to periodontitis, because of the increase in pro-inflammatory cytokines [24,25].

The adipose tissue actively secretes a variety of cytokines and hormones that are involved in inflammatory processes, pointing toward similar pathways involved in the pathophysiology of obesity, periodontitis and related inflammatory diseases. Adipocytes appear to secrete pro-inflammatory cytokines which may be the molecules linking the pathogenesis of these diseases. For example, it has been well established that inflammation is an essential component in the development of atherosclerosis, and observational studies showed that periodontitis is associated with a moderately, but significantly higher risk of coronary heart disease [26].

Inflammatory diseases like periodontitis induce the production of proinflammatory cytokines such as TNF-α, IL-1 and IL-6. It has been suggested that the secretion of TNF-α by adipose tissue triggered by LPS from periodontal gram-negative bacteria promotes hepatic dyslipidemia and decreases insulin that may enhance periodontal degradation [27]. Systemic inflammation, defined by increased circulating IL-6, is associated with obesity and periodontitis and has been proposed as a mechanism for the connection between these conditions [28]. For example, poor diet and physical inactivity could be such factors. The possibility that these mechanisms might act simultaneously is not excluded either [29].

Pro-inflammatory cytokines may be a multidirectional link among periodontitis, obesity and other chronic diseases. The adipose tissue is a large reservoir of biologically active mediators. Studies have demonstrated a close involvement of the adipokines –such as leptin and adiponectin - in inflammatory processes [30]. However, their role in periodontal inflammation has yet to be defined. Whether the relationship between obesity and periodontitis is causal needs to be assessed in future studies

In future, if obesity is to be acknowledged as a multiple-risk-factor syndrome for overall and oral health, general and oral risk assessment in the dental office should include the evaluation of body mass index on a regular basis.

To truly clarify the direction of the association between body weight and periodontal infection, longitudinal studies are needed. The link between obesity and periodontitis is inflammation. Since it is impossible to have a direct impact on a patients' BMI, it is possible to eliminate or control the inflammatory contribution of periodontitis by intervening and treating this chronic inflammation. Obesity may be the link between periodontitis and other diseases. For example, obesity is a risk factor for atherosclerotic cardiovascular disease and, due to its associations with periodontitis, it is a potential confounder in the association between periodontitis and atherosclerotic cardiovascular disease.

Conclusion

The results of this study indicate that overweight and obesity are potential confounders and significant predictors of periodontal disease.These results indicate that obesity increases the risk of periodontitis, and suggest that people exhibiting several components of obesity should be encouraged to undergo a periodontal therapy.

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