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Association between Dental Caries and Body Mass Index-For-Age among 6-11-Year-Old Children in Isfahan in 2007

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Abstract

Background and aims. Childhood obesity has been associated with high refined sugar intake. The relationship between sucrose intake and development of dental caries has been established. The aim of this study was to determine the association between age-specific body mass index (BMI-for-age) and dental caries in children.

Materials and methods. In this cross-sectional study a total of 1003 children were screened. Weight, height, BMI-for-age and dental caries of 633 (317 boys, 316 girls) 6-11-year-old children were clinically examined for dental caries using the World Health Organization criteria by a dentist on a dental chair. Decayed and filled teeth (DFT/dft) indices were used. BMI-for-age and dental caries were analyzed with multiple linear regression, chi-square, and t-tests using SPSS computer software.

Results. The findings showed that 16% of the children had a normal weight, 16.9% were at risk of overweight, and 67.1% were overweight. In the normal weight, at risk of overweight, and overweight groups, the mean ± SE for DFT were 0.34 ± 0.08, 1.23 ± 0.13 and 0.73 ± 0.05, respectively; and 2.01 ± 0.19, 2.76 ± 0.18 and 2.59 ± 0.13 respectively, for dft. Multiple linear regression showed that there was no statistically significant association between BMI-for-age and DFT (R = 0.06) and dft (R = 0.07) indices. 27.7%, 14% and 37.2% of children with normal weight, at risk of overweight and with overweight were caries free, respectively. There was statistically significant association between BMI-for-age and being caries free (p = 0.0001).

Conclusion. There was no association between BMI-for-age and DFT/dft indices. In addition, a high prevalence of at risk of overweight and overweight was seen among 6-11-year-old children in Isafahan, Iran.

Key words: **Body mass index, child, dental caries, Iran.**

Introduction

The prevalence of child obesity is increasing rapidly worldwide.[1] Based on the data of the World Health Organization (WHO), over 30% of the people in the Mid-

dle East are overweight.[2] A review of some studies from Iran reveals that the prevalence of obesity among Iranian children has been doubled between 1993 and 1999, which could be attributed to the changes in lifestyle.[1,3,4] Obesity in adults is not easy to treat and is often correlated with obesity during childhood.[5]

In the last decade, consumption of soft drinks and fast foods together with less activity and exercise contributed to the increasing number of overweight people worldwide.[6] Along with increasing caries risk, increased consumption of sugar-sweetened beverages and snack foods also has been linked to obesity. Health risks associated with childhood overweight and obesity are strong indicators for predisposition to adult morbidity and mortality and include type 2 diabetes, cardiovascular disease, fatty liver disease, early maturation, endometrial, colon, breast and other cancers, psychological stress, as well as orthopedic problems, general poor health, and hepatic problems.[7-10] An Iranian study detected a high prevalence of cardiovascular risk factors in overweight and obese children aged 7-12 years.[11]

Obesity is also related to several aspects of oral health, such as caries, periodontitis and xerostomia.[8] Fruit drinks and other sweetened beverages represent high sugar sources, which may contribute to cariogenic potential.[10] Oral health is strongly influenced by the daily intake of food and can also play a significant role in nutritional intake and general status of health, particularly in the elderly.[6] WHO recommends limiting added sugars to 10% of total calories on the grounds that added sugars contributed to overall caloric density of the diet.[13] A study in Scotland showed that among 165 children aged 3-11 years, whom with the worst decay were significantly thinner also severe dental decay was associated with underweight.[14] One Brazilian study concluded that there was no statistically significant association between dental caries and obesity in adolescents aged 12 to 15 years.[15]

Among children and teenagers aged 2-20 years, body fat amount changes as the body grows and is different for boys and girls. Unlike body mass index (BMI) assessments for adults, assessments for children and teenagers take these growth and gender specific differences into account. These child-specific BMI values are referred to as "BMI-for-age." Categories describing amount of body fat for children and teenagers is also different from the categories describing amount of body fat in adults. Among adults, BMI categories include "underweight," "normal," "overweight," and "obese." Among children and teenagers, BMI-for-age categories include "underweight," "normal," "at risk of overweight," and "overweight." There is no "obese" category for children and teenagers.[12]

Since the frequent consumption of high caloric and cariogenic substances are two of the many factors associated with caries and obesity,[9] and to the best of our knowledge there are no studies that have investigated the association between BMI-for-age and dental caries in Iran to date, the purpose of this study was to determine whether BMI-for-age, might be associated with dental caries in children in Isfahan, Iran.

