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Relationship between body mass index and oral health indicators: a cross-sectional study

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Abstract

Today's prevalence of obesity is dramatically increasing and a two-way interaction between higher body mass index (BMI) and oral health is described in scientific litterature. Accordingly, the present study was aimed to evaluate the relation of BMI and oral health indicators. In this cross-sectional study, 240 individuals according to their BMI were placed in the following experimental groups; underweight (BMI<18), normal weight (18≤BMI≤24.9), overweight (25≤BMI≤29.9) and obese (30≤BMI). Plaque index (PI), gingival index (GI), bleeding on probing (BOP) and decayed, missed and filled teeth (DMFT) were obtained. Data was analyzed by SPSS 26 using descriptive tests and one-way ANOVA at the level of 0.05. The mean age and sex distribution of participants of experimental groups had no significant difference (p>0.05). GI and BOP were significantly lower in normal weight persons than individuals with high BMI (p<0.05). DMFT, the number of decayed, missed and filled teeth was approximately similar in all experimental groups (p>0.05). Pearson correlation coefficient showed a positive significant relation between GI as well as BOP with BMI (p=0.000). Based on the results achieved by the present study, although periodontal health status of overweight and obese individuals was significantly compromised compared to normal weight persons, the dental health status was not affected by BMI.

Key Words: oral health, periodontal index, periodontitis, dental caries, obesity.

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Recently, obesity, as a worldwide problem, has become severely prevalent.[1] Obesity occurs as a result of an imbalance between body uptake and consuming energy which leads to overt fat accumulation, adiposity and high total body mass.[2] It is one of the most common problems that could affect public general health since it is considered an effective self-sufficient factor that could result in cardiovascular diseases.[3,4] In high income countries, obesity plays an important role in disability-adjusted life years.[3] Different methods have been introduced for obesity assessment. However, none of them is completely perfect. The body mass index (BMI) is the most applicable anthropometric indicator.[5] BMI can neither differentiate fat mass from lean mass nor central fat from the peripheral one, but then, because of its feasibility and high accuracy, it is still one of the most practical methods for evaluating obesity.[3] Increased inflammatory reactions in the body could be one of the basic mechanisms of obesity.[6] Systemic distribution of inflammation via tooth destruction and periodontal pockets cause increased inflammatory cytokines secretion, which plays an important role in development of obesity.[7] Various composition of oral microorganisms,which may result in many diseases,[8] are more different in obese people and those who are overweight.[2,9] Therefore, oral hygiene habits that decrease the amount of microorganisms and improve oral health status could inhibit illnesses as well as obesity.[10] Besides, tooth brushing by stimulating oral proprioceptive pathway, which are linked to histamine-hypothalamic pathways could motivate leptin secretion, suppress appetite and control body mass.[11] Saito et al. reported that higher BMI is related to an increased risk of periodontitis.[12] Techatanawat and Komchornrit in their study concluded that periodontitis is directly relevant to

blood lipid profile.[11] Based on Chang et al. although tooth caries as well as tooth loss is in accordance to higher BMI, lower BMI is related to frequency of toothbrush.[1] Because of the possible effects of oral health status, periodontal disease, and dental caries on obesity, the present study was conducted to evaluate the relationship of BMI with oral health indices and also to compare oral health indices between those with different BMI.

Materials and Methods

Study Population

In this cross-sectional study, 240 dentulous attendances in Dental clinics in 2021 randomly participated. The inclusion criteria were subjects aged between 20 and 60 years old. The exclusion criteria included antibiotic therapy in the last 3 months, bearing any medical illnesses, receiving orthodontic treatment, smoking, pregnancy and being a professional athlete. Participants were placed into four experimental groups based on the BMI, as follows; underweight (BMI<18), normal weight (18≤BMI≤24.9), overweight (25≤BMI≤29.9) and obese (30≤BMI).[13]

Ethical statement

All participants were made aware about the conditions and were insured not to enroll in the study did not influence their treatment. An informed consent was sighed by each subject before they were recruited into the study. The study was conducted in accordance with the Declaration of Helsinki, and was approved by the ethical committee.

