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TÜBİTAK

Original Article

The oral health status of healthy and obese children in a Turkish population: a cross-sectional study

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Aim: To compare the oral health status of a group of obese and healthy Turkish children.

Materials and methods: The study involved 43 healthy (19 boys and 24 girls, mean age: 9.88) and 53 obese (18 boys and 35 girls, mean age: 10.4) children who were admitted to a pediatric dentistry clinic in 2008 and 2009. The parents were asked to complete a questionnaire concerning medical history and dietary/oral hygiene habits. The number of decayed, missing, and filled permanent teeth (DMFT); number of decayed, missing, and filled primary teeth (dmft); and gingival bleeding index (GBI) scores of patients were recorded. Statistical differences were evaluated using Student's t-test and the Mann-Whitney U test and the nominal variables were tested with Pearson's chi-square test and Fisher's exact test ($P \leq 0.05$).

Results: The educational status of parents did not differ significantly between obese and healthy children ($P = 0.064$). On a daily basis, obese children consumed significantly more snacks ($P = 0.003$). The carbohydrate intake of healthy children was restricted to mealtimes ($P < 0.001$) while obese children consumed significantly more carbohydrates as snacks ($P < 0.001$). In both groups, the participants displayed similar oral hygiene habits and DMFT and dmft scores although GBI scores were significantly higher in obese children.

Conclusion: No relationship was found between obesity and the oral health status of the child population evaluated. Similar oral hygiene habits and socioeconomic status might have contributed to this result.

Key words: Childhood obesity, dental caries, gingival health

Introduction

The increasing prevalence of childhood obesity has become a serious health problem worldwide (1,2). Obesity is a risk factor for several diseases such as heart disease, hyperinsulinemia, hypertension, early atherosclerosis, and obstructive sleep apnea, as well as for the early onset of puberty in women (3,4). Environmental and genetic factors, the consumption of energy-dense and highly refined foods, dietary habits, and food insecurity have been identified as potential contributors to obesity (5,6). Although the contribution of genetic factors to obesity is not yet fully understood, a possible cause appears to be the variability in genes coding for hormones and neurotransmitters such as growth hormone, leptin, ghrelin, neuropeptide Y, and melanocortin (7).

Dental caries, the most prevalent chronic disease of childhood, is a significant public health problem known to affect 58.6% of children aged 5-12 years in the United States (8). In the search for possible associations between childhood obesity and dental caries, it has been demonstrated that childhood

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obesity is responsible for an increase in dental caries and alterations in dental development (9,10). Alm et al. (11) investigated the prevalence of approximal caries in the posterior teeth of 15 year olds and demonstrated that overweight or obese adolescents had a significantly higher prevalence of approximal caries than did normal weight individuals. However, a study by Chen et al. (12) failed to demonstrate any significant difference in the total decayed or filled primary tooth (dft) scores of child groups with different body mass indexes (BMIs). Similarly, no significant associations were found between childhood obesity and caries in the United States National Health and Nutrition Examination Survey carried out from 1999 to 2002 (13).

Because of conflicting results published thus far, Hilgers et al. (9) suggested that there is a need for future studies in order to assess the effect of obesity on caries, taking into account patient demographics and behavioral patterns. Therefore, the present cross-sectional study aimed to compare the dietary habits, oral hygiene, and dental caries rates of obese and healthy Turkish children. The study tested the null hypothesis that childhood obesity is not associated with a higher incidence of dental caries.

Materials and methods

Patient selection

This was a cross-sectional study conducted at a university pediatric dentistry clinic after approval was received from the institutional review board and informed consent from the participants' parents. Inclusion criteria stipulated that the children were living in an area without fluoridated drinking water and had not previously benefited from any form of systemic or professionally applied fluoride.

A questionnaire that assessed dietary habits, oral hygiene habits, familial health history, and socioeconomic status was implemented. Among patients who were admitted for regular check-ups between November 2008 and February 2009, 43 healthy (19 boys and 24 girls, mean age: 9.88) and 53 obese children (18 boys and 35 girls, mean age: 10.4) who met the inclusion criteria and whose parents agreed to their participation were included in the study. Children in the obese group had been previously diagnosed by the department of pediatric endocrinology at the same institution. Participants' BMI was calculated as weight (in kg) divided by height (in m^2). Participants with a BMI above the 95th percentile for their age and sex were classified as obese. Children in the control group were randomly chosen from among otherwise healthy patients admitted to the same pediatric dentistry clinic for regular dental visits in the absence of any dental complaint.

The questionnaire assessed the following criteria:

A. History: Medical history and family history of obesity

B. Parental educational status

C. Monthly income

D. Dietary habits: Snack eating (snack eating at school, snack eating before going to bed, and snack eating at any time during the day); breakfast eating status; chewing rapidly or slowly; large or small bite sizes; and intake of carbohydrates.

E. Oral hygiene habits: Tooth brushing at bedtime; tooth brushing in the morning; brushing with fluoridated toothpaste; using ultrasonic toothbrush; and using dental floss.

