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Original Article

The relationship between obesity and oral health

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Abstract

Introduction: Obesity as a pervasive phenomenon in recent years has the risky consequences on public and oral health and endangers the teeth especially periodontal tissues. This aim of this study was to assess the relationship of oral health (teeth and periodontal tissue) with obesity and anthropometric measures such as waist circumference (WC) and body mass index (BMI).

Materials &Methods: This cross sectional study was conducted on 180 subjects in 3 groups of normal weight, over-weight and obese. Periodontal pocket depth (PPD), bleeding on probing (BOP) and Community Periodontal Index (CPI) were recorded. Multivariate logistic regression was also applied after adjusting for the confounding factors.

Results: Of 180 subjects, 54, 68 and 58 cases were normal, overweight and obese. 75 and 105 participants were male and female, respectively. Generally, a pocket depth was increased 1.394 times with one unit increase of BMI (OR: 1.394, 95% CI: 0.936-2.077). Dental caries index enhanced to 1.036 with one unit increase of waist circumference (WC) (OR: 1.036, 95% CI: 1.001-1.071). One centimeter rise of WC increased CPI up to 0.625 times (OR: 1.122, 95% CI: 0.053-0.078).

Conclusion: Obesity even in the absence of underlying systemic diseases can cause the potential risk in oral health.

Keywords: Obesity, Oral health, Periodontal disease, Dental caries

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بررسی ارتباط بین چاقی و سلامت دهان

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چکیده

مقدمه: چاقی پدیده فراگیر سالهای اخیر پیامدهای مخاطره آمیز فراوانی در سلامت عمومی و دهانی داشته و باعث به خطر افتادن دندانها و بخصوص بافتهای پریودنتال می گردد. هدف از این مطالعه بررسی ارتباط بین سلامت دهان(بافت دندانی و پریودنتال) با چاقی است.

مواد و روش ها: در این مطالعه مقطعی مقایسه ای مشخصات دموگرافیک و سبک زندگی، عمق پاکت، خونریزی حین پروبینگ و شاخص CPI در ۱۸۰ نفر در طی مصاحبه ثبت شد. پس از بررسی نرمالیته شاخصها و تعیین فراوانی آنها فاصله اطمینان ۹۵٪ برای شاخصها بدست آمد. از آنالیز چندگانه مدل رگرسیون لجستیک و مدل رگرسیون خطی چندگانه، شاخص Odd Ratio برای نشان دادن میزان پیش بینی کنندگی استفاده شد. سطح معنی داری آزمون ها نیز $P<0.05$ در نظر گرفته شد.

یافته ها: از ۱۸۰ نفر شرکت کننده در مطالعه ۵۴ نفر با توده بدنی نرمال (BMI=18.5–24.9 kg/m^2)، ۶۸ نفر اضافه وزن (BMI =25-29.9 kg/m^2) و ۵۸ نفر چاق (BMI= 30< kg/m^2) بودند. ۷۵ نفر از شرکت کنندگان مرد و ۱۰۵ نفر زن بودند. به طور کلی با افزایش یک واحد توده بدنی، عمق پاکت ۱/۳۹۴ بارافزایش می یابد (OR:1.394 95% CI:0.936-2.077) ، به ازای افزایش هرواحد دورکمر، ۱/۰۳۶ به میزان DMFT افزوده می گردد (OR: 1.036،95%CI: 1.001 -1.071) ، به ازای هر ۱ سانتی متر افزایش دور کمر، ۰/۶۲۵ بار شانس تخریب پریودنتال CPI افزایش می یابد (OR 1.122: ،95%CI: 0.053-0.078).

نتیجه گیری: چاقی حتی بدون وجود بیماریهای زمینه ای سیستمیک می تواند دلیلی بر به مخاطره افتادن سلامت دهان باشد.

