



RELATIONSHIP BETWEEN BMI AND CARIES EXPERIENCE AMONG 15 YEAR OLD STUDENTS IN INDIA – A CROSS SECTIONAL STUDY

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ABSTRACT

Background: The growing prevalence of increased obesity has raised steadily both in developed and developing countries. Being overweight in adolescence is a predictor of subsequent adult obesity. Obesity has adverse effects on general health and numerous comorbidities. Oral diseases are one such group of obesity comorbidities, and dental caries is considered as one among the oral diseases sharing some common risk factors with obesity. **Aim:** To assess the relationship between body mass index and dental caries experience among 15 year old students in Davangere city.

Methods: A cross sectional survey was conducted among 1200, 15 year old students from government and private high schools in Davangere city. With the help of self-designed pretested proforma details regarding socio-demographic characteristics of the subjects were obtained. Body mass index was measured using Quetlet's Index and dental caries experience was assessed by using DMFT index. The data obtained was analyzed using unpaired t test, one-way Analysis of variance and Multivariate logistic regression analysis.

Results: Caries experience was high among obese subjects compared to underweight and normal weight subjects but this was not statistically significant.

Conclusion: Body Mass Index was not significantly associated with dental caries experience among 15 year old students in Davangere city.

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INTRODUCTION

Obesity is a multifactorial disorder, influenced by environmental and genetic risk factors, where a sustained imbalance between energy intake and energy expenditure facilitates storage of excess energy as fat.¹ Obesity is defined as an abnormal growth of adipose tissue due to enlargement of fat cell size (hypertrophic obesity) or an increase in fat cell number (hyperplastic obesity) or a combination of both.²

Obesity is a “global epidemic disease” across various countries around the world as quoted by WHO.³ It is one of the most common public health problems of increasing importance. In some countries, obesity has doubled within the last twenty years. In India the problem of obesity has been scantily explored in the affluent population groups. Being overweight in adolescence is a predictor of subsequent adult obesity and obese adults have a increased risk of morbidity and mortality. In addition to obesity's direct adverse effects on general health, numerous comorbidities are the focus of

scientific investigations, many of which have common risk factors with complex implications on health. Oral diseases are one such group of obesity comorbidities, and dental caries is considered as one among the oral diseases sharing some common risk factors with obesity.⁴ Dental caries is a “multi-factorial disease” that affects most populations throughout the world. It is the common cause of oral pain and tooth loss.⁵ It is defined as an irreversible microbial disease of the calcified tissues of the teeth, characterized by demineralization of the inorganic portion and destruction of the organic substance of the tooth, which often leads to cavitation.⁶ There are recent studies that report alarming increases in caries prevalence worldwide.⁷ According to National Oral Health Survey conducted in India in the year 2004, dental caries was found in 51.9% of five year-old children, 53.8% of 12 year-old children and 63.1% of 15 year-old teenagers.⁸

Obesity and dental caries are considered as global epidemics and both are health problems of modern era. Improper dietary habits and lifestyle are implicated in the occurrence of both the health problems. Dietary patterns over years like increased consumption of soft drinks, fast food, high intake of refine

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sugars have led to significant dietary changes amongst populations and are considered to be common risk factors for obesity as well as dental caries.²

Given the strong evidence supporting the association of dental caries with irregular dietary patterns and quality and the fact that abnormal dietary intake has been linked to the development of obesity at young age, a link between dental caries and body weight is biologically plausible. Perhaps, obesity in children and adolescents can be considered as a predictor of dental caries.

Certain studies conducted in many countries have found the association between dental caries and Body Mass Index,^{1,3,5,9} while some studies have shown no association between dental caries and Body Mass Index (BMI).^{4,10,11} Inconsistent and varying results have been reported even in India with respect to association between BMI and dental caries.^{12,13,14} In the wake of such an equipoise, a cross-sectional survey was designed to assess the relationship between body mass index (BMI) and dental caries experience among 15 year old students in Davangere city.

