

The Correlation Between Body Mass Index and Oral Health in 12-Year-Old Students in Tehran During 2011

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Abstract

Background: The growing prevalence of being overweight and obesity in children has raised significant public health concerns. Obesity is considered a risk factor for several chronic health conditions and is associated with increased mortality. In addition, recent studies have shown an association between obesity and periodontal disease.

Objectives: The present study sought to assess the correlation of body mass index (BMI) with periodontal disease.

Materials and Methods: A total of 1,024 12-year-old elementary school students were selected by cluster sampling from five regions of Tehran. BMI was used as a measure of being overweight and obesity, and the oral hygiene index (OHI) was used to assess periodontal disease. A linear regression model was applied to estimate the association between BMI and OHI. The parents' level of education and family income were also evaluated.

Results: A significant association was found between BMI and OHI ($P = 0.001$). Also, a significant reverse correlation was detected between the parents' education level with OHI ($P < 0.05$).

Conclusions: Obesity is not a potential risk factor for periodontal disease in children of low-income families. However, periodontal disease is associated with increased BMI. Promotion of healthy nutrition and adequate physical activity may prevent the progression of periodontal disease.

Keywords: BMI, Obesity, Overweight, Periodontal, Student

1. Background

Obesity is defined as having excess body fat and can be attributed to genetic or environmental factors (1). Obesity is a multifactorial disease and several social, medical and behavioral factors, such as overeating and immobility, are responsible for its development. In other words, overweight and obesity result from an imbalance between caloric intake and energy output (2). At present, obesity is the most common health hazard in developed countries. Childhood obesity can lead to serious diseases, decreased life expectancy and many other problems. Obesity is associated with a greater risk of type II diabetes and is considered a risk factor for cardiovascular diseases, asthma, arthritis and behavioral problems (3). BMI is the most common method for measurement of overweight and obesity. According to the World Health Organization (WHO) and the National Heart, Lung and Blood Institute, a BMI of 25-29.9 is considered overweight and a BMI > 30 is consid-

ered obese. For children, the three most important national and international standards for being overweight and obesity include the 2000 centers for disease control and prevention (CDC) growth charts for the United States, the international standards for estimating child obesity published in 2000 by the international obesity task force and the WHO growth reference for school-aged children and adolescents. In the present study, the CDC standards were used. Childhood obesity is defined by a BMI greater than the 95th percentile. It has been shown that preventive measures for obesity are more effective in childhood than in adulthood.

Studies conducted in the United States have demonstrated that 31% of adults possess the criteria for obesity and more than 65% have a BMI of over 25. Also, 15.8% of 6-11 year-olds and 16.1% of 12-19 year-olds are overweight (4).

Data regarding childhood obesity in Iran is scarce. According to a study in Tehran, the prevalence of being overweight and obesity in adolescents in the puberty stage was

17.9 and 7.1 per 100,000, respectively (5).

In relation, children and adolescents may suffer various forms of periodontal disease, including aggressive and chronic forms of periodontitis or periodontal disease, as a manifestation of a systemic underlying condition. The chronic form is more common in adulthood, while the progressive type is more common in children. However, periodontal disease in children is mostly in the form of gingivitis with no bone loss. Its manifestation is usually acute and transient and mostly involves interdental papilla and gingival margins. In some cases the condition can become chronic and continue until adulthood, becoming progressive. According to an extensive study in the U.S., the incidence of periodontal disease among 12 - 17 year-old American teenagers is increasing. Iranian national statistics have demonstrated that 88.7% of Tehran middle school students have unfavorable periodontal status. According to the mentioned statistics, the prevalence of aggressive periodontitis was 13% among 15-18 year-old teenagers in Tehran (6).

The risk of periodontal disease is greatly increased by the shortage of calcium and vitamin C in the daily diet (7, 8). Foods and drinks rich in carbohydrates and deficient in calcium and vitamin C comprise a major part of the daily diet of overweight children and adolescents. Adolescents are more susceptible to calcium deficiency, since it plays an important role in the growth and development of bones (9). On the other hand, some unhealthy lifestyle behaviors, such as a sedentary lifestyle, reduce the overweight person's interest in oral hygiene measures (i.e., tooth brushing and flossing) (9). Depression, stress and low self-confidence are seen among obese children and can be responsible for non-compliance with oral hygiene measures and a tendency towards unhealthy habits such as overeating and consumption of high-calorie foods (10). These factors can directly or indirectly lead to the development of periodontal disease (common risk factor approach). It has been stated that poor oral hygiene, just like obesity, greatly depends on lifestyle. Overweight children and adults usually have unhealthy dietary habits (10). One study reported a 16% increase in the risk of periodontitis for each 1 kg/m² increase in body mass index (11). Also, significant associations have been reported between obesity and the severity of periodontal disease (12, 13).

