International Journal of Dental Hygiene

Official Journal of the International Federation of Dental Hygienists

ORIGINAL ARTICLE

T Honne
K Pentapati
N Kumar
S Acharya

Relationship between obesity/overweight status, sugar consumption and dental caries among adolescents in South India

Authors' affiliations:
T Honne, Department of Public Health Dentistry, Bapuji Dental College and Hospital, Davangere, Karnataka, India
K Pentapati, Department of Community Dentistry, Manipal College of Dental Sciences, Manipal, Karnataka, India
N Kumar, Department of Prosthodontics, Bapuji Dental College and Hospital, Davangere, Karnataka, India
S Acharya, Community Dentistry, Manipal College of Dental Sciences, Manipal, Karnataka, India

Correspondence to:
T Honne
Department of Public Health Dentistry
Bapuji Dental College and Hospital
Main Road First Cross
Davangere
Karnataka 577004
India
Tel.: +91 9986016626
Fax: +91 08192 220578
E-mail: dentisttips@gmail.com

Abstract: *Objective:* To evaluate the relationship between obesity/overweight status, sugar consumption and dental caries among adolescents in Udupi District, India. *Methods:* Study population consisted of 463 school children aged between 13 and 15 years. Information on age, sex, type of school attending and frequency of sugar consumption per day was recorded by a structured self-administered questionnaire. Body mass index (BMI) (height in metres and weight in kilograms) and caries measurements (DMFT) were taken by a trained recorder according to standard criteria. *Results:* Majority of the children were having low normal weight, with 18.6% in overweight and 3.5% in obese groups. There was a significant difference in the frequency of sugar consumption between the BMI groups. Obese group of children had more caries than the overweight and low-normal-weight children. Correlation analysis showed significant positive relation with BMI, decayed teeth and DMFT. Regression analysis showed that caries experience had a significant association with male sex (OR = 2.09, CI = 1.01–4.33), overweight/obese (OR = 3.68, CI = 1.79–7.56) and frequency of sugar consumption more than once per day (OR = 3.13, CI = 1.25–7.85). *Conclusion:* There was a significant association between overweight/obesity and caries experience among school children of Udupi District. Obesity and dental caries have common risk determinants and require a comprehensive multidisciplinary approach to paediatric patients by both medical and dental healthcare professionals.

Key words: body mass index; dental caries; India; obesity; overweight; sugar consumption

Introduction

Obesity and overweight are defined as being an excess of body fat related to lean mass, with multifactor conditions involving psychological, biochemical, metabolic, anatomic and social alterations (1). Obesity has reached epidemic proportions globally, with more than 1 billion adults overweight – at least 300 million of them clinically obese – and is a major contributor to the global burden of chronic disease and disability. Often coexisting in developing countries with under-nutrition, obesity is a complex condition, with serious social and psychological dimensions, affecting virtually all ages and socio-economic groups [http://www.who.int/dietphysicalactivity/media/en/gsfs_obesity.pdf (accessed 26 January 2011)]. Studies

Dates:
Accepted 5 October 2011

To cite this article:
Int J Dent Hygiene **10**, 2012; 240–244
DOI: 10.1111/j.1601-5037.2011.00534.x
Honne T, Pentapati K, Kumar N, Acharya S. Relationship between obesity/overweight status, sugar consumption and dental caries among adolescents in South India.

from developing countries such as India report a high prevalence of obesity and overweight among school children (2–6).

A person's susceptibility to weight gain is mainly determined by genes, while energy balance is determined by calorie intake and physical activity concomitant with the role of genes. The societal changes and worldwide nutrition transition can be the driving force for the obesity epidemic. Economic growth, urbanization and globalization of food markets are some of the forces that can possibly influence this epidemic. As incomes rise and populations become more urban, diets rich in complex carbohydrates give way to more varied diets with a higher proportion of saturated fats and sugars [http://www.who.int/dietphysicalactivity/media/en/gsfs_obesity.pdf (accessed 26 January 2011)].