MATERIALS AND METHODS

The present study is a “*descriptive, cross sectional study*” conducted to assess the relationship between body mass index and dental caries experience among 1200 fifteen year old students in Davangere city. Permission to conduct the study was obtained from the Directorate of Department of Public Health Instructions, Principal of the each school and Principal of Bapuji Dental College and Hospital. Ethical approval was obtained from the Institutional Review Board, Bapuji Dental College and Hospital. Voluntary written informed consent from the guardians and assent from the study participants were obtained

A self-designed format was used to record all relevant data pertaining to study which had five sections. *First section* was designed to record demographic details like Participants’ age, gender, occupation, residential address and family income. *Second section* had a provision to record oral hygiene practices. *Third section* included provision to record dietary habits. *Fourth section* included provision to record body mass index. *Last section* included tables to record Dental caries experience and Oral hygiene status.

Dental caries experience was assessed using Decayed, Missing and Filled Teeth Index (DMFT) with modified criteria given by WHO in 1986¹⁵ and Oral hygiene status was assessed using Oral Hygiene Index Simplified (OHIS) index.¹⁶ The proforma was scrutinized for its feasibility by conducting a pilot study involving 8% of calculated sample size.

Sample size was calculated using the formula for descriptive design. The prevalence of dental caries required for calculating the sample size was taken from the previous study¹⁷. The significance level (type I error) was fixed at 5% with the probability of committing type II error was 20%. The power of the study was fixed at 80%. The final sample size was calculated and it was found to be 1200 subjects. Multistage sampling technique was employed to select the study subjects. Davangere district is an administrative district of Karnataka state in southern India. It is arbitrarily divided into four zones (North east, North West, South east and South

west) for administrative purposes. One government high school and three private high schools were selected from each zone of the city randomly and from each zone 300 students (150 from government and 150 from private schools) were randomly selected.

Subjects were selected based on the selection criteria. Subjects of fifteen years old studying in high schools of Davangere city were included in the study, while subjects suffering from systemic diseases like asthma, juvenile diabetes and epilepsy, subjects under medications for systemic diseases, subjects on antibiotics in the last three months, subjects undergoing orthodontic treatment, subjects who were mentally retarded and physically handicapped were excluded from the study.

Intra examiner calibration was done by assessing fifteen subjects on whom investigator applied the self-designed format and recorded the findings. The kappa coefficient scores were 0.88 and 0.78 with respect to DMFT index and OHIS index respectively. Examiner was calibrated to match a benchmark. Kappa co-efficient values for inter examiner reliability with respect to DMFT index and OHIS index were 0.88 and 0.77 respectively.

Information regarding sociodemographic details, oral hygiene practices and dietary habits was asked and recorded from each participant, with the help of predesigned and pretested proforma, followed by clinical examination. Weight of the subjects was recorded using a weighing machine which was calibrated daily and expressed in terms of kilograms. Height was recorded using measuring tape and expressed in terms of meters. The subjects were made to sit comfortably on a chair with back rest and the oral cavity was examined under natural lighting condition. Body mass index was calculated using Quetlet’s index developed by WHO² and it was classified as age specific BMI according to International Classification System for childhood obesity (isoBMI)¹⁸.

Statistical analyses were performed using a personal computer with Statistical Package for Social Sciences software (SPSS version 19, USA). Data comparison was done by applying specific statistical tests to find out the statistical significance of the obtained results. Depending upon the nature of the data, the statistical tests were chosen.

1. One-way ANOVA test was used to compare mean DMFT scores in different BMI groups.
2. Unpaired t test was used to compare mean DMFT between two different groups.
3. Multivariate regression analyses done was to check the association between BMI and dental caries by controlling the confounding variables.

RESULTS

The study was conducted to assess the relationship between Body Mass Index and Dental caries experience among 15 year old students in Davangere city. Totally 1200 subjects participated in the study.

Among 1200 study subjects majority were male subjects 631 (52.6%) compared to female subjects 569 (47.4%). Overweight and obese categories were clubbed under ‘obese group’. Out of 1200 study subjects, underweight children 789 (65.74%) were more when compared to normal weight

children 341 (28.41%) and obese children 70(5.85%) [Table 1].