Al-Zahrani et al., in 2003, evaluated the correlation of obesity and periodontal disease in adolescents, adults and the elderly and found that being overweight and obesity increased the incidence of periodontal disease in adolescents, while being underweight (BMI < 18.5) decreased its prevalence. In their study, no association was observed between periodontal disease and being overweight or obesity in adults and the elderly (14).

Morita et al., in 2011, assessed the correlation of a 5-year incidence of periodontal disease with BMI in a population of Japanese individuals and detected a dose-response correlation between BMI and the development of periodontal disease (15).

In 2010, Chaffee et al. performed a systematic review of the relationship of obesity and chronic periodontal disease and suggested to expect a higher prevalence of periodontal disease among obese adults in the clinical setting (16).

In another systematic review, Suvan et al. evaluated the association of overweight and obesity with periodontitis in adults. Their results supported an association between overweight and obesity and development of periodontal disease. However, the magnitude of this relationship remained unclear (17).

The presence of confounding factors, such as diet and socioeconomic status, as well as underlying variables such as age, oral hygiene status, and fluoride intake make it difficult to cast a final judgment on the correlation of obesity with periodontal disease.

To the best of our knowledge no study has been conducted in Tehran to evaluate the correlation of obesity with periodontal disease.

2. Objectives

Considering the importance of this issue and the necessity of prevention of periodontal disease and obesity in children, the present study was carried out to assess the relationship between obesity and periodontal disease in 12-year-old students in Tehran during 2011 - 2012.

3. Materials and Methods

This descriptive, analytical, cross-sectional study was conducted on middle school students who were 12 years of age in five districts of Tehran. The city of Tehran was hypothetically divided into five areas of north, south, east, west and center and from each area one municipality district was selected. In each selected district, two schools (one male and one female school) were randomly chosen. Following coordination with the authorities, a total of 10 schools were finalized for inclusion in the study. An in-formatory session was held for the school principals, and the phases and objectives of the study were thoroughly explained. Students were also thoroughly informed about the study. All parents signed written informed consent and students were provided with a questionnaire. Students who met the inclusion criteria were examined and their height, weight, gender, family income and the educational

level of their parents were recorded. Weight was measured by a digital scale (IS55 LG). BMI, calculus index (CI), debris index (DI) and oral hygiene index (OHI) were calculated according to the WHO standards. The CI and DI were determined using a disposable dental mirror and a standard explorer.

The OHI index had two components: DI and CI. The simplified DI is based on the following numerical determinations:

0 = No debris

1 = Soft debris not covering more than one-third of tooth

2 = Soft debris covering between one-third to two-thirds of tooth or presence of extrinsic stains

3 = Soft debris covering more than two-thirds of tooth

Simplified CI is based on the following numerical determinations:

0 = No calculus

1 = Supragingival calculus not covering more than one-third of tooth

2 = Supragingival calculus covering between one-third to two-third of tooth or presence of small amount of subgingival calculus

3 = Supragingival calculus covering more than two-third of tooth or presence of subgingival calculus covering the entire surface

DI and CI are measured on the buccal surface of the upper first molars, the upper right and the lower left central incisors, and the lingual surface of the lower first molars. OHI is the sum of the scores of these two components.

Obesity is defined as having a high level of excess body fat. It is different from being overweight. A person may be overweight because of having extra muscle, bone, water or excessive fat.

In order to match the results, the examination was repeated 10 times by a pediatric dentist. The association between BMI and periodontal disease was assessed. A general report regarding the oral and dental health of students was also offered to the school principals. Emergency cases were also reported to the parents.

The inclusion criterion was students born in 1999, and the exclusion criteria were presence of systemic disease, students born earlier than 1999 and students who were not interested in participating in the study.

The collected data were entered into SPSS version 18 software. Mean and standard deviation were used to report quantitative variables, while frequency and ratio were used for qualitative variables. Simple and multiple regression models were used for statistical analysis and a value of $P < 0.05$ was considered statistically significant.

