Relationship between Body Mass Index and Dental Caries among Adolescent Children in South India

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ABSTRACT

Objective: *To evaluate the relationship between body mass index (BMI) and dental caries and to study the role of sweet consumption in predicting this relationship among adolescent children in Udupi district, India.*

Methods: *The study population consisted of 463 school children in the 13−15-year age group. Anthropometric (height in metres and weight in kilograms) and caries measurements and decayed missing filled teeth (DMFT) index, were carried out by a trained recorder according to standard criteria.*

Results: *The majority of the children were having low normal weight (BMI < 25) with 18.6% classified as overweight (BMI 25−29.9) and 3.5% as obese (BMI ≥ 30). The frequency of sweet consumption significantly increased from low normal weight children to overweight and obese children. Analysis showed that the 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 (DT) [r = 0.254,* $p < 0.001$*] and DMFT (r = 0.242,* $p < 0.001$*). Binomial logistic regression showed that males (OR = 2.09, CI = 1.01, 4.33), obese/overweight children (OR = 3.68, CI = 1.79, 7.56) and those who consumed sweets more than once a day (OR = 3.13, CI = 1.25, 7.85) were more likely to have high caries experience.*

Conclusion: *There was a significant association between overweight/obesity and caries experience among school children of the Udupi district. Obesity and dental caries have common risk determinants and require a comprehensive multidisciplinary approach by both medical and dental healthcare professionals.*

Keywords: Body mass index, dental caries, India, obesity, overweight.

La Relación entre el Índice de Masa Corporal y las caries Dentales entre los Adolescentes en el sur de la India

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RESUMEN

Objetivo: *Evaluar la relación entre el índice de masa corporal (IMC) y las caries dentales y estudiar el papel del consumo de dulces en la predicción de esta relación entre los adolescente en el distrito de Udupi, India.*

Métodos: *El estudio de la población consistió en 463 niños escolares en el grupo etario de 13 a 15 años. Las mediciones antropométricas (altura en metros y peso en kilogramos) y de las caries – índice de dientes cariados, perdidos, u obturados (DMFT) fueron realizadas por un registrador entrenado, de acuerdo con criterios estándar.*

Resultados: *La mayoría de los niños estaba teniendo peso normal bajo (IMC < 25) con 18.6% clasificados como sobrepeso (IMC 25-29.9) y 3.5% como obesos (IMC ≥ 30). La frecuencia de consumo de dulce aumentó significativamente de bajo en niños de peso normal a niños con sobrepeso y*

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obesos. El análisis mostró que los niños en el grupo de obesos tenían más caries que los niños con sobrepeso y los niños de peso normal bajo. El análisis de la correlación mostró una relación significativamente positiva con el IMC, los dientes cariados (DT) [r = 0.254, p < *0.001] y DMFT (r = 0.242,* p < *0.001). La regresión logística binomial mostró que los varones (OR = 2.09, CI = 1.01, 4.33), los niños obesos y pasados de peso (OR = 3.68, CI = 1.79, 7.56) y aquéllos que consumían dulces más de una vez al día (OR = 3.13, CI = 1.25, 7.85) tenían mayor probabilidad de presentar serios problemas de caries.*

Conclusión: *Hubo una asociación significativa entre el sobrepeso/obesidad y la presencia de caries entre los escolares del distrito de Udupi. La obesidad y la caries dentales tienen determinantes de riesgo en común y requieren un enfoque multidisciplinario integral por parte de los profesionales de la atención tanto médica como odontológica.*

Palabras claves: Índice de masa corporal, caries dentales, India, obesidad, sobrepeso

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INTRODUCTION

Obesity and overweight are defined as having an excess of body fat related to lean mass, with multifactorial conditions involving psychological, biochemical, metabolic, anatomic and social alterations (1). Low normal weight was defined as body mass index (BMI) < 25, overweight as BMI 25−29.9 and obesity as BMI ≥ 30. Obesity has reached epidemic proportions globally, with more than 1 billion adults overweight – at least 300 million of them clinically obese – and it is a major contributor to the global burden of chronic disease and disability (2). Often coexisting in developing countries with undernutrition, obesity is a complex condition, with serious social and psychological dimensions, affecting virtually all ages and socio-economic groups (2). Recent studies on urban Indian school children report a high prevalence of obese and overweight children (3−7).

While genes are important in determining a person's susceptibility to weight gain, energy balance is determined by calorie intake and physical activity. Thus societal changes and worldwide nutrition transition are driving the obesity epidemic. Economic growth, modernization, urbanization and globalization of food markets are some of the forces that can possible influence this epidemic. As incomes rise and populations become more urban, diets high in complex carbohydrates give way to more varied diets with a higher proportion of fats (saturated fats) and sugars (2).