An increased caries experience is biologically plausible in obese/overweight children. Childhood obesity may also lead to serious diseases such as decrease in life expectancy, greater risk of type 2 diabetes, cardiovascular disease, asthma, arthritis and poor general health (7). Obese adolescents are more likely to become obese adults, posing an increased risk of morbidity and mortality in adulthood (8). Thus, the claimed eating pattern among overweight or obese children may be a common risk factor for obesity, caries and many other diet-related diseases. Studies conducted so far showed inconsistent association between dental caries and body adiposity (9, 10). Larsson *et al.* (11) and Alm *et al.* (12) reported that dental caries correlates positively with body mass index (BMI), while a systematic review of studies published from 1984 to 2004 showed an inconclusive relationship between obesity in dental caries (10). Although there are few studies in India reporting the high prevalence of obesity/overweight, the literature assessing the relationship with obesity and dental caries is seemingly scant (13). Therefore, the present study was conducted to evaluate the relationship between obesity/overweight status, sugar consumption and dental caries among 13- to 15-year-old school children of Udupi District, India.

Materials and methods

This study was carried out among a group of 463, 13- to 15-year-old school children studying in two private and two government schools located within the field practice area of Manipal University in Udupi District. This district had a total of 220 high schools of which 128 were government-run. This information was obtained from the district administration. As the distribution of the government and private schools was roughly the same, two government and two private schools were selected randomly using lottery method from the list of schools. No regular dental care programme was present in any of the selected schools. A pilot survey was conducted in one government and one private school with random selection of 50 students from class rooms. It showed that 49% of the children had decayed teeth (DT). The final sample size was thus calculated to be at least 385 children, with a confidence level of 95% and a sampling error of 5%. Written informed consent forms were distributed 1 week prior to the survey. All the children were asked to get these forms duly signed by either of the parent to express their willingness for participation in the study. Before conducting the survey, a verbal consent was obtained from the children after briefing about the purpose of the survey. Permission was obtained from school authorities prior to the study. The study was also approved by the Institutional Ethics Committee, Manipal University, Manipal, India. All children of 13–15 years of age who were present on the day of the survey and who gave consent for the study were included constituting a total sample of 463.

Demographic measures and sugar consumption

Information on age, sex, type of school attending and frequency of sugar consumption per day was recorded by a structured questionnaire. A close-ended self-administered questionnaire for assessing sugar consumption was used. The questionnaire had five items for the assessment of consumption of soft drinks, fruit juices, sweets, ice cream or biscuits with responses: (i) once a day (ii) twice a day (iii) thrice a day and (iv) more than thrice a day.

Body mass index

Obesity/overweight status was determined by calculating BMI. Anthropometric measures (weight in kilograms and height in metres) for the calculation of BMI were recorded by investigator himself (THM). Weight in kilograms was assessed using a standard physician's scale. Height in metres was measured using a Stadiometer (WS 021; Anand Medical Exports, Delhi, India). BMI was calculated by the formula weight/height^2. The adolescents were cluster-classified into three strata according to the international obesity task force cut-off values as low normal weight (BMI < 25), overweight (25–29.9) and obesity (BMI ≥ 30) (14).

Clinical examination

Caries for permanent dentition was assessed according to the guidelines given by WHO (1997) using plain mouth mirrors and CPI probes under natural day light. Decayed (DT), missing (MT) and filled teeth (FT) owing to caries were recorded for each individual and summarized as decayed, missing, filled teeth (DMFT) index by one of the calibrated investigator who was not aware of the BMI (PKC). Only teeth missing owing to caries were considered as missing. The investigator took the history regarding the cause of tooth loss at the time of clinical examination. The intraexaminer reliability for caries diagnosis was assessed by re-examining 10% of the sample, after 1 week of the first examination. Cohen's kappa coefficient for the assessment of dental caries was 0.92, indicating good intraexaminer agreement.

Statistical analysis

Chi-square test was performed for assessing differences between socio-demographic factors in relation to BMI strata.

ANOVA followed by *post hoc* Tukey's analysis was used to compare the differences in mean DT, MT, FT and DMFT among three strata of BMI. Spearman's rank correlation was performed to check the association between BMI and DT, MT, FT and DMFT. The variables frequency of sugar consumption (once per day and more than once per day), caries experience (DMFT of ≤4 and more than 4 using median split) and iso-BMI (low normal weight and overweight/obese groups) were dichotomized for logistic regression. Binomial logistic regression was performed using caries experience as dependent variable with predictor variables being age, sex, school, BMI and frequency of sugar consumption. All statistical analyses were performed using SPSS software version 17.0 (SPSS Inc., Chicago, IL, USA). A P value of <0.05 was considered statistically significant.