واژگان کلیدی: چاقی، سلامت دهان، بیماری های پریودنتال، پوسیدگی دندانی

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Introduction

According to the World Health Organization (WHO), obesity is the fastest-growing and most significant health hazard in developed and developing countries. [1] Its prevalence rate varies from 9 to 35% in different parts of the world. Based on a report by the WHO, one billion people are overweight or obese worldwide and this rate will reach 1.5 billion by 2017. [2] Obesity is a risk factor for several adulthood diseases such as cardiovascular disease, type II diabetes, atherosclerosis, cerebrovascular disease, etc. [1, 3] Its growing incidence is attributed to the nutritional habits, high consumption of fast foods, sedentary lifestyle and occupations, and decreased physical activity. Environmental factors and genetics play the a role in development of obesity. [4] Recent reports have suggested a role of infectious agents particularly salivary microorganisms namely Selenomonas noxia in females and firmicutes in the intestines in this respect. The infectious obesity phenomenon became known as "infect obesity". [5] Iran is a fast-growing country and is no an exception. Obesity has an ascending trend in different parts of Iran. [4, 6] In a population screened for the risk of cardiovascular disease in Guilan, the rate of obesity in individuals over 35 years was 24.6%. [7] Tooth decay and periodontal disease are among the most common chronic diseases. The relationship of obesity with oral health has been suggested by several researchers. [8] The underlying biological mechanism for this correlation is pro inflammatory cytokines, adipokines and C-reactive protein, released from the adipose tissue and can be responsible for bone resorption and periodontal tissue loss. [1, 2, 9-12] On the other hand, the presence of periodontal disease per se is a predictive marker for high risk of metabolic syndromes and rises $HbA1_c$ in the future. [13] Dissemination of fat is a more dangerous health risk factor than total body fat. Excess body fat is usually determined by the BMI. However, WC is a more important risk factor indicative of adiposity in the body. It is associated with mortality, diabetes mellitus and cardiovascular disease. [1, 9, 11, 14-17] However, it is not clear which one has a greater impact on oral health. The relationship of obesity or overweight with increased

risk of dental conditions has been confirmed in some previous systematic studies. However, the majority of these studies evaluated children. [18-22]However, the negative effect of obesity on permanent teeth has been confirmed as well. [23-29] The aim of this study was to assess the correlation of oral health (dental and periodontal health) with BMI and WC.

Materials & Methods

Methodology and Data Collection: This comparative analytical cross-sectional study was conducted in 2013 at Guilan University of Medical Sciences. The study design was approved in the Ethics Committee of the university (IR.GUMS.REC.1395.241). A total of 180 consecutive dental patients who met the inclusion criteria were entered into the study It was estimated 66 subjects for each group with expecting 3-score differences in DMFT, power 80 and P<0.05 was statistically considered significant. There were no age limitation and subjects were consecutively recruited. Informed consent was obtained from subjects. The inclusion criteria were age range of 18-60 years, no recent periodontal treatment and no systemic disease such as diabetes mellitus (DM), hyperthyroidism, hypothyroidism, hyperlipidemia or hypertension (metabolic syndrome). Subjects with psychological diseases and those receiving psychiatric medications causing xerostomia were not included. Pregnant or nursing women, professional bodybuilders and addicts were also excluded. Data were collected via interview and oral and dental examination. The intra- and inter-examiner agreement was tested before the study and was over 90%. The intra- and inter-examiner reliability was tested several times during the study to ensure high reliability.

Demographic measurements: Demographic characteristics of patients namely age, gender, level of income, level of education and brushing times per day as confounding variables were collected through an interview and were recorded. In terms of level of income, subjects were divided into 3 groups of low income (<600,000 Toomans per month), average income (600,000-1,000,000 Toomans) and high income (1,000,000 Toomans) according to ministry of labor and social affairs. In terms of level of education, subjects were categorized as below high school diploma, high school diploma to Bachelors (BS) degree and higher than BS degree. In terms of brushing times per day, patients were grouped as rarely, once, twice and three times a day.

Anthropometric measurements: Patients were asked to take off their shoes and coats. Height was measured using wall-mounted height rods and recorded in centimeters. WC was measured in centimeters above the iliac crest and below the umbilicus passively using a measuring tape. It should be noted that the ideal WC varies based on gender and must be ≤102 in men and ≤88 in women. [1, 9, 14, 15] Weight was measured in kilograms using a digital scale (PW24, Germany) with 0.1 kg increments.

The following equation was used for BMI calculation:

$$\text{BMI: } = \frac{\text{Mass (kg)}}{\text{Height (m)2}}$$

BMI was calculated for each patient and based on its value; subjects were divided into 3 groups of normal weight (18.5-24.9), overweight (25-29.9) and obese (≥30) [9, 15, 24 and 25] according to the WHO classification. [30]

Measurement of periodontal parameters: Periodontal pocket was measured at the mesial, middle and distal thirds of the buccal and palatal (lingual) surfaces of eight teeth (first molars of both jaws, maxillary left first premolar, mandibular right first premolar, maxillary left central incisor and mandibular right central incisor) using a WHO community Periodontal Index probe. [26] Periodontal Pocket was determined by inserting the tip of the probe into the pocket along the longitudinal axis of the tooth and measuring the distance from the gingival margin to the depth of the pocket. If two different values were obtained at the same site of the tooth surface, the smaller value was recorded as the final periodontal pocket.

