

Association between Dental Caries and Body Mass Index-for-Age among 10-12-Year-Old Female Students in Tehran

Abstract

Introduction: Dental caries and obesity are multifactorial diseases with diet being a common contributory factor. Many studies have reported varied outcomes about the association between dental caries and body mass index. But, there is no published study that investigates this association among female students in Tehran. The main aim of this study was to examine the relationship between dental caries and body mass index (BMI) in a sample of female students in Tehran. **Methods:** In this cross-sectional study, 416 students aged between 10 to 12 years was examined for dental caries using WHO standard diagnostic criteria. The Decayed, missing and filled of permanent teeth (DMFT) were recorded. The student's weight and height were measured by two trained examiner and their BMI were calculated. BMI-for-age and dental caries categories were analyzed with Pearson correlation coefficient, Chi-square, and *t*-tests using SPSS computer software. **Results:** The mean DMFT score and BMI of the study population was 1.03 ± 1.41 and 18.11 ± 3.33 respectively. The findings showed that 58.9% of the children had a normal weight, 27.9% were overweight, 10.3% were obese, and only 2.9% of the students were thin when they were compared with WHO standard of BMI for children with the same age. The respective mean DMFT values for BMI groups (thin, normal, overweight and obese) were 1.25, 0.73, 1.42, and 1.65, respectively. There was a significant association ($P < 0.05$) between dental caries and high BMI. **Conclusions:** This study demonstrated a significant association between caries frequency with high body mass index. For these reasons, the evaluation of nutritional status in students should be implemented in control programs for dental caries both on the community, schools, and individual levels.

Keywords: *Body mass index, children, dental caries*

Introduction

Dental caries (DC) and high body mass index (BMI) create important health problems world-wide especially in children and adolescent.^[1] Obesity represent a rapidly growing threat to the health of populations in an increasing number of countries.^[2] Globally, its prevalence in childhood obesity varies from 30% in USA^[3] to less than 8% in sub-Saharan Africa.^[4] In Iran, the prevalence of overweight and obesity was reported as 21.1% and 7.8% among adolescents.^[5] Worldwide, prevalence of dental caries is significantly increasing particularly among adolescents. Almost 60-90% of school children and nearly 100% of adults have dental caries. The highest prevalence is in Asia and in Latin America.^[6] The mean value of an average decay, missing, and filling tooth (DMFT) among 12-year-old children in the world is 1.61. These indexes

in Europe, Africa, America and West Pacific are reported to be 2.57, 1.3, 2.76, and 1.48, respectively.^[7] Based on WHO (2005), the best index of DMFT is 1 among 12-year-old children all over the world.^[8] In the eastern Mediterranean region, which also includes Iran, the mean number of decay missing teeth (DMT) is the highest in the Mediterranean region.^[9] Dental caries (DC) and obesity are both multifactorial diseases and are associated with dietary habits.^[10] Dental caries and high body mass index are dietary health problems which may result from high consumption of carbohydrates, snacks and soft drinks.^[11] The snacks, often high in refined carbohydrate, and in particular all types of sticky and sweet foods are associated with increased dental caries and obese risk.^[12] Obesity and dental caries have a dire influence on a student's health; they can be potentially prevented by increasing the knowledge and awareness of suitable oral health behaviors in addition to healthy food use.^[12] High BMI and DCs are

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closely related to lifestyle; for example, low sugar intake, regular brushing, and regular dental check-ups diagnosing oral diseases may help to improve the general health.^[13] The relationship of high BMI with DC has been suggested by few researchers. But results to date have been inconclusive. Some investigators suggest that a positive association between BMI and DC.^[14-21] But other researchers have not.^[3,22,23] Exploring the relationship between students high BMI and DC helps us understand each of the diseases individually and also how they relate to one another. Finding these relationships are important for furthering health promotion and prevention strategies.^[24] Therefore, this study was aimed to determine the correlation between body mass index and dental caries and some its related factors in 12-year-old female students in Tehran, Iran.

Methods

Inclusion criteria

The inclusion criteria were 5th grade female student (aged 10-12 years), studying in public schools, and having a signed consent from the child's parent or legal guardian.

Participants

The present cross-sectional study was conducted on the female students, among primary schools in Tehran, Iran in December 2016. In order to collect the data female students were randomly selected based on a two-stage cluster sampling method. First, ten regions were randomly selected from 20 regions. Then, 416 students having the above-mentioned criteria were randomly selected from each school based on the total population and the number of schools and students in each school in each region.