Although an increased carious experience is biologically plausible in obese/overweight children, childhood obesity may also lead to serious diseases, decrease in life expectancy, greater risk for Type 2 diabetes, cardiovascular disease risk factors, asthma, arthritis and poor general health (8). Obese adolescents are more likely to become obese adults, posing an increased risk of morbidity and mortality in adulthood (9). Thus, the claimed eating pattern among overweight or obese children may be a common risk factor for overweight, caries and many other diet-related diseases. Studies conducted so far in developed countries showed inconsistent association between dental caries and body adiposity (10, 11). Larsson *et al* (12) and Alm *et al* (13) reported that dental caries correlate positively with BMI while a systematic review of studies published from 1984 to 2004 showed an inconclusive relationship between obesity in dental caries (11). Although there are a few studies in India reporting the high prevalence of obesity/overweight, the literature assessing the relationship of obesity and dental caries is seemingly scant (14). Therefore, the present study was conducted to evaluate the relationship between BMI, dental caries and frequency of sweet consumption among 13 to 15-year old school children of the Udupi district, India.

SUBJECTS AND METHODS

This study was carried out among a group of 463, 13−15-year old school children studying in two private and two government schools located within the field practice area of the Manipal College of Dental Sciences in Udupi District. This district had a total of 220 high schools of which 128 were government run and the remaining was privately run. This information was obtained from the district administration. Since the distribution of the government and private schools was roughly the same, two government and two private schools were randomly selected from the list of schools. Pilot survey showed that the prevalence of decayed teeth was 49%. 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%. 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. Children with systemic diseases, prolonged illnesses and those who had undergone orthodontic treatment were excluded from the study. Calibration and training for measurement of clinical indices were done in the Department of Public Health Dentistry, Manipal College of Dental Sciences, Manipal University. The University Ethics Committee, Manipal University, Manipal, approved the study.

Anthropometric measurements were recorded by the investigator himself (THM) using standardized procedure.

Weight in kilograms was assessed using a standard physician's scale. Height in metres was measured using a Stadiometer (WS 021, Anand Medical Exports, and Delhi). Body adiposity status was determined by calculating BMI (weight/height^2). The adolescents were cluster classified into three strata using age-specific body mass index values (isoBMI) given by the international obesity task force (15) *ie*, low normal weight (isoBMI < 25), overweight (isoBMI 25−29.9) and obesity (isoBMI ≥ 30).

A specially designed questionnaire was used to collect information on age, gender, type of school attending and frequency of sweet consumption per day. Responses regarding 'consumption of sweets' such as soft drinks, fruit juices, sweets, ice cream, or biscuits, were stratified into four groups: (i) once a day, (ii) twice a day, (iii) thrice a day and (iv) more than thrice a day. These were categorized into once per day and more than once per day for the final analysis. This was followed by clinical examination done by one of the calibrated investigators using DMFT index given by WHO (1997). Cohen's Kappa coefficient for assessment of dental caries was 0.92, indicating good intra-examiner agreement.

Chi-square test was used for assessing differences between sociodemographic factors and the three BMI strata. ANOVA followed by Post hoc Tukey's analysis was used to compare the differences in mean decayed teeth (DT), missing teeth (MT), filled teeth (FT) and DMFT among three strata of BMI. Spearman's ranked correlation was done to check the association between BMI and DT, MT, FT and DMFT. Binomial logistic regression was done using caries experience as dependent variable. All statistical analyses were performed using SPSS software version 17.0. A *p*-value of < 0.05 was considered statistically significant.

RESULTS

A total of 475 children were present on the day of the examination in both private and government schools out of which 12 children were excluded from the study. Final sample constituted 463 children (252 boys and 211 girls). The majority of the children (78.1%) had low normal weight, 18.6% (86) were overweight and 3.5% (16) were obese. More girls were overweight/obese than boys although the difference was not significant ($p = 0.231$). There was no significant difference in proportion of overweight/obese children among private and government schools ($p = 0.152$). There was significant difference between the frequency of sweet consumption and the three BMI groups [$p < 0.001$] (Table 1).

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 children had more caries than the overweight and low normal weight children (Table 2). Correlation analysis showed a significant positive relation between BMI and DT (r = 0.254, $p < 0.001$) and BMI and DMFT [r = 0.242, $p < 0.001$] (Table 3).