Assessment of obesity

In order to evaluate the obesity status of participants, BMI was calculated for each subject. BMI was defined as weight (kg) divided by a square of height (m^2).Height was measured as the participant stood barefoot with head horizontal in the frankfurt planeusing a tape measure placed 50 cm above the ground. For weight measurement, subjects were asked to wear light cloth and stand on a digital scale, which was placed on a hard surface on the floor.[3]

Assessment of oral health variables

A complete dental examination was carried out for all subjects enrolled in the study by a dentistry student who was performing a DDS doctoral thesis under the supervision of an oral medicine specialist. The teeth examination was done on a dental chair using a light, mirror and #17 dental probe. Number of filled teeth (FT), decayed teeth (DT) and missing teeth (MT) were calculated for decayed, missed and filling teeth (DMFT). In order to evaluate periodontal health status, löe-silness gingival index (GI)and bleeding on probing (BOP) index were used. GI, which assesses gingival inflammation,is scored from 0.1 to 3; 0.1- 1 is for mild inflammation of gingiva, 1.1-2 shows moderate inflammation, 2/1-3 shows severe inflammation.[14] The BOP was measured by probing around the teeth gently. After waiting 30 seconds, bleeding was recorded (yes/no) per tooth, expressed in percent of the bleeding site.[15] Additionally, plaque index of disease was assessed to evaluate the oral hygiene of participants.[16]

Statistical Analysis

Data was analyzed using SPSS 26.0 software produced by IBM Company in Chicago, USA. For statistical analysis, descriptive statistics were performed to explain the characteristics of the population who participated in the study using counts, percentages, means and standard deviation, as appropriate. Kolmogorov–Smirnov test was used to evaluate the normal distribution of data (significant level of 0.05). One-way ANOVA and Tukey posthoc test were used to compare continuous variables. Pearson correlation coefficient was calculated to evaluate the potential relationship between BMI and oral health index.

Table 1. Sex distribution, age and BMI of participants of each experimental group.

Experimental Groups		Age(Years)			BMI¥(Kg/m^2)			Sex	
	N	Mean±SD	Min∞	Max¶	Mean±SD≠	Min∞	Max¶	Female (%)	Male (%)
Underweight	60	32.55±8.05	20	49	17.56±0.71	15.08	17.98	27(45)	33(55)
Normal weight	60	33.98±7.90	20	50	22.78±1.40	18.53	24.97	28(46.7)	32(53.3)
Overweight	60	32.98±7.59	20	50	27.15±1.50	25.07	29.90	33(55)	27(45)
Obese	60	35.32±7.43	24	48	33.98±3.04	30.03	41.97	24(40)	36(60)

∞minimum, ¶maximum, ≠Standard Deviation, ¥ Body Mass Index

Table 2. Minimum, Maximum, mean ± SD of oral health indexes. P value of less than 0.05 was considered significant.

	Experimental Groups	minimum	maximum	Mean±SD≠	P.value
Plaque index	Underweight	0.40	2.40	1.08±0.53	0.014
	Normal weight	0.00	2.30	0.89±0.05	
	Overweight	0.30	2.60	1.20±0.55	
	Obese	0.20	2.40	1.12±0.54	
Gingival index	Underweight	0.00	1.90	0.71±0.51	<0.001
	Normal weight	0.00	1.80	0.64±0.44	
	Overweight	0.00	2.50	1.05±0.61	
	Obese	0.00	2.40	1.00±0.60	
Bleeding on probing	Underweight	0.00	23.70	2.14±4.95	0.001
	Normal weight	0.00	24.30	2.19±5.05	
	Overweight	0.00	44.20	5.92±9.27	
	Obese	0.00	36.10	6.31±9.29	
DMFT¶	Underweight	2	21	12.53±4.48	0.643
	Normal weight	0	24	12.88±6.21	
	Overweight	2	21	12.13±5.07	
	Obese	2	23	11.66±5.79	
Decayed teeth	Underweight	0	14	5.63±3.91	0.813
	Normal weight	0	13	5.31±4.05	
	Overweight	0	13	4.93±4.08	
	Obese	0	14	5.30±3.69	
Missed teeth	Underweight	0	13	3.20±2.85	0.910
	Normal weight	0	12	3.51±3.20	
	Overweight	0	16	3.25±2.83	
	Obese	0	11	3.51±3.46	
Filled teeth	Underweight	0	21	3.70±3.44	0.183
	Normal weight	0	24	4.05±3.45	
	Overweight	0	21	3.95±3.72	
	Obese	0	23	2.85±2.60	