4. Results

A total of 1024 12-year-old students, including 467 boys and 557 girls were evaluated. The mean value of weight, height, BMI, and OHI index were 45.39 ± 11.08 kg, 150 ± 8.4 cm, 19.94 ± 3.95 and 11.22 ± 0.05 , respectively.

The highest academic degree of most fathers was a high school diploma (38%). Illiterate fathers had the lowest frequency. Among the subgroups of the father's level of education, a significant association was found between the bachelor's degree level of education and the OHI of children ($P = 0.035$) (Table 1).

The majority of mothers had a high school diploma (41%). Mothers with master's degrees or higher were seen with the lowest frequency (3.1%). Among the subgroups of the mother's education, middle school education ($P < 0.001$), high school education ($P = 0.003$) and high school diploma ($P = 0.051$) were significantly associated with OHI of children (Table 1).

More than half the families had a monthly income over 10 billion Rials. The BMI of more than 60% of the students was between the 5th - 85th percentiles.

Without accounting for the effect of sampling, no correlation was found between CI and BMI ($P = 0.08$), but a significant reverse correlation existed between BMI and OHI, and DI ($P < 0.001$ for both).

When accounting for the effect of sampling, a significant association was detected between BMI and OHI ($P = 0.001$). No significant association was found between OHI and gender ($P = 0.28$), but the correlations between OHI and father's level of education ($P = 0.02$), mother's level of education ($P = 0.009$), most recent dental visit ($P = 0.007$), periodic checkups ($P = 0.03$) and family income ($P = 0.004$) were all statistically significant.

Multiple regression analysis showed a significant association between BMI ($P < 0.001$) and father's and mother's education levels with OHI. However, family income and periodic checkups had no significant association with OHI (Table 1).

5. Discussion

Obesity and periodontal disease can greatly compromise general health. More than 50% of American adults are suffering from periodontal disease (18). Recognition of obesity as a risk factor of periodontal disease, especially in children and adolescents, is especially important considering the increasing trend of obesity in this age group.

Several factors, such as poor oral hygiene, diet, number of meals per day, socioeconomic status of the person and salivary immunoglobulins are involved in the development and progression of periodontal disease.

Table 1. Association of Predictors of Oral Health Index in 12 Year Old Students in Tehran During 2011

	Estimates	Standard error	95% confidence interval		P Value ^a
			Lower limit	Upper limit	
Father's level of education					
Illiterate	-0.005	0.080	-0.189	0.180	0.950
Middle school education	-0.001	0.066	-0.153	0.150	0.988
High school education	-0.098	0.071	-0.262	0.066	0.167
High school diploma	-0.057	0.053	-0.180	0.066	0.282
Bachelor degree	-0.101	0.048	-0.212	0.010	0.035
Master degree	Ref.				
Parents' income					
< 5,000,000 Rials	0.139	0.083	-0.052	0.329	0.094
5,000,000 - 10,000,000 Rials	0.015	0.061	-0.125	0.155	0.806
> 10,000,000 Rials	Ref.				
Dental care					
1 - 2 month ago	0.010	0.037	-0.077	0.096	0.787
3 - 6 month ago	-0.030	0.042	-0.126	0.067	0.475
6 - 12 month ago	0.066	0.060	-0.073	0.204	0.271
> 1 year	Ref.				
Mother's level of education					
Illiterate	0.125	0.117	-0.146	0.396	0.285
Middle school education	0.337	0.099	0.109	0.565	< 0.001
High school education	0.338	0.114	0.074	0.602	0.003
High school diploma	0.149	0.074	-0.022	0.320	0.051
Bachelor degree	0.058	0.072	-0.109	0.224	0.420
Master degree	Ref.				
Body mass index	-0.019	0.003	-0.027	-0.012	< 0.001

^aData analysis: Multiple linear regression considering sampling design (gender as strata and schools as clusters).

Being overweight and obesity depends on a variety of genetic and environmental factors (19). Overweight and obese children are more susceptible to obesity in the future. Environmental factors also play a role in this respect (20). Measuring the BMI of children and adolescents is especially important, because by measuring we can identify the overweight and obese children. Then parents and school health instructors can be informed about the child's condition and changes in diet, as well as other necessary measures, can be taken to prevent their obesity.