The questionnaire

Questionnaires were utilized to obtain demographic data (for example age, and parents' level of education). The body weight of each student was measured while wearing minimal clothing to the nearest 0.1 kg with a digital scale (Seca 767). Height was determined without shoes to the nearest 0.5 cm, using a stadiometer (Seca 220). Body mass index (BMI; kg/m²) was calculated as body weight (kg) divided by height squared (m²) Z scores of weight for age, weight for height, height for age and body mass index for age were calculated from the WHO Growth Reference Data for children aged 5-19 years.^[25] The students were grouped into four categories according to the body mass index for age: low weight, normal weight, overweight, and obese, in accordance with the cut-off points of < -2 SD, ≥-2 SD — +1 SD, >+1 SD—+2 SD, and >+2SD z-scores respectively. The decayed, missed, and filled teeth (DMFT) in the students were assessed by a dentist using a non-invasive technique (mirror, dental probe, cotton roll). The intra-rater reliability of the examiner was examined by using the kappa statistics, which was 92% for DMFT. Each student underwent an oral examination

and dental caries was diagnosed using World Health Organization (WHO) recommendations for oral health surveys.^[26] Caries was defined as the presence of at least one cavitated or filled surface. DMFT for each student was obtained by calculating the number of Decayed teeth (D), Missing teeth (M), and Filled teeth (F). Oral data were recorded on examination forms in accordance with the WHO criteria and classification of DMFT. For analysis, DCs was coded as 1 = caries present and 0 = caries absent. The performance measurement was conducted based on two questions: brushing behavior frequency (brushing less than twice a day = 0, brushing twice a day or more = 1), use of dental floss daily (dental floss once a week or less than once a day = 0, dental floss once a day or more = 1). The items were derived from previous studies on the topic.^[5,27,28] The content validity was performed via expert panel of fourteen specialists; four health education experts, five school health teachers and five dentists who have worked on administered oral health in the Ministry of Health. The mean Content validity ratio (CVR) and Content validity index (CVI) were calculated as 0.66 and 0.83, respectively. The construct's validity was assessed by performing explanatory factor analysis, and its reliability was evaluated by assessing internal consistency. The Root mean square of residuals (RMSR) was 0.04, Tucker Lewis Index of factoring reliability was equal to 0.918, and RMSEA (Root Mean Square Error of Approximation) index was 0.035 with 90% confidence intervals of 0.026-0.038, indicating acceptable fit indices in EFA. In this study, Cronbach's alpha reliability coefficients for various construct scales ranged from 0.72 to 0.80 indicates an acceptable internal consistency (The detailed results are not shown but are available from the main investigator).

Ethics approval and consent to participate

Ethics approval and consent to participate The Medical Ethics Committee of Tarbiat Modares University confirmed this study (IR.TMU.REC.1394.242); the parents provided written consent to their elementary school-age children's participation in the study.

Statistical analysis

Data analysis was carried out through SPSS 21.0 software package (SPSS Inc., IBM, and Chicago, IL, USA). Data was analyzed by One-way ANOVA, Chi-square, T-student, and Pearson correlation coefficient software. All values are reported as the mean ± standard deviation (SD). The Kolmogorov-Smirnov test was used to determine whether outcome variables were normally distributed.

Results

In this study, 416 fifth grade girl students who had the inclusion criteria were examined. Demographic variables showed that the average age of the participants was 10.88 ± 0.628 years. The education level of 43.5% of the mothers was diploma, and 41.8% of the fathers had the

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diploma. Family income status of 39.9% of the participants was appropriate. Table 1 shows the results of demographic variables. From the total sample, the mean BMI was 18.11 ± 3.33 . Almost 3% of the children were thin 58.9% had a normal weight, 27.9% were overweight and 10.3% were obese. Nearly 47% of children presented with caries (DMFT >0). Frequency percentage of dental caries in the thin, overweight and obese groups was 66.7, 55.2, and 72.1 respectively. In Figure 1 it shows the number of the subjects in each BMI category that (DMF >0).

The mean DMFT values for groups BMI-1 to BMI-4 were, respectively, 1.25, 0.73, 1.42, and 1.65 [Table 2], and for the total sample it was 1.03. Based on the one-way ANOVA test, there were significant differences between Mean DMFT scores of normal - weight children with overweight and obese groups. There is no significant difference between normal - weight students with under-weight children.

Table 3 shows the relationship between BMI and DC and some its related factors in students. There were statistically significant correlation between BMI, DT, MT, FT, and DMFT ($P < 0.01$). DMFT has stronger role in correlation than other determinants.

