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Is there a correlation between dental caries and body mass index-for-age among adolescents in Iran?

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Aim Obesity in adolescents is a public health problem and is steadily increasing in many countries. The aim of this study was to investigate the association between age-and gender-specific body mass index (BMI-for-age) and dental caries among adolescents aged 12 -15 years in Rafsanjan, Iran. ***Materials and Methods*** Following ethical approval, 747 students aged 12-15 years were randomly selected from 12 state and private secondary schools in Rafsanjan, Iran. The DMFT index (following World Health Organization criteria) was used to assess the subjects' previous and existing dental caries experience. The BMI (Body Mass Index) percentile was calculated using BMI-for-age criteria as underweight (<5th percent), normal-weight (5th-85th percent), at risk of being overweight (>85th and <95th percent) and overweight (≥95th percent). ***Results*** Of 353 males and 394 females examined, 7.5% were underweight, 72.8% were normal-weight, 13.8% were at risk of being overweight, and 5.9% were overweight. The mean DMFT was 2.83. There was no significant difference between DMFT scores amongst the BMI-for-age groups (underweight = 2.91, normal-weight = 2.92, at risk of overweight = 2.54, overweight = 2.34, $p>0.05$). However, males were more likely to have caries than females (11% of males were caries-free, in comparison to 20.6% of females; $p<0.05$). ***Conclusion*** Almost one in five adolescents (19.7%) examined were deemed to be at risk of being overweight, or were classified as overweight. There was no association between DMFT scores and BMI-for-age scores.

Keywords: Adolescent, BMI-for-age, body mass index (BMI), dental caries, Iran, obesity.

Introduction

Obesity is now one of the most common public health problems of increasing importance in the developed world (Popkin, 2001). In some countries obesity has doubled within the last 20 years. Being overweight in adolescence is a predictor of subsequent adult obesity (Macek & Mitola, 2006); and obese adults have an increased risk of morbidity and mortality in adulthood (Freedman, *et al.,* 2001). The percentage of at risk of overweight and overweight adolescents in Iran is approximately 14.2-28.9%, and a significant rising trend has been recognized (Mohammadpour-Ahranjani, *et al.*, 2004).

The current global changes within the last decade towards consumption of soft drinks and fast food have led to significant dietary changes amongst the population. High sugar intake is reported to be more common among overweight and obese adolescents than those with normal weight; however frequent sugar intake is also recognized as a risk factor for dental caries (Macek & Mitola, 2006).

Among children and teenagers aged 2-20 years, body fat amounts 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 age-and gender-specific BMI values are referred to as "BMI-for-age". Categories describing amount of body fat for children and teenagers are also different from the categories describing amount of body fat in adults. BMI categories used for children and teenagers (in common with adult classifications) include underweight, normal-weight, at risk of overweight and overweight (Hong *et al.,* 2008). However, there is no obese category for children and teenagers (Hilgers *et al.,* 2006, Marshall *et al.*, 2007, Hong *et al.,* 2008).

Associations between weight and oral health has been suggested in adults, whereas evidence supporting this association in children is limited and controversial at best (Pinto *et al.*, 2007). While oral health is influenced by the daily intake of appropriate foods, oral heath can also play a significant role in nutritional intake and general status of health of the individual. Dental caries and obesity are both associated with dietary habits (Marshall *et al.*, 2007). It is well established that dental caries and frequent ingestion of refined carbohydrates are highly correlated. The World Health Organization (WHO) states that nutrition should be placed at the forefront of public health policies and programmes, because foods containing high sugar energy contribute to obesity and dental diseases (WHO, 2003). Controversially, some studies concluded that there was no significant association between dental caries and obesity (Macek & Mitola, 2006).

Given the causative relationship between refined carbohydrates and dental caries (Macek & Mitola, 2006), it is appropriate to hypothesize that increasing BMI-for-age might also be a marker for dental caries in adolescents. Therefore, the aim of this study was to determine the

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association between dental caries and BMI-for-age in 12-15 years adolescents in Rafsanjan, Iran.

Materials and Methods

This cross-sectional study was conducted from January to June 2008 in Rafsanjan, Iran. Ethical approval was obtained from the Ethics Committee at the Rafsanjan University of Medical Sciences. Using systematic/ cluster random sampling, a total 747 of students aged 12-15 years from 12 state and private secondary schools with different social backgrounds were selected. Approximately 60 – 80 students were chosen in each school. The sample size was estimated to allow for a caries prevalence of 60%, and precision of 0.05% (Sadeghi, 2007).

All the subjects who participated in the examinations were of Iranian nationality and were permanent residents of the Rafsanjan. Bodyweight was recorded to the nearest 100-gram using a standard digital scale (Hopeway Industrial Ltd. Guangdong, China) with the subject barefoot and wearing light dress. Body height was recorded to the nearest 0.5cm according to the following protocol: no shoes, heels together and head touching the ruler with line of sight aligned horizontally.