≠ Standard Deviation, ¶Decayed, missed and filled teeth

Results and Discussion

Table 1 presents demographic characteristics of the participants in each group. Table 2 shows the oral health indices separately including DMFT, PI, GI and BOP of the experimental groups. One-way ANOVA test showed that the difference between GI and BOP of experimental groups was statistically significant ($p<0.05$). However, there was no significant difference between PI and DMFT ($p>0.05$). Tukey post-hoc test revealed that GI and BOP of obese and overweight individuals were significantly higher than those who were normal or underweight ($p<0.05$). Pearson correlation coefficient showed a positive significant linear correlation between BOP as well as GI with BMI ($r>0$, $p<0.05$). (Table 3)

The results of the present study demonstrated that, according to the GI and BOP, poor periodontal health had a positive significant association with higher BMI in a way that, along with weight gains, the periodontal health was compromised. However, despite the lower PI of normal weight persons, no relation between PI and BMI was established. Additionally, DMFT neither was significantly diffrent between groups with different BMI, nor had a positive relationship to obesity.

There are some previous studies which assessed the relationship between oral health status and periodontitis

Table 3. Pearson correlation of plaque index, bleeding on probing, gingival index and DMFT variables with Body Mass Index.

	Pearson correlation	Sig.
Plaque index	0.094	0.149
Bleeding on probing	0.235	0.000*
Gingival index	0.245	0.000*
DMFT¶	-0.064	0.323

**Correlation is significant at 0.01 level*
¶Decayed, missed and filled teeth

with obesity. In consistent with the present study, the results of a nation-wide longitudinal study conducted in South Korea by Chang et al.[1] showed that the prevalence of periodontitis in population with lower BMI was less than obese ones and they had more satisfactory oral hygiene. However, in contrast to our results, the lower BMI was associated with less dental decay. Deshpande and Amrutiya in an observational study demonstrated that the severity of periodontitis is directly related to the high BMI.[17] Dhaifullah et al.[18] concluded that although there was a strong positive association between gingivitis as well as oral hygiene with high BMI, obesity and periodontal status had no significant relationship. The results of the present study are in accordance with data of Alwast et al.[19] and Idrees et al.[20] showing that there was no correlation between tooth decay prevalence and obesity, but in contrast, Ashour et al.[21] mentioned that there was a statistically significant association between dental caries and BMI (adjusted odds ratio=2.7; 95%CI=1.4-4.3; p<0.0001). Additionally, Hamasha et al.[22] presented that more dental caries were more likely to occur in high BMI population. Abnormal inflammatory adipokine secretion from hypertrophic adipocytes and infiltration of immune cells in fat tissue is enhanced in obesity.[23] High-fat food intake in obese persons could change oral and gut microbiota which result in endotoxemia, accumulation of activated macrophage in adipose tissue, increased toll-like receptor 4 (TLR4) ligands in the liver and finally high incidence of inflammatory diseases.[24] Tumor necrosis factor α secreted from the macrophage induces production of interleukin 6 in adipocytes that leads toacute phase protein production, including C-reactive protein and serum amyloid A (SAA). SAA increases dendritic interleukin 6 secretions and promotes differentiation of T helper 17, which produces interleukin 17 and is strongly suggested for being responsible for periodontal diseases.[25] Besides all mentioned above, a low tendency of obese individuals for oral hygiene is a risk factor for periodontitis.[18] Obesity and periodontitis could affect each other and their combination results in amplified inflammation which affect the whole body via adipose tissue. In the other words, obesity accelerates the severity of periodontitis and the periodontal inflammation could more likely result in systemic effects in obese individuals compared to those of normal weight.[23] The present study had some limitations, including a relatively small sample size, not evaluating oral health behaviors of participants, as well as not considering years of obesity for fat individuals. According to what are mentioned above, first it is suggested that future studies will be designed for various races. A second suggestion is to conduct prospective studies as dental decay and periodontitis are chronic processes and take time to happen. Thirdly, as oral hygeine behavior plays an important role in oral health status, consider it for better interpretation.

In conclusion, acoording to the results of the present study, compromised periodontal health status had positive strong association with obesity. However, dental health status were almost similar in individuals having different BMI.

List of acronyms

BMI - body mass index
PI - plaque index
GI - gingival index
BOP - bleeding on probing
DMFT - decayed, missed and filled teeth
TLR4 - toll-like receptor 4
SAA - serum amyloid A

Contributions of Authors

All authors have read and approved the final edited typescript.

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Conflict of Interest

The authors declare no conflicts of interest.

Ethical Publication Statement

We confirm that we have read the Journal's position on issues involved in ethical publication and affirm that this report is consistent with those guidelines.

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