Results

A total of 475 of 481 children were present on the day of the examination in both private and government schools. Children with systemic diseases, with prolonged illness and who had undergone orthodontic treatment were excluded from the study (n = 12). The final sample constituted 463 children (252 boys and 211 girls). Majority of the children (361) had low normal weight, 18.6% (86) were overweight and 3.5% (15) were obese. There was a tendency, although not statistically significant, that girls more often were obese than boys (P = 0.231). There was no significant difference in the proportion of overweight/obese children among private and government schools (P = 0.152) (Table 1). All the participants had at least once per day sugar consumption. There was significant difference in the frequency of sugar consumption between the three BMI groups (P < 0.001) (Table 2).

There was a significant difference in mean DT and DMFT among the three groups of BMI (P < 0.001). *Post hoc* Tukey's test showed that obese and overweight children had more caries than low-normal-weight children (Table 3). Correlation analysis showed a significant weak positive relation between BMI and DT (r = 0.25, P < 0.001) and between BMI and DMFT (r = 0.24, P < 0.001).

Boys were more likely to have caries as compared to girls (OR = 2.09, CI = 1.01–4.33). Similarly, overweight/obese children had 3.67 times higher chance of having carious than low-normal-weight children (CI = 1.79–7.56). Children with more than once a day sugar consumption had higher chance of caries than who consumed once per day (OR = 3.13, CI = 1.25–7.85) (Table 4).

Table 1. **Frequency distribution of low-normal-weight, overweight and obese children in relation to demographics**

	Low normal weight *n* (%)	Overweight *n* (%)	Obesity *n* (%)	*P*-value
Sex				
Male	204 (56.5)	40 (46.5)	8 (50)	NS
Female	157 (43.5)	46 (53.5)	8 (50)	
School				
Private	221 (61.2)	61 (70.9)	12 (75)	NS
Government	140 (38.8)	25 (29.1)	4 (25)	

$P \leq 0.05$ was considered significant.

Table 2. **Frequency of sugar consumption in relation to body mass index groups**

	Low normal weight *n* (%)	Overweight *n* (%)	Obesity *n* (%)	*P*-value
Frequency of sugar consumption				
Once per day	171 (47.4)	19 (22.1)	2 (12.5)	<0.001
Greater than once per day	190 (52.6)	67 (77.9)	14 (87.5)	

$P \leq 0.05$ was considered significant.

Table 3. **Caries experience among the three body mass index (BMI) groups**

BMI	Mean	SD	*P*-value	*Post hoc* comparisons
DT				
Low normal weight (1)	1.49	1.54	<0.001	2 > 1, 3 > 1
Overweight (2)	2.41	1.80		
Obesity (3)	3.44	2.31		
MT				
Low normal weight (1)	0.06	0.34	NS	–
Overweight (2)	0.05	0.21		
Obesity (3)	0.00	0.00		
FT				
Low normal weight (1)	0.10	0.46	NS	–
Overweight (2)	0.10	0.43		
Obesity (3)	0.31	1.25		
DMFT				
Low normal weight (1)	1.66	1.62	<0.001	3 > 2 > 1
Overweight (2)	2.56	1.86		
Obesity (3)	3.75	2.44		

$P \leq 0.05$ was considered significant; figures in parenthesis depict groups for *post hoc* comparisons.
DT, decayed teeth; MT, missing teeth; FT, filled teeth; DMFT, decayed, missing, filled teeth score; BMI, body mass index.

Discussion

The study of dental caries and its associated factors remains a daunting task to the healthcare professionals owing to its multifactorial nature. Owing to recent increase in global prevalence of obesity, a plausible biological gradient between obesity and dental caries was proposed in the literature using diet as a common risk factor. A systematic review by Kantovitz *et al.* (10) reported inconclusive results.