Materials and Methods

This cross-sectional study was conducted from June to August 2007 in Isfahan, Iran. Using a random cluster sampling, a total of 1003 pupils aged 6-11 years from six private and state elementary schools with different social backgrounds were screened. The O'Leary index was used for evaluation of oral hygiene and plaque.[16] The children thoroughly chewed one disclosing tablet (Svenska Dentorama AB, Stockholm, Sweden) and rinsed their mouth with water, according to the manufacturer's instructions. The children who had 70% or fewer teeth surfaces with plaque were invited for further evaluations. The sample size was estimated allowing for caries prevalence of 60%,[17] and significance level of 0.05. All of the children participated in the clinical examination were Iranians and permanent residents of the city. Initially, information on age and educational level was collected. Body weight was recorded to the nearest 100-gram using a standard beam balance scale with the subject barefoot and wearing light dresses. The balance was calibrated at the beginning of each working day and at frequent intervals throughout the day. Body height was recorded to the nearest 0.5 cm according to the following protocol: no shoes, heels together and head touching the ruler with line of sight

aligned horizontally. To avoid subjective errors, all the measurements were done by the same person and by one observer.

BMI-for-age percentiles, representing eating habits in children and teenagers, were used. BMI-for-age [(weight in kilograms) / (height in meters)^2] percentiles are dependent on gender and age-specific weight for height curves for those aged 2-20 years. According to these curves, "underweight" is defined as BMI-for-age < 5th percentile, "normal" is defined as 5th percentile < BMI-for age < 85th percentile, "at risk of overweight" is defined as 85th percentile < BMI-for-age < 95th percentile, and "overweight" is defined as BMI-for-age > 95th percentile.[12] Since the number of samples in underweight group was insufficient (three samples), this group was excluded from the study. The remaining 633 children (317 boys and 316 girls) enrolled in the study.

All selected children were clinically examined for dental caries by a specialist utilizing the WHO criteria for diagnosis of dental caries.[18] The examination was carried out using a cycle and cow horn two-headed dental explorer (Aesculap AG, Tuttlingen, Germany), a plane mouth mirror (Aesculap AG) and cotton rolls to remove any plaque or debris where necessary, and recorded on special charts. All examinations were performed on a dental chair in a dental clinic. Teeth were considered as decayed when in addition to showing clinical signs such as a color change, wedging and catching of an explorer tip during the examination of occlusal surface encountered some degree of resistance. Marthateler method was used for the proximal surfaces.[19] According to this method, a surface is diagnosed as decayed if the explorer is retained. Dressed and restored teeth that had recurrent caries were recorded as caries. Teeth filled with temporary materials were considered as filled, and not as decayed; no radiographs were taken. White spots were not considered as decayed in this study. Missing teeth were not marked correspondingly, since no definite statement could be made without a proper anamnesis whether the tooth really existed, or if an early extraction had taken place. To assess the caries frequency the DFT index for the permanent dentition and the dft index for primary dentition were used, since it gives a good insight into the state of decay in the patient.[18] If both the deciduous and permanent teeth were present, only the permanent teeth were evaluated.

Data was statistically analyzed using SPSS software. *t*-test was used to analyze the mean decayed and filled permanent/primary teeth (DFT/dft) and the difference between groups, chi square test for evaluation of association between BMI-for-age and gender, and multiple linear regression for evaluation of association between BMI-for-age and DFT/dft indices. $P \leq 0.05$ was considered statistically significant. The Authors certify that all applicable institutional and governmental regulations concerning the ethical use of human volunteers were followed during this research.

Results

The findings showed that 16% of the children were within normal weight range, 16.9% at risk of overweight, and 67.1% overweight. There was no statistically significant association between BMI-for-age and gender (P = 0.2) (Table 1). The mean ± SE of DFT in the normal weight, at risk of overweight and overweight groups were 0.34 ± 0.08, 1.23 ± 0.13 and 0.73 ± 0.05, respectively; and mean ± SE of dft were 2.01 ± 0.19, 2.76 ± 0.18 and 2.59 ± 0.13, respectively. Multiple linear regression showed that there was no statistically significant association between BMI-for-age and DFT (R = 0.06; CI: −0.01 to −0.09), and BMI-for-age and dft (R=0.07; CI: −0.003 to −0.046).

By taking the BMI-for-age into account, 27.7% of the children with normal weight were caries free, whereas only 14% of children at risk of overweight and 37.2% of the overweight children were caries free. There was statistically significant association between BMI-for-age and being caries free (P = 0.0001).