Overweight and obese individuals usually have unhealthy dietary habits. Factors related to lifestyle, such as dietary habits, as well as diseases, obesity and caries, all correlate with socioeconomic status. Evaluation of this variable, considering its confounding effect on the corre-

lation of periodontal disease and BMI, is especially important. In the present study, two indicators of the socioeconomic status, namely the parents' level of education and family income, were evaluated. These variables were significantly correlated with OHI. Study results demonstrated a reverse correlation between the level of income and the prevalence of periodontal disease in students. Also, a significant difference was detected in mean OHI between the northern, central and western districts of Tehran. This difference can be due to the mutual effect of socioeconomic status and the place of residence of the individual.

A study by Pakpour-Hajiagha found significant associations between monthly income, parents' educational level, age, number of brushings per day, use of dental floss and history of dental visits with DMFT (21).

In a study by Behrouzi et al., low family income and a high number of persons per household were associated with periodontal disease (22).

A study by Khader et al. in 2008, regarding the association of obesity with periodontal disease in adults in Jordan, reported that high BMI, obesity, high waist circumference and high fat percentage were associated with an increased risk of periodontitis (23).

A study by Reeves et al., in 2006, demonstrated that body weight and waist circumference had a positive association with periodontitis, but this correlation changed with age as adolescents grow. Those aged 13 - 16 years did not have an increased risk of periodontitis, while those aged 17 - 21 years were at an increased risk based on each 1 cm increase in waist circumference (24).

Significant associations have been reported between BMI and age with periodontitis (25), and obesity has been reported to be associated with dental caries and periodontitis (26).

In 2007, Marshall et al. evaluated the role of diet and socioeconomic status in the development of dental caries and childhood obesity. According to this study, the level of education of the parents and family income had a significant association with dental caries and childhood obesity (27). Therefore, low income can adversely affect knowledge about personal care and access to health care services. Also, due to the lack of knowledge and low dietary education, people may consume junk foods and inappropriate food items (24).

In a study on Japanese women, the frequency of periodontitis in subjects with low BMI was significantly lower than in subjects with normal weight. Frequency of periodontitis was higher in overweight subjects (28). This finding is in accordance with our study results regarding the significant reverse correlation of obesity with OHI.

Khosravi et al. evaluated the effect of obesity on periodontal tissue and demonstrated that in overweight and obese patients, serum levels of TNF- α and FBS were significantly higher than those in subjects with normal BMI. This finding showed an association between childhood obesity and an increase in the plasma concentration of TNF- α and revealed a susceptibility to periodontal disease (29). However, this finding is in contrast to our study results. Adequate nutrition may be an important factor in periodontal health in this age group.

Based on a national systematic review of the correlation of being overweight and obesity, and periodontitis in the United States, most subjects with periodontitis were African American males in low socioeconomic classes. In addition, their most recent dental visit was more than three years ago (17). In the present study, no significant correlation was found between the time of the most re-

cent dental visit and periodontal disease. This may be attributed to the close intervals in our classification. American patients with periodontitis had the lowest intake of calcium and vitamin C and were on average 7 kg heavier than their matched controls. Their waist circumference was 8 cm larger as well (17). In the present study, a significant difference was observed in mean OHI at different BMI percentiles.

Our study evaluated subjects that were randomly selected from five different areas of Tehran. By doing so, the authors tried their best to match the subjects studied socioeconomically. However, further prospective and longitudinal studies are required to evaluate the mechanism of the effect of obesity on periodontitis, while controlling for confounding factors.

Investigations on different age groups and ethnicities, with consideration of demographic factors, are also necessary to evaluate further the association of obesity with periodontitis.

Within the limitations of this study, our results revealed that obesity is not a potential risk factor for periodontal disease in children of low-income families. However, periodontal disease is associated with increased BMI. Promotion of healthy nutrition and adequate physical activity may prevent the progression of periodontal disease.

Footnotes

Authors' Contribution: Ghasem Meighani: developed the original idea and the protocol, study concept, design and study supervision; Ahmad Reza Shamshiri: provided statistical analysis and interpretation of data, wrote the manuscript, and is guarantor; Afroz Nakhostin: drafted the manuscript, provided critical revision of the manuscript for important intellectual content; Ahmad Abbasi: contributed to the development of the protocol, acquisition of data, abstracted data, and prepared the manuscript.

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