Clinical examination

The dental health status of patients was examined using number of decayed, missing, and filled permanent teeth (DMFT) and number of decayed, missing, and filled primary teeth (dmft) scores. The periodontal status was recorded in accordance with the gingival bleeding index (GBI), based on WHO criteria (14). An experienced pediatric dentist performed all intraoral examinations. During the visual examination, a dental explorer was used to confirm questionable caries findings (15). Dental caries, missing teeth, and restored teeth (DMFT, dmft) were diagnosed and recorded.

The GBI was evaluated by the same operator. In brief, a standard periodontal probe was used to measure the extent of gingival bleeding and periodontal destruction at the buccal and mesiobuccal sites. After gentle probing, the findings were categorized as bleeding or no bleeding. Additionally, parents were asked about the frequency of spontaneous bleeding and answers were categorized as "yes," "no," or "rarely."

Statistical analyses

All data were analyzed using SPSS (Version 11.5, SPSS Inc., Illinois, USA). Descriptive statistics included continuous data, shown as mean ± standard deviation, and categorical data, shown as frequency and contingency tables. Statistical differences between groups were evaluated using Student's t-test and the Mann-Whitney U test for continuous data, and the nominal variables were tested with Pearson's chi-square test and Fisher's exact test. For all analyses, a P-value of ≤0.05 was considered statistically significant.

Results

The systemic and oral hygiene status of obese and healthy children and their cariogenic food consumption and eating habits are presented in Tables 1-4. The mean ages of obese and healthy children were 10.4 and 9.88 years, respectively. Both sex and age showed homogeneity among the groups (P = 0.306 and P = 0.393, respectively). The socioeconomic statuses of families were similar for obese and healthy children (P > 0.05). The educational statuses of the mothers and fathers were also similar (P = 0.064), revealing that the majority of mothers had graduated from high school while the majority of fathers were college or university graduates. Obese children had significantly more systemic disease (P = 0.002) and obese relatives in their families (P < 0.001) than did healthy children, with the majority of reported systemic diseases being metabolic syndromes other than diabetes.

The evaluation of dietary habits showed that the majority of obese (86%) and healthy (99%) children had breakfast before starting the day. Obese children consumed significantly more snacks during the daytime and chewed significantly larger pieces of food while eating (P < 0.05 for both). Chewing time did not significantly differ among obese and healthy children (P = 0.960). Obese children consumed more carbohydrates as snacks while the carbohydrate intake of healthy children was restricted to mealtimes only (P < 0.001 for both; Table 4).

Significantly more healthy children than obese children brushed their teeth at night (P = 0.011) while tooth brushing in the morning did not differ among the obese and healthy groups. Other than tooth brushing at night, both obese and healthy children had similar oral hygiene habits. The majority of participants (75% of obese and 81.4% of healthy children) brushed their teeth with fluoridated toothpaste and a manual toothbrush. Only a few obese (9.4%) and healthy (11.6%) children reported the use of ultrasonic toothbrushes. The majority of the obese (51%) and a large proportion of healthy (41%) children did not use dental floss.

DMFT and dmft scores were similar between groups. However, GBI was significantly higher among obese children (P < 0.001) than among healthy children. In contrast, the frequency of spontaneous bleeding did not differ among obese and healthy children (P = 0.151) (Table 5).

Discussion

It is widely accepted that a BMI between the 85th and 95th percentiles is defined as overweight and a BMI greater than the 95th percentile defines obesity (16). However, cross-national differences may affect BMI values (17,18). For example, the 85th percentile of children of the United States, which brings the percentage of obesity to about 12.5%, fits into the 95th percentile of Brazilian children and the 90th percentile of British children (18). A recent study confirmed that data and curves of BMI values in

Table 1. Systemic statuses of obese and healthy children. Values are presented in percent (%).

	Obese children	Healthy children
Obesity in relatives	54.7*	4.7
Present systemic diseases	24.5**	0

* P = 0.002, ** P = 0.000

Table 2. Oral health statuses and oral hygiene habits of obese and healthy children. Values are presented in percent (%).

Criteria	Obese children	Healthy children
DMFT	0.43	1
dmft	1.64	2
Gingival bleeding (+)	84.8*	39.5
Tooth flossing	3.8	4.7
Tooth brushing at night	41.5**	67.4
Tooth brushing in the morning	34.0	44.2
Using an ultrasonic toothbrush	9.4	11.6
Using fluoridated toothpaste	75.5	81.4

* $P < 0.001$, ** $P = 0.011$

healthy Turkish children are compliant with those of Western countries (19). Thus, in the present study, the widely accepted cut-off values, in which a BMI between the 85th and 95th percentile indicates being overweight and a BMI greater than the 95th percentile equates to being obese, were used for the diagnosis of obesity.