Presence of at least one area with ≥3mm depth was considered as having as periodontal disease. [15, 24] If any of the mentioned teeth was missing, the adjacent tooth was evaluated instead. BOP was evaluated using a WHO probe and mild pressure. Presence or absence of BOP was recorded after 10-20 seconds. It should be noted that periodic visits were made during the study to ensure the accuracy of periodontal pocket measurement. Overall oral health was evaluated using the community periodontal index (CPI) according to WHO oral health survey methods. [15, 24, 26]

DMFT: The teeth were directly examined using a dental mirror, an explorer, cotton rolls, water and air spray and radiographs. Decayed, missing and filled

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teeth according to the WHO criteria were recorded and the sum of decayed, missing and filled teeth (D+M+F) was calculated for each patient. [31]

Statistical analysis: Data were analyzed using SPSS 19. Relative and absolute frequencies were calculated with 95% CI. Normality of the parameters was tested using Kolmogorov-Smirnov test. WC, BMI and DMFT did not have a normal distribution. Therefore, Mann Whitney test and Wilcoxon's non-parametric test were used for the comparison among the 3 groups. Other variables namely periodontal pocket (PP), CPI, age and gender had a normal distribution. Thus, independent t-test was used for their pairwise comparison. The Spearman's correlation coefficient was used to assess the correlation among qualitative variables namely level of income, brushing times per day and level of education. Multivariate logistic regression (backward method) was applied to evaluate the predictive factors for dental conditions and periodontal disease in subjects with different BMI and WC. The odds ratio was calculated to indicate the predictive value. P<0.05 was considered statistically significant.

Results

A total of 180 subjects were evaluated including 75 males and 105 females. The mean age of patients was 35.47±8.84 years (range 56-20); 54 subjects had normal BMI (18.5-24.9 kg/m^2), 68 were overweight (25-29.9 kg/m^2) and 58 were obese (>30 kg/m^2). The mean WC was 96.89±11.64 cm; this value was 97.59±11.48 cm in males and 96.40±11.78 cm in females. Table 1 shows the demographic characteristics and frequency of tooth brushing of subjects. According to findings, most individuals had moderate income, with high school diploma and brushed their teeth at least once a day.

The mean BMI was 28.20±5.29 kg/m^2 and it was significantly higher in females (P<0.003). The mean height and weight were significantly different between males and females as well (P<0.001). However, WC was not significantly different in men and women (although its ideal value is different). The mean DMFT was 14.28 and the mean PD was 0.9±0.22mm. Table 2 indicates the mean value of understudy variables in 3 groups of normal weight, overweight and obese subjects (Fig 1).

Table1. Demographic characteristics and frequency of tooth brushing of subjects

Variables		Number	Percentage
Level of income	Low	42	23.3
	Moderate	132	73.3
	High	6	3.3
Level of education	> high school diploma	53	29.4
	High school diploma	81	45.0
	College degree-BS	41	22.8
	Higher than BS	5	2.8
Brushing times per day	Once	94	52.2
	Twice	60	33.3
	Three times	17	9.4
	Rarely	9	5.0
Age	18-27	30	16.7
	28-37	71	39.4
	38-47	60	33.3
	48-57	19	10.6

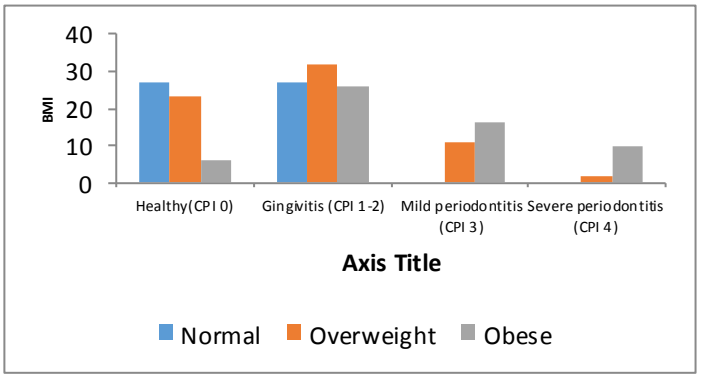


Fig 1. The frequency distribution of BMI based on the periodontal status

Table 2. The mean value of understudy variables in the 3 groups

Variables/BMI	Normal	Overweight	Obese
Age	31.21±9.35	36.93±7.69	37.72±8.35
BMI	22.44±2.01	27.70±1.37	34.13±3.78
WC	84.87±6.52	96.57±5.49	108.45±8.79
DMFT	12.7±5.99	15.16±5.53	14.72±5.88
PPD	0.81±0.12	0.90±0.26	0.99±0.2