Discussion

This study showed a relationship between the dental caries and BMI among a group of children in Tehran city. Our results demonstrated that a positive correlation between BMI with DMFT index and its components. We found

that students with high body weight have a higher risk of developing dental caries than normal weight children so that, dental caries in the normal weight students were less than other participants that were thin, overweight and the obese. The students of obese had the highest dental caries frequency. In this study about 66.7% of thin children were in DMFT >0 group who need special attention from both aspects. There were no statistically significant differences between normal- weight students other than under-weight students groups in mean DMFT value. However, they might need intervention for oral examination and treatment which may tend to weight increasing on them. Previous evidence has shown that the importance of improvement in BMI-for-age indicators after dental care especially in thin group.^[29-33] This needs to be investigated in Iranian students and at both genders a community level in further researches. Many of Studies have attempted to demonstrate a relationship between dental caries and body-mass-index in children and adolescent.^[10,34,35] Several European studies have shown that children with higher BMI have higher caries rate. Willerhausen *et al.* conducted three studies conducted on German school children ages between 6-11 found a significant correlation between BMI and caries frequency.^[14,36,37] Dental caries and obesity are present great challenges for public health worldwide.^[38] The interaction between high BMI and DC is not a simple cause and effect relationship.^[39] The relationship between BMI category and dental caries is complex because it is a multifactorial disease varies depending on many factors for example: age, gender, race, oral hygiene, available nutrients (sugar intake), saliva, and family income.^[39,40] However, both obesity and poor oral health may increase a person's risk for systemic disease and poor dietary habits may be one of the factors linking both multifactorial conditions together.^[36] The results of this study showed that there were significant positive correlation between high BMI with DCs in students. The evidence supporting an direct relationship between DCs and high BMI comes from studies in developing countries.^[41,42] Alm *et al.* conducted two studies conducted on Swedish children they reported that overweight and

Table 1: Demographic characteristics of the studied students (n=416)

| Variable | Level | Rate | Percent |
|----------------------------|------------------|------|---------|
| Mother's educational level | Uneducated | 9 | 2.2 |
| | Primary | 42 | 10.1 |
| | Secondary school | 21 | 5.0 |
| | High school | 17 | 4.1 |
| | Diploma | 181 | 43.5 |
| | Associate degree | 34 | 8.2 |
| | Bachelor of Arts | 64 | 15.4 |
| | Master of Arts | 41 | 9.9 |
| | Doctorate | 7 | 1.7 |
| Father's educational level | Uneducated | 6 | 1.4 |
| | Primary | 40 | 9.6 |
| | Secondary school | 31 | 7.5 |
| | High school | 21 | 5.0 |
| | Diploma | 174 | 41.8 |
| | Associate degree | 31 | 7.5 |
| | Bachelor of Arts | 58 | 13.9 |
| | Master of Arts | 46 | 11.1 |
| | Doctorate | 9 | 2.2 |
| Family income | Low | 39 | 9.4 |
| | Appropriate | 166 | 39.9 |
| | Well | 113 | 27.2 |
| | Excellent | 98 | 23.6 |

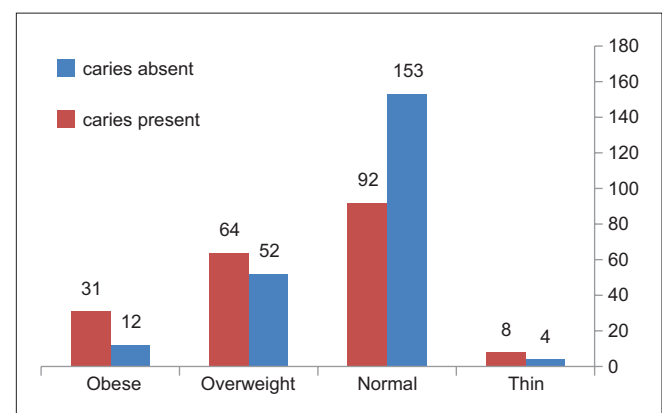


Figure 1: Frequency of study participants in each body mass index (BMI) category that (DMFT >0)

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Table 2: Cross tabulation BMI (Body Mass Index) and DMFT (Decayed, Missing, Filled, Teeth) and Mean score BMI and DMFT index among participants for each group

| | | DMFT category | | | | | | | |
|----------------|---------------|---------------|------------|---------------|------------|----------------|------------|--------|------------|
| | | DMFT | BMI | Caries absent | | Caries present | | Total | |
| | | Mean±SD | Mean±SD | Number | Percentage | Number | Percentage | Number | Percentage |
| BMI categories | 1. Thin | 1.25±1.28 | 13.43±1.67 | 4 | 33.3 | 8 | 66.7 | 12 | 100 |
| | 2. Normal | 0.73±1.16 | 16.28±1.62 | 153 | 62.4 | 92 | 37.6 | 245 | 100 |
| | 3. Overweight | 1.42±1.63* | 20.31±1.12 | 52 | 44.8 | 64 | 55.2 | 116 | 100 |
| | 4. Obese | 1.65±1.68* | 23.80±3.04 | 12 | 27.9 | 31 | 72.1 | 43 | 100 |
| Total | | 1.03±1.41 | 18.11±3.33 | 221 | 53.1 | 195 | 46.9 | 416 | 100 |