BMI-for-age percentiles [(weight in kilograms)/height in meters)^2] were calculated. The following classification was used (Centers for Disease Control and Prevention, 2006, Hong *et al*., 2008):

- "underweight" was defined as BMI-for-age <5th percentile;
- "normal-weight" was defined as 5th ≤ BMI-for-age <85th percentile;
- "at risk of overweight" was defined as 85th ≤ BMI-for-age <95th percentile;
- " overweight" was defined as BMI-for-age ≥95th percentile.

The students were examined in the school premises in suitable places with the subjects seated in ordinary chairs. In keeping with WHO criteria, the dental examinations were conducted with help of a lamp and using a cycle dental explorer (Medisporex Ltd. Sailkot, Pakistan), a plane mouth mirrors (Precision Dental International Inc, CA, USA) and cotton rolls to remove any plaque or debris (WHO, 1997).

To assess the caries frequency, the decayed, missing and filled teeth (DMFT) index was used (WHO, 1997). According to these criteria, a tooth is diagnosed as decayed if there is a change in tooth color and sticking of the dental explorer is retained. Alternatively carious lesions were diagnosed by the presence of cavitation. Dressed and restored teeth that had recurrent caries were also recorded as carious. Teeth filled with temporary materials were regarded as filled teeth; no radiographs were taken. White spots were not considered as decayed teeth. Teeth missing for orthodontics reasons were not included in the DMFT index. The numbers of caries-free subjects were also recorded.

All data were statistically analyzed by SPSS-16 software (SPSS® for Windows® v.16.0, Chicago, Ill., USA). The t-test, Chi-square and one-way ANOVA tests were used to test associations/ differences at a 5% significance level.

Results

In total, 747 adolescents (353 males and 394 females) were examined. The mean age was 13.1±1 years. The overall prevalence of underweight, normal-weight, at risk of overweight and overweight were 7.5%, 72.8%, 13.8% and 5.9%, respectively. There was no significant difference between gender and BMI-for-age scores (Table 1).

The overall mean ± SD of DMFT scores was 2.83±2.2. In the underweight, normal-weight, at risk of overweight and overweight groups, these values were 2.91±2.2, 2.92±2.3, 2.54±1.8 and 2.34±1.9, respectively. A one-way ANOVA test showed there was no significant difference between DMFT in each of the BMI-for-age scores. Linear regression also showed there was no statistically significant association between BMI-for-age and DMFT index.

In relation to gender, the mean DMFT values were significantly higher amongst male adolescents (mean and SD of DMFT values in males= 3.15±2.1 and females= 2.51±2.3, $p<0.05$). The percentage of subjects who were caries free was 16.1% (11% males and 20.6% females; $p<0.05$). The percentage of subjects who were caries free in each group was 16.1% in underweight, 15.1% in normal-weight, 17.5% in at risk of overweight and 25% in overweight adolescents. There was no statistically significant association between BMI-for-age and the frequency of caries-free subjects. The decayed teeth (DT) contributed the greatest proportion (72.8%) of the DMFT and the missing teeth (MT) contributing the least (5.7%) (Table 2).

Discussion

Global changes over the past decade have led to significant behavioral changes in populations, such as the increased consumption of soft drinks and fast food (Alm *et. al*, 2008), which, together with a lack of activity and less exercise, the increasing popularity of personal computers, influences by the media, and social changes in family structure, have contributed to the ever increasing number of overweight people worldwide. There is a growing epidemic of obesity in Iran among children and teenagers. It seems that increasing fat intake is one of the most important aspects of nutrition transition in Iran, which can somehow explain the changes that have occurred in the prevalence of obesity over the last 10 years (Mohammadpour-Ahranjani *et al.,* 2004). The World Health Organisation reports indicate that the DMFT index in Iran was 2, 1.5 and 1.8 in 1995, 1998 and 2003, respectively. It is also reported that more than 50% of 12-year-old children have caries experience, with the decayed component being the greatest component. (Pakshir, 2004). The natural fluoride content in the water supply in Rafsanjan City (where the study was performed) is between 0.3-0.7 ppm. Flouridated toothpastes and mouthrinses are commercially available locally. The Ministry of Health and Medical Education distribute flouride mouthrinses for use by school students. The Department of Community Dentistry arranges for school children to receive a dental check-up and oral hygiene instruction on an annual basis.

Table 1. Distribution of BMI-for-age according to gender among 747 12-15 years adolescents in Rafsanjan, Iran, 2008.