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Fisher's exact test revealed significant differences in periodontal pocket of 3 groups (P=0.001). Kruskal Wallis test revealed a significant rise in DMFT by increased BMI (P=0.05) in overweight's. The Spearman's correlation coefficient illustrated significant correlations of PPD and BOP with BMI and WC in both genders (P<0.05 for all). Level of income and level of education were significantly correlated with Periodontal pocket depth (P<0.05). A significant correlation was also observed between the level of income and DMFT (P<0.05).lower level of education and income represented poor periodontal status. In terms of the frequency of CPI categories, 31% of subjects had healthy gingiva, 47% had gingivitis (CPI 1), 15% had mild periodontitis and 7% had severe periodontitis (CPI 4).

Chi square test indicated a significant relationship between age group and CPI status (P=0.003, Table 3). Figure 2 illustrates the periodontal status based on WC in two genders.

Table 3. DMFT, periodontal pocket and CPI based on the multivariate logistic regression model

Dependent variables	Confounding variables	Regression coefficient	P value	95% CI		Odds ratio
				lower	upper	
DMFT	Age	0.038	0.017	0.995	1.085	1.038
	WC	0.0305	0.042	1.001	1.071	1.036
	constant	-4.468	0.005	----	-----	1.011
PPD	BMI	0.184	0.000	1.103	1.311	1.203
	BOP	-1.818	0.005	0.046	0.571	0.162
	constant	-4.440	0.005	-----	-----	0.012
CPI	WC	0.115	0.000	1.071	1.171	1.122
	constant	0.974	0.001	----	-----	0.000

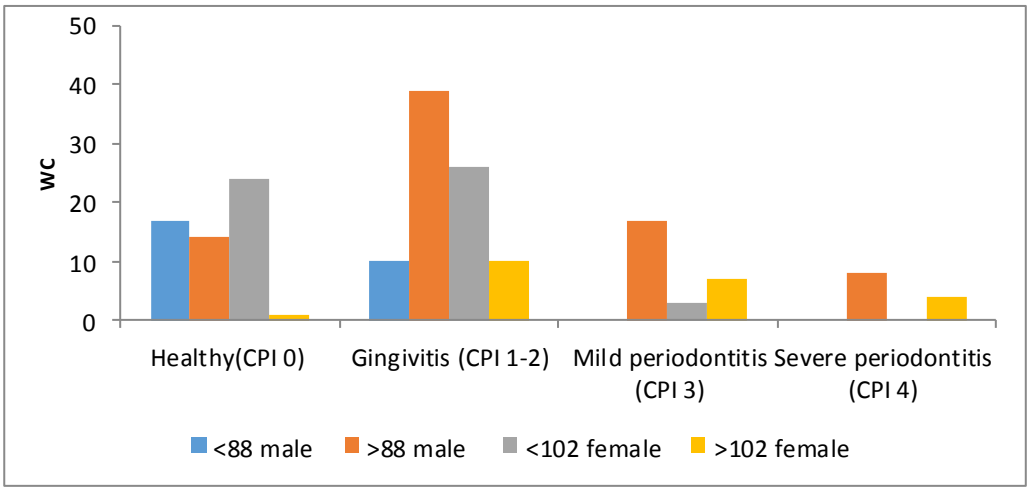


Fig 2. The frequency distribution of WC based on the periodontal status in female

Multivariate logistic regression analysis model matched the variables (BMI, WC)by adjusting for the confounding factors entering equal 0.05 and removal 0.1 variables in the model associated to DMFT such as age, gender, WC, level of income, level of education and BMI and only age and WC remained in the final model . Using this analysis, BMI and BOP remained in the final model as the factors related to in increased odds of periodontal pocket depth (table 3). In the final model the main factor (WC) remained as a potential predicting factor for CPI. In general, according to study, the odds of increasing DMFT may rise 0.964 (OR: 0.964, 95% CI: 0.818-1.138) more than mean (n=14) by one unit increase of BMI, and PD increased by 0.028 (OR: 0.028, 95% CI: 0.017-0.040). By one unit increase of WC, DMFT increased by 1.036 (OR: 1.036, 95% CI: 1.001-1.071) and PD increased by 0.684 (OR: 0.684, 95% CI: 0.00-4.67). One unit increase of

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WC enhanced CPI by 0.625 (OR: 1.122, 95% CI: 0.053-0.078).