SD=Standard deviation, BMI=Body mass index, DMFT=Decayed missed filled index. *P<0.05 vs. Normal weight students with other of groups (LSD comparison between groups)

Table 3: Relationship between body mass index with dental caries and some its related factors among participants

| Variables | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|----------------------------|---------|---------|---------|---------|---------|---------|--------|---------|---------|---------|----|
| 1 BMI | 1 | | | | | | | | | | |
| 2 Age | -0.036 | 1 | | | | | | | | | |
| 3 Father's education level | -0.015 | -0.083 | 1 | | | | | | | | |
| 4 Mother's education level | -0.009 | -0.086 | 0.624** | 1 | | | | | | | |
| 5 Family income | -0.029 | -0.025 | 0.182** | 0.248** | 1 | | | | | | |
| 6 Brushing behavior | -0.007 | 0.149** | 0.044 | 0.102* | 0.161** | 1 | | | | | |
| 7 Use of dental floss | 0.012 | 0.074 | 0.001 | 0.080 | 0.100* | 0.320** | 1 | | | | |
| 8 Decayed | 0.153** | 0.030 | -0.055 | -0.072 | -0.082 | 0.021 | -0.091 | 1 | | | |
| 9 Missing | 0.128** | 0.034 | -0.043 | -0.034 | 0.097* | -0.058 | -0.068 | 0.117* | 1 | | |
| 10 Filled | 0.191** | 0.027 | 0.134** | 0.070 | -0.057 | -0.039 | -0.024 | 0.030 | 0.022 | 1 | |
| 11 DMF | 0.195** | 0.046 | 0.084 | 0.118* | 0.011 | -0.027 | -0.007 | 0.543** | 0.298** | 0.440** | 1 |

**Correlation is significant at the 0.01 level (2-tailed). *Correlation is significant at the 0.05 level (2-tailed)

obese Swedish children at age 15 had more proximal caries than normal-weight children. A longitudinal study by Alm *et al.* that included this same group of children, found that obese children had higher caries prevalence at age 15 and 20.^[10,34] Hooley *et al.* a systematic search for papers between 1980 and 2010 addressing childhood obesity and dental caries was conducted and a random effects model meta-analysis applied. They find there is evidence of an association between dental caries and BMI, although a clearer understanding of this association is needed.^[18] The study by Hayden *et al.* indicates that when standardized definitions for the assessment of child obesity are used, a small overall association between obesity and level of caries in the permanent dentition is encountered: caries is more prevalent in obese children than in normal weight children.^[17] High BMI and dental caries in children have been associated, although the results obtained in different studies are inconsistent. Some studies have shown that obese children have more caries.^[18,19,36] several studies have shown no association between childhood obesity and caries.^[28,43]

The considerable heterogeneity of the studies could limit their external validity and the generalization of their results. Assessment of child weight status was not uniform across studies, and this variation in measurements may partly explain the inconclusive reports on the relationship

between dental caries and obesity in the literature to date. There is another confounding variable that may have influenced this relation is socioeconomic statuses (parents' education, and family income).^[38] Although, this is a hypothesized that BMI-for-age would be associated with oral health behaviors (brushing frequency and use of dental floss), there was no association between BMI-for-age and this behaviors ($P > 0.05$). We found that low levels of mother's education and family income are reflected in poor oral health outcomes in students that, a number of studies reported similar results.^[44,45] we find no association between socioeconomic statuses and BMI in primary female students in Tehran. While, other studies illustrate that socioeconomic statuses is considered an associated factor in the relation between BMI and dental caries.^[41,46] Perhaps this is because the environment (capital of Iran) in which children spend their early years has an impact on their BMI. Parental education levels and family income were not significantly associated with students BMI. We recommend that further studies use suitable sample sizes, unify the criteria for BMI categorization and the dental caries index, and investigate the confounding factors that might influence dental caries and BMI. In this study, only female children were included in the present study, which limited the finding of association between caries and gender.

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Conclusions

The results of this study support an association between dental caries and overweight and obesity among female students in Tehran. This finding has important concepts for the promotion public health of among female students by focusing on specific risk factors associated with two diseases: dental caries and high BMI with a common risk factor. Health educators should put emphasis on the important role of healthy nutrition in the framework of oral health educational interventions. Future research should incorporate complete dietary evaluation, oral health compliance, demographic characteristics and other factors that may act as confounders or effect modifiers.

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Conflicts of interest

There are no conflicts of interest.

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