BMI-for-age / *Gender*	*Underweight n (%)*	*Normal-weight n (%)*	*At risk of overweight n (%)*	*Overweight n (%)*
Boys 353(47.3)	30(8.5)	252(71.4)	54(15.3)	17(4.8)
Girls 394(52.7)	26(6.6)	292(74.1)	49(12.4)	27(6.9)
Total 747(100)	56(7.5)	544(72.8)	103(13.8)	44(5.9)

Table 2: Mean ± SD of D, M and F compartments, and DMFT index and percentage of caries free among 747 12-15 years adolescents according to BMI-for-age in Rafsanjan, Iran, 2008.

Index / BMI-for-age	DMFT Category				
	DT Mean±SD	MT Mean±SD	FT Mean±SD	DMFT Mean±SD	Caries free n (%)
Underweight	2.16±2.2	0.18±0.6	0.57±1.1	2.91±2.2	9(7.5)
Normal-weight	2.10±2.1	0.16±0.5	0.66±1.4	2.92±2.3	82(68.3)
At risk of overweight	1.66±1.8	0.17±0.5	0.71±1.1	2.54±1.8	18(15)
Overweight	1.82±1.6	0.16±0.5	0.36±0.9	2.34±1.9	11(9.2)
Total	2.03±2.1	0.16±0.5	0.64±1.3	2.83±2.2	120(16.1)

Oral health is strongly influenced by the intake of sugar-rich foods and high dental caries incidences are associated with an unbalanced diet. Sugar-rich diets have been associated with various health problems such as obesity, bone loss and bone fractures (Bailleul-Forestier *et al.,* 2007). Obesity also could be a potential risk factor for periodontal disease; Wood *et al.* (2003) reported a positive correlation between BMI and the incidence and severity of periodontitis. Recent studies have identified an association between dental caries and overweight in adolescents, and have demonstrated that overweight or obese adolescents were more likely to have dental caries than normal-weight adolescents (Hilgers *et al.* 2006, Bailleul-Forestier *et al.*, 2007, Alm *et al.* 2008). However, some other studies reported no association between BMI-for-age and dental caries experience (Pinto *et al.,* 2007, Hong *et al.*, 2008). For example, Macek & Mitla (2006) found no significant association between BMI-for-age and dental caries among US children aged 2-17 years.

The main finding in this study was that underweight and overweight adolescents did not have more dental caries than normal-weight individuals. 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 DMFT index. This result is in agreement with a Finnish study that reported obesity alone is not a good predictor of dental caries in 5-13-year-olds (Tuomi, 1989). Our findings do not agree with those of Larsson *et al* (1995, 1997), who showed that adolescents with higher DMFT values tended to be obese. Alm *et al.* in two studies (Alm, 2008, Alm *et al.* 2008) demonstrated that overweight and obese adolescents had a significantly higher approximal caries than normal-weight individuals. The findings of this study illustrate that the relation between increasing BMI-for-age and dental caries is far more complex than can be explained by BMI alone. As the aetiology of dental caries is multifactorial in origin, other considerations such as dietary habits, oral hygiene, ethnicity and low socioeconomic status must be taken into account (Hilgers *et al.* 2006, Marshall *et al.*, 2007, Alm *et al.,* 2008). The results also demonstrate that the normal-weight adolescents were more unlikely to be caries free than other groups, again illustrating the multifactorial aetiology of dental caries. It should also be remembered that obesity is often associated with increased consumption of fats, which are not as cariogenic as dietary sugars. Notwithstanding this, obesity is a serious threat to general health and dental professionals have an important role to play in preventing this disease via their delivery of dietary counseling and health promotion, as well as in the management of dental caries.

It is well established that obesity has both genetic and environmental components; and distinguishing between the contributions of each in an observational study is not possible (Marshall *et al.,* 2007). Given the tremendous increase in the prevalence of obesity in children, dentists should promote a healthy diet not only to prevent dental decay but also to reduce the risk for obesity (Bailleul-Forestier *et al.*, 2007). However, the limitations of this study should also be considered including: its cross-sectional nature does not allow us to follow the

development of the identified carious lesions and future caries experience of the individual patients examined; the sensitivity of the caries diagnosis method (albeit the WHO guidelines were followed): this, and the fact that radiographic investigations were not used suggest a risk that the incidence of caries in some individuals was under-estimated, particularly in young teenagers where approximal caries is a problem. However the use of the WHO guidelines was practical, standardized and allows comparison of our results to those in other parts of the world. The lack of use of radiographs is also comparable to other studies; the use of radiographs in this study was not practical given the resources available.

Conclusion

Although it was hypothesized that age-and gender-specific body mass index (BMI-for-age) would be associated with increased dental caries prevalence, there was no association between BMI-for-age and DMFT index. Underweight and overweight adolescents did not have significantly more dental caries than normal-weight individuals. However, further studies are needed to better understand this relationship.

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