Discussion

This study evaluated the relationship of obesity and overweight with oral health and showed a significant correlation between the obesity markers and oral health regarding adjusting other confounding factors. Tooth decay and periodontal disease are correlated with the level of education and income as well as the advanced age (which per se affects oral health). Our findings confirmed the role of increased fat distribution (both systemic and local i.e. WC) as a risk factor for damage to oral health like similar studies. [9, 14, 15, 24, 29, 31-36] It compromises general health and predisposes patients to chronic diseases such as atherosclerosis, cardiovascular disease and type II diabetes and can also lead to chronic oral conditions. These are all consequences of an unhealthy lifestyle. [1, 3, 4] Thus, dentists should provide weight control instructions (particularly for WC) in addition to the routine oral health instructions.

This study also evaluated the association of obesity with tooth health assessed by DMFT similar to previous studies. [14, 15, 31, 33] and showed that both age and WC remained as influential factors in the final model. However, it should be noted that the majority of previous studies have been conducted on the primary or mixed dentition systems in children. [23-28] Our study confirmed the significant effect of WC on permanent teeth; which has also been mentioned as an influential factor in some previous studies. [14, 15] This may be due to the accumulation of fat in the salivary glands or tooth supporting structures or its impact on microbial flora in obese subjects. This issue has been discussed as part of new phenomenon called infect obesity and necessitated greater attention to oral changes in obese subjects. [5] In a systematic review, the effect of obesity on permanent teeth was found to be more significant than on deciduous teeth. [27] It should be noted that in this study DMFT was high in all age groups because our understudy subjects were selected among those referred to dental clinic seeking dental treatment. However, by increased BMI, DMFT significantly increased as well. [14, 37]

Several recent studies have investigated the correlation of obesity and periodontal disease. These studies have mostly focused on the etiologies of metabolic syndrome suggesting an increased risk of cardiovascular disease and DM due to periodontal disease. [9, 14, 15, 24, 29, 32-44] A general consensus has been reached by the WHO, International Diabetes Federation, European Group for the Study of Insulin Resistance (EGIR) and American Heart Association that WC is a major risk factor for metabolic syndrome and its predictive value for cardiac disease and diabetes has been well emphasized. [45] However, most studies evaluating the relationship of periodontal disease and obesity have mentioned BMI as the leading risk factor. Similarly, the present study confirmed the correlation of WC and oral conditions and multivariate analysis indicated BMI as an important risk factor to disturb periodontal health .Some previous studies have given the same value to BMI and WC. [14, 15, 34] Systematic reviews and meta-analyses can better elucidate the predictive value of these two factors. The current study similar to some previous investigations demonstrated that one unit increase of BMI raised the odds of periodontal disease (PD and CPI). This finding is in complete agreement with the results of previous studies. [14, 29, 36] BOP is also indicative of poor oral health and its association with BMI and WC was also demonstrated in our study. BOP is an early sign of periodontal disease [15, 29] while gender differences with obese female susceptibility to periodontal diseases have also been discussed in previous studies [46]; Howevert, no significant difference was found between males and females in our study.

Although overweight and obesity are noticeable, the resultant gradual tissue destruction may remain unnoticed. A previous study evaluated the blood glucose level of subjects presenting to a dental clinic and showed that 12.2% of obese subjects (a major risk factor for Diabetes mellitus =DM) had DM without knowing it and 5.7% were pre-diabetic. [47, 9] The relationship of obesity and periodontal disease has been confirmed by several researchers. [9, 14, 15, 24, 29, 33-44] Although known diabetic patients (with recognized symptoms) were excluded in the majority of previous studies, blood glucose level of patients was not evaluated and underlying conditions and morbidity related to diabetes were not well considered in these studies.

The current study had some limitations as well. The samples were selected among subjects presenting to a dental clinic to seek dental treatments; which explains their poor oral health status. Future studies are recommended on the general population with matched ages range to better elucidate this relationship.

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Conclusion

Obesity has always been a risk factor of general health. Its currently high prevalence in most communities is alarming causing high morbidity and mortality due to the cardiovascular disease and diabetes. The present study demonstrated that even in the absence of important risk factors such as DM, hyperlipidemia and hyperglycemia; obesity per se can initiate a destructive path in terms of oral health. Obese person has to be more obsess for their oral hygiene to prevent destructive effect. Dentists should be well aware of the adverse effects of obesity on oral health.

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Conflict of interest: The authors declare that they have no conflict of interest.

Author Contributions

1- Maryam Rabiei, Design the study, literature review, data acquisition, provide manuscript , approve it

2- Bardia Vadiati Saberi, Literature review, data collection, clinical study, writing manuscript, approve the study

3- Masoudi Rad Hossein, design the study, experimental study, analysis data, provide manuscript, approve the study

4- Seyed Ahmad Bahre Khazan, literature review, clinical study, data acquisition, approve the study

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