The responses for frequency of sweet consumption (once per day and more than once per day), caries experience (DMFT of ≤ 4 and more than 4) and isoBMI (low normal weight and overweight/obese groups) were dichotomized for the logistic regression analysis. Male subjects had significantly higher carious experience than females (OR = 2.09, CI

Table 1: Distribution of low normal weight, overweight and obese children in relation to demographics and frequency of sweet consumption

Variable		Low normal weight n (%)	Overweight n (%)	Obesity n (%)	Total n (%)
Sex	Male	204 (56.51)	40 (46.51)	8 (50)	252 (54.43)
	Female	157 (43.49)	46 (53.49)	8 (50)	211 (45.57)
School	Private	221 (61.22)	61 (70.93)	12 (75)	294 (63.5)
	Government	140 (38.78)	25 (29.07)	4 (25)	169 (36.5)
Frequency of sweet consumption*	Once	171 (47.37)	19 (22.09)	2 (12.5)	192 (41.47)
	Twice	112 (31.02)	25 (29.07)	1 (6.25)	138 (29.81)
	Thrice	41 (11.36)	22 (25.58)	5 (31.25)	68 (14.69)
	> Thrice	37 (10.25)	20 (23.26)	8 (50)	65 (14.04)
Total		**361 (78.1)**	**86 (18.6)**	**16 (3.5)**	**463**

* $p \leq 0.05$ was significant

Table 2: Caries experience among the three BMI strata

	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	0.708	–
	Overweight (2)	0.05	0.21		
	Obesity (3)	0.00	0.00		
FT	Low normal weight (1)	0.10	0.46	0.263	–
	Overweight (2)	0.10	0.43		
	Obesity (3)	0.31	1.25		
	Low normal weight (1)	1.66	1.62	**< 0.001**	**3 > 2 > 1**
DMFT	Overweight (2)	2.56	1.86		
	Obesity (3)	3.75	2.44		

$p \leq 0.05$ was considered significant

DT: Decayed Teeth, MT: Missing Teeth, FT: Filled Teeth, DMFT: Decayed Missing Filled Teeth, BMI: Body Mass Index

Table 3: Correlation analysis between strata of BMI and DT, MT, FT and DMFT

	Spearman's rho	DT	MT	FT	DMFT
	Correlation coefficient	0.254 (**)	-0.010	0.013	0.242 (**)
BMI	*p*-value	**< 0.001**	0.837	0.774	**< 0.001**
	n	463	463	463	463

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

DT: Decayed Teeth, MT: Missing Teeth, FT: Filled Teeth, DMFT: Decayed Missing Filled Teeth, BMI: Body Mass Index

= 1.01, 4.33). Similarly, overweight/obese children had a 3.67 times higher chance of having carious teeth than low normal weight children (CI = 1.79, 7.56). Children who consumed sweets more than once a day had a higher chance of caries than those who consumed once per day [OR = 3.13, CI = 1.25, 7.85] (Table 4).

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

Variable	df	*p*-value	Adjusted Odds ratio	95% CI Lower	Upper
Age	1	0.192	1.36	0.86	2.14
School (private)	1	0.924	0.97	0.47	2.00
Sex (male)	1	**0.047**	2.09	1.01	4.33
BMI (Overweight/obese)	1	**< 0.001**	3.68	1.79	7.56
Frequency of sweet consumption (More than once)	1	**0.015**	3.13	1.25	7.85

$p \leq 0.05$ was considered significant

Binomial logistic regression with predictor variables being age, sex (female – reference category) school (government school – reference category), BMI (low normal weight-reference category) and frequency of sweet consumption (once daily-reference category). Outcome variable being caries experience. df – degrees of freedom, CI – confidence interval

DISCUSSION

The study of dental caries and its associated factors remains a daunting task to the healthcare professional due to its multifactorial nature. Due 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. Although previous studies showed equivocal results, a systematic review by Kantovitz *et al* (11) reported inconclusive results.

Evidence from national health surveys in Asia points to 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 evolution in most Asian countries. A similar nutritional transition is underway in India as well. The prevalence of obesity among children in the present study was higher than that reported by Mohan *et al* (16), in Ludhiana, but lower than that reported by Sharma and Hegde in Mangalore (14). This finding may be due to different sampling techniques and to differences 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 (17, 18). On the contrary, elevated BMI was found to be associated with increased dental caries in other studies (19, 20). The present study showed that overweight and obese children had higher caries experience than low normal weight children.

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, saliva, tooth enamel, 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 or sugar among children. Barkeling *et al* (23) showed that the mutans streptococcus count correlated with BMI and intake of sweet foods. Previous studies of caries-related factors showed that caries associated dietary habits during infancy are maintained throughout early childhood. 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 snacks and fermentable carbohydrates to avoid overweight/obesity and caries.

Limitations of this study include its cross-sectional nature and self-reporting of consumption of sweets. Also in the present study, type of school attended was taken as proxy measure to assess socio-economic status. Obesity and dental caries are complex issues with multifactorial aetiology; our analysis was limited to dietary and demographic characteristics. Further follow-up studies are recommended to evaluate the triangular relationship between consumption of sweets, caries and obesity.

CONCLUSION

Overweight/obesity and dental caries experience were significantly associated in school children of the Udupi district. The percentage of overweight/obese children significantly increased with frequency of sweet 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. Further, longitudinal studies are needed to explore the triangular association of obesity, dental caries and sweet consumption.

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