Since the 2 prevalent diseases in this study, dental caries and obesity, are clearly related to the consumption of fermentable carbohydrates, it would be reasonable to assume that they would correlate well. However, most authors have failed to report a positive association between dental caries and obesity. Studies conducted within and outside the United States have reported conflicting results (9,12,13,20,21). In addition, obvious ethnic and cultural differences between countries may limit the applicability of the results of those studies to other nations. Obesity alone was found to be a poor predictor of dental caries in Finnish children aged between 7 and 16 years (20). However, the accuracy of predicting risk of dental caries increased after controlling for a history of dental caries and obesity (20). Larsson et al. (21) evaluated the relationship between dental caries and risk factors for atherosclerosis in Swedish adolescents. They compared DFS scores with obesity in 15-year-old children and found a significant positive correlation between DFS scores and BMI. The results of a recent study conducted in a Mexican population showed that children with a high BMI had

Table 3. Frequencies of carbonated beverage and carbohydrate consumption in obese and healthy children. Values are presented in percent (%).

	Carbonated beverages		Carbohydrates	
Frequency	Obese children	Healthy children	Obese children	Healthy children
1/day	11.3	7.0	11.3	7.0
2/day	1.9	7.0	1.9	7.0
4/day	1.9	0	1.9	0
1/week	34.0	30.2	34.0	30.2
2/week	11.3	14.0	11.3	14.0
3/week	1.9	2.3	1.9	2.3
4/week	1.9	2.3	1.9	2.3
None	35.8	37.2	35.8	37.2

Table 4. Eating habits of children. Values are presented in percent (%).

Criteria	Obese children	Healthy children
Carbohydrate intake between meals	73.6*	23.3
Carbohydrate intake during meals	24.5**	74.4
Eating fast	67.9	67.4
Chewing large pieces	60.4***	20.9
Number of snacks	2.38 (mean)****	1.44 (mean)
Having breakfast	86.8	97.7

* P < 0.001, ** P < 0.001, *** P < 0.001, **** P = 0.003

lower levels of dental caries in their primary teeth, whereas no association was detected between BMI and DMFS scores (22). Regarding these conflicting results, the authors stated that both dental caries and obesity are multifactorial diseases in which social and behavioral aspects play important roles. Thus, the different trends observed with respect to the association between obesity and dental caries reflect the complex etiology of both conditions.

The authors do not think that the systemic disease of obese children would affect the results. Although some diseases, such as Type 1 diabetes mellitus (T1DB), have been reported to be related with dental caries, a recent study failed to demonstrate the correlation (23). None of the children had T1DB in the present study. Obese children had other metabolic syndromes weakly related with dental caries or periodontal disease (24).

In the present study, both DMFT and dmft of obese and healthy children were similar, resulting in an acceptance of the null hypothesis. This might be due to 2 factors: First, the majority of participants brushed their teeth with fluoridated dentifrice at least once a day (in the morning). Second, and perhaps more importantly, the socioeconomic statuses of the parents in both groups were found to be similar. It has been previously documented that a high prevalence of caries is associated with low socioeconomic status (25); therefore, the similarity in DMFT and dmft among healthy and obese children in the present study could be attributed to the similarity of the socioeconomic status of the parents.

Compared with the relationship between obesity and dental caries, the association between periodontal disease and obesity is subtle, but has been widely acknowledged (26,27). Although the association is still under careful evaluation, possible mechanisms have been reported, including the interaction between salivary flora and gut flora. Obesity resulting from infection is known as "infectobesity" (28). It is estimated that approximately 1 g of bacteria (10^{11}) is swallowed with 500-1500 mL of saliva that is produced daily (29). It is therefore plausible that salivary microflora affect gastrointestinal microflora. A recent study demonstrated that 98.4% of overweight individuals were correctly identified by the presence of the bacterium *Selenomonas noxia* at a concentration greater than 1.05% of the total gut flora (28).

Table 5. Occurrence of spontaneous bleeding.

Occurrence of gingival bleeding	Obese children	Healthy children
Yes	10%	10%
No	30%	29%
Sometimes	13%	4%

Another mechanism underlying the link between periodontal disease and obesity may be related to inflammatory mediators, as it is well known that both conditions produce increased levels of inflammatory mediators (27,30). Since adipose tissue has been recognized as a reservoir for inflammatory cytokines, it has been suggested that obesity can affect periodontal disease (30). Although the present study did not directly aim to test the salivary microbiota or inflammatory mediators, GBI, which was assessed in this study, is the first and most common tool in the clinician's arsenal to assess periodontal health. Further research is required to confirm the association between obesity and gingival disease, as well as the mechanism underlying this correlation.

Along with the strict inclusion criteria regarding exposure to fluorides, the cross-sectional design of this study, which is inevitably limited by the sample size, can be regarded as a technical shortcoming that merits further improvement.

Conclusion

Although the frequency of spontaneous bleeding did not differ significantly between healthy and obese children, GBI was significantly higher in obese children. Thus, obesity should be recognized as a predisposing risk factor for gingival disease. This interpretation is noteworthy for both the pediatrician and the dentist who provide obese patients with counseling regarding healthy diets in childhood and adolescence.

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