Evidence from national health surveys in Asia points significant differences in prevalence of overweight and obesity among countries. Rapid economic growth has improved the nutritional, socio-economic and health status of many countries. Obesity has increased markedly with this nutritional

Table 4. **Multivariate analysis to determine the possible risk factors for caries occurrence in the study population**

	d.f.	*P*-value	Adjusted odds ratio	95% confidence interval	
				Lower	Upper
Age	1	0.192	1.36	0.86	2.14
School (private)	1	0.924	0.97	0.47	2.00
Sex (boys)	1	0.047	2.09	1.01	4.33
BMI (overweight/obese)	1	0.000	3.68	1.79	7.56
Frequency of sugar consumption (more than once)	1	0.015	3.13	1.25	7.85

$P \leq 0.05$ was considered significant.

evolution in most Asian countries. A similar nutritional transition is under way in India as well. The prevalence of obesity among children in the present study was higher than that reported by Mohan *et al.* (15) but lower than that reported by Sharma and Hegde (13). This could be due to difference in lifestyle and cultural practices between the two regions.

The mean DMFT in the present study population was considered low according to WHO criteria. Little or no association was found between BMI and caries scores in some previous reports (16, 17). On the contrary, elevated BMI was found to be associated with increased dental caries in other studies (18, 19). The present study showed that overweight and obese children had higher caries experience than low-normal-weight children. Major component of the DMFT score constituted DT owing to which there were significant differences between BMI groups with respect to mean DT and DMFT. The association between caries and sugar consumption to a great extent has disappeared in the developed countries, probably due to massive preventive measures such as use of fluorides both in self-care (fluoridated dentifrices and mouth rinses) and at dental clinics (topical fluoride applications), whereas in developing countries, this relationship can still be observed. When caries prevalence is very low, the relationships between overweight/obesity and caries could not be established (20). Boys in the current study were more likely to have caries than girls. This could be attributed to the fact that because Indian society is a patriarchal one, boys are given importance in food preferences and availability. Adolescent girls express larger interest in maintaining healthy lifestyle practices. These might be associated with gender differences in prevalence of caries.

Many factors contribute to obesity, but evidence does not single out dietary sugar as a cause (21). On the other hand, dental caries is a chronic multifactorial disease whose risk factors include sugars, oral bacteria, food substrate and host susceptibility (22). A possible factor in the relationship between obesity and dental decay was the tendency of frequent snacking on food high in fat with sugar or sugar alone among children. Previous studies of caries-related factors showed that caries-associated dietary habits during infancy are maintained throughout early childhood (12). Consequently, it was assumed that early established behaviour with a high-sucrose intake appears to persist during childhood and adolescence. In future preventive programmes, the strategies should aim at reducing frequency of intake of sugars to avoid both overweight/obesity and caries. Established measures such as fluoride applications can also be easily incorporated in such programmes to prevent caries in this high-risk group.

Caries prevalence (23) and obesity/overweight (2, 4) in India, similar to those in western countries, have shown a strong association with socio-economic circumstances as reported by various investigators. Our results are in agreement with previous studies reporting on this association (13). Limitations of this study include its cross-sectional nature and self-reported sugar consumption. Also, in the present study, type of school attended was taken as proxy measure to assess the socio-economic status. Caries was diagnosed as per WHO recommendations under natural day light using mouth mirror and CPI probe. This method is widely followed in oral health surveys and acceptable for countries like India where resources are scant. Obesity and dental caries being complex issues with multifactorial aetiology, our analysis was limited to dietary and demographic characteristics. Further follow-up studies are recommended to evaluate the relationship between sugar consumption, caries and obesity.

Conclusion

Overweight/obesity and dental caries experience were significantly associated in school children of Udupi District. The prevalence of overweight/obesity was higher among those with higher frequency of sugar consumption. Both obesity and dental caries have common risk determinants and require a comprehensive multidisciplinary approach to paediatric patients by both medical and dental healthcare professionals. Furthermore, longitudinal studies are needed to explore the relationship between obesity, dental caries and sugar consumption.