Table 1. Distribution of BMI-for-age according to gender in 6-11-year-old children

BMI-for-age / Gender	Normal weight n (%)	At risk of overweight n (%)	Overweight n (%)
Boys n = 317	50 (15.8)	45 (14.2)	222 (70)
Girls n = 316	51 (16.1)	62 (19.6)	203 (64.2)
Total n = 633	101 (16)	107 (16.9)	425 (67.1)

n: number

Table 2. Mean ± SE of DFT/dft indices and number (%) of caries free in 6-11-year-old children according to BMI-for-age

Index / BMI-for-age	dft Mean ± SE	DFT Mean ± SE	Caries free n (%)
Normal	2.01 ± 0.19	0.34 ± 0.08	28 (27.7)
At risk of overweight	2.76 ± 0.18	1.23 ± 0.13	15 (14)
Overweight	2.59 ± 0.13	0.73 ± 0.05	158 (37.2)
Total	2.52 ± 0.10	0.75 ± 0.04	201 (31.8)

Discussion

Given the causative relation between refined carbohydrates and dental caries, it is appropriate to hypothesize that overweight might also be a marker for dental caries in children and teenagers.[12] Although BMI is widely used to screen adults for obesity, its use in adolescents is controversial. BMI is a commonly used measure of adiposity, because it is easy to calculate, quick to measure, and noninvasive. Unfortunately, it is a fairly poor index in children unless age and gender are taken into consideration.[9] Therefore, BMI-for-age categories were used in this study which might produce controversial results compared to the other studies. Results of the present study showed the high prevalence of overweight and at risk of overweight in the 6-11-year-old children in Isfahan. There is a growing epidemy of overweight in Iran among children and teenagers.[4] A study showed that prevalence of overweight was 20.8% in 3-9 year-old children according to BMI.[1]

Palmer[10] implicated that the relationship between obesity and caries in children needs further exploration; it is clear that there are common denominators that both diseases share. Negative changes in eating and activity patterns, increased frequency of snacking and increased consumption of fermentable carbohydrates are common in both obesity and caries in children.

The mean DFT/dft indices in the normal weight children were less than children at risk of overweight and the overweight. The children at risk of overweight had the highest DFT/dft values. Although it was hypothesized that BMI-for-age would be associated with increased dental caries prevalence, there was no association between BMI-for-age and DFT/dft indices ($R \leq 0.07$). The relationship between nutrition and dental caries is complex because it is a multifactorial disease; oral hygiene, available nutrients, saliva, and oral flora influence dental caries. These results confirm other studies. Chen et al[20] investigated BMI index and dft score in three-year-old children. They concluded that there were no significant differences in the dft score of carious children among different BMI groups and there is no relationship between carious deciduous teeth and weight status. Kantovitz et al[21] in a systematic review on the relationship between obesity in childhood found that only one

study with high level of evidence showed direct association between obesity and dental caries. Macek & Mitola[12] concluded that there is no statistically significant association between BMI-for-age and dental caries prevalence for children in either dentition and overweight children with a positive history of dental caries in the permanent dentition exhibit fewer DMFT than do their normal weight peers. The authors found that overweight children aged 6-17 years had a significantly lower dental caries severity than did children of normal BMI-for-age.

The results of this study are in disagreement with some studies. Hilgers et al[9] found that the mean caries average for permanent molars significantly increased with increased BMI, even after adjusting for age and gender. They concluded that elevated BMI is associated with an increased incidence of permanent molar interproximal caries. Burt & Pai[22] reported that children of low birth weight subsequently developed more caries in the primary dentition than did children with normal to high birth weight. They concluded that this may be related to social deprivation factors during the development of the primary dentition. Willerhausen et al[23] indicated a strong association of obesity and caries in 1290 children of elementary schools in a city in Germany. Certainly obesity per se is not causal to caries. Another study found that there was a significant correlation between the BMI and caries frequency even after adjustment for the age of the children.[24] One Finnish study followed 516 children from birth to age 12 and used weight to predict caries experience (DMFT/dmft). The investigators reported that obesity alone was not a very good predictor of dental decay.[25]

The present study demonstrated a significant association between BMI-for-age and being caries free (P = 0.0001). This is in line with the results of the study of Willerhausen et al[23] that showed number of healthy teeth decreased with age and BMI. A Swedish study examined the relationship between dental caries and risk factors for atherosclerosis and reported that children with a DMFT score greater than 9 had significantly higher BMI-for-age values than caries-free children.[26]

Glick[27] noted that, while the consequences of obesity will have an indirect effect on oral conditions, this alone is not justification to get involved. Rather, there needs to be a stronger desire to have an impact on the patients' general health. These findings might also show that further investigation should be conducted to determine if an association exists between dental caries and BMI-for-age and to address what factors specific to overweight in children might be protective against dental caries especially in permanent dentition. The future preventive programs must include strategies for nutrition control to avoid obesity as well as dental caries.

Conclusions

There is a high prevalence of at risk of overweight and overweight in 6-11-year-old children in Isfahan. At risk of overweight and overweight children had higher DFT/dft score than did normal children, but there was no association between BMI-for-age and DFT/dft indices.

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