References

1 Taubes G. As obesity rates rise, experts struggle to explain why. *Science* 1998; **29:** 289–291.
2 Chhatwal J, Verma M, Riar SK. Obesity among pre-adolescent and adolescents of a developing country (India). *Asia Pac J Clin Nutr* 2004; **13:** 231–235.
3 Ramachandran A, Snehalatha C, Vinitha R *et al.* Prevalence of overweight in urban Indian adolescent school children. *Diabetes Res Clin Pract* 2002; **57:** 185–190.
4 Marwaha RK, Tandon N, Singh Y, Aggarwal R, Grewal K, Mani K. A study of growth parameters and prevalence of overweight and obesity in school children from Delhi. *Indian Pediatr* 2006; **43:** 943–952.
5 Khadilkar VV, Khadilkar AV. Prevalence of obesity in affluent school boys in Pune. *Indian Pediatr* 2004; **41:** 857–858.
6 Kapil U, Singh P, Pathak P, Dwivedi SN, Bhasin S. Prevalence of obesity amongst affluent adolescent school children in Delhi. *Indian Pediatr* 2002; **39:** 449–452.

7 Sinha R, Fisch G, Teague B. Prevalence of impaired glucose tolerance among children and adolescents with marked obesity. *N Engl J Med* 2002; **46:** 802–810.
8 Freedman DS, Khan LK, Dietz WH, Srinivasan SR, Berebson GS. Relationship of childhood obesity to coronary heart disease risk factors in adulthood: the Bogalusa heart study. *Pediatrics* 2001; **08:** 712–718.
9 Gerdin EW, Angbratt M, Aronsson K, Eriksson E, Johansson I. Dental caries and body mass index by socio-economic status in Swedish children. *Community Dent Oral Epidemiol* 2008; **36:** 459–465.
10 Kantovitz KR, Pascon FM, Rontani RM, Gaviao MB. Obesity and dental caries – a systematic review. *Oral Health Prev Dent* 2006; **4:** 137–144.
11 Larsson B, Johansson I, Hallmans G, Ericson T. Relationship between dental caries and risk factors for atherosclerosis in Swedish adolescents? *Community Dent Oral Epidemiol* 1995; **23:** 205–210.
12 Alm A, Isaksson H, Fåhraeus C *et al.* Body adiposity status in teenagers and snacking habits in early childhood in relation to approximal caries at 15 years of age. *Int J Pediatr Dent* 2008; **18:** 189–196.
13 Sharma A, Hegde AM. Relationship between body mass index, caries experience and dietary preferences in children. *J Clin Pediatr Dent* 2009; **34:** 49–52.
14 Cole TJ, Bellizzi MC, Flegal KM, Dietz WH. Establishing a standard definition for child overweight and obesity worldwide: international study. *BMJ* 2000; **320:** 1240–1243.
15 Mohan B, Kumar N, Aslam N *et al.* Prevalence of sustained hypertension and obesity in urban and rural school going children in Ludhiana. *Indian Heart J* 2004; **56:** 310–314.
16 Macek MD, David MJ. Exploring the association between overweight and dental caries among US children. *Pediatr Dent* 2006; **28:** 375–380.
17 Tuomi T. Pilot study on obesity in caries prediction. *Community Dent Oral Epidemiol* 1989; **17:** 289–291.
18 Willershausen B, Haas G, Krummenauer F, Hohenfellner K. Relationship between high weight and caries frequency in German elementary school children. *Eu J Med Res* 2004; **31:** 400–404.
19 Hilgers KK, Kinane DF, Scheetz JP. Association between childhood obesity and smooth surface caries in posterior teeth: a preliminary study. *Pediatr Dent* 2006; **28:** 23–28.
20 Ismail AI, Tanzer JM, Dingle JL. Current trends of sugar consumption in developing societies. *Community Dent Oral Epidemiol* 1997; **25:** 438–443.
21 Gibson SA. Are high fat, high sugar foods and diets conductive to obesity? *Int J Food Sci Nutr* 1996; **47:** 405–415.
22 Dye B, Shenkin J, Ogden C, Marshal T, Levy S, Kanellis M. The relationship between healthful eating practices and dental caries in children aged 2–5 years in the United States, 1988–1994. *J Am Dent Assoc* 2004; **135:** 55–66.
23 Acharya S, Pentapati KC, Singh S. Influence of socioeconomic status on the relationship between locus of control and oral health. *Oral Health Prev Dent* 2011; **9:** 9–16.