Table 1 Distribution of study subjects based on Body Mass Index (BMI)

BMI	Number of subjects n (%)
Underweight	789 (65.74)
Normal	341 (28.41)
Obese	70 (5.85)
Total	1200 (100)

Socio-economic status (SES) was categorized according to Kuppuswamy’s classification (2010), according to which SES is divided into five classes. For the convenience of data analysis, Class I (Upper) was considered as High SES, Class II and Class III were considered as Middle SES and Class IV and Class V (Upper lower and Lower) were considered as Lower SES. As there were very less number of subjects in the upper SES class, it was clubbed with the middle SES class for the purpose of statistical analysis. Mean DMFT (0.8962) of lower SES subjects was significantly high compared to mean DMFT (0.7074) of middle SES subjects (p = 0.009). [Table 2] In the underweight and obese group, the mean DMFT was significantly higher among females compared to males with p value 0.6601 and 0.9947 respectively. In normal weight subjects, there was no significant difference seen in DMFT values between both gender.

Table 2 Distribution of mean DMFT among study subjects based on socio-economic status (SES)

SES	Number of subjects n (%)	Mean DMFT	t value	p value
Middle	728 (60.66)	0.7074	2.632	0.009*
Lower	472 (39.33)	0.8962		

As there were very few subjects (4) who had poor oral hygiene status they were considered in fair oral hygiene status. The mean DMFT was significantly higher among the subjects with fair oral hygiene status (0.9531) when compared to subjects with good oral hygiene status (0/7302) (p=0.007).[Table 3]

Table 3 Distribution of mean DMFT among study subjects based on oral hygiene status (OHIS)

OHIS	Number of subjects n (%)	Mean DMFT	t value	p value
Good	923 (76.91)	0.7302	2.680	0.007*
Fair	277 (23.08)	0.9531		

Most of the subjects (59.66%) brushed their teeth more than once a day when compared to 40.33% subjects who brushed only once a day. There was no significant difference between mean DMFT of those who brushed once a day and those who brushed more than once a day. Majority of the subjects (78.5%) rinsed their mouth daily while rest (21.5%) did not rinse. However, no significant difference in mean DMFT was found between the two groups.

Out of 1200 subjects, 38.75% subjects consumed sweets less than thrice a week and 61.25% of the subjects consumed sweets thrice or more than thrice a week. Mean DMFT was more among the subjects who consumed sweets thrice or more than thrice a week compared to those who consumed

less than thrice a week. This was not statistically significant. No significant difference was found in mean DMFT between the subjects consuming snacks less than twice a day and subjects consuming snacks twice or more than twice a day.

Majority of the subjects in this study were underweight (65.75%), while rest were (28.41%) normal weight and very few subjects (5.83%) were obese. The caries experience was higher among obese subjects compared to normal and underweight subjects but this was not statistical significant (p = 0.901).[Table 4]

Table 4 Distribution of mean DMFT among study subjects based on Body Mass Index (BMI)

BMI	Number of subjects n (%)	Mean DMFT	F value	p value
Underweight	789 (65.75)	0.7744	0.105	0.901 (NS)
Normal	341 (28.41)	0.7859		
Obese	70 (5.83)	0.8429		

NS = Not statistically significant difference
F = table value of ANOVA test

The dependent variable that is caries experience was dichotomized to dental caries (present/absent). Independent variables considered for analysis were BMI, SES, OHIS, gender and type of school. Multivariate adjusted logistic regression analysis showed no significant association between caries experience and obesity when adjusted for oral hygiene status, socioeconomic status, gender and type of school. Highly significant association was found between socioeconomic status and dental caries experience. [Table 5]

Table 5 Multivariate adjusted logistic regression analysis between dependent variable (DMFT) and independent variables (BMI, OHIS, SES, gender and type of school)

	B (slope)	S.E.	df	p value	OR
OHIS	-.005	.141	1	0.970	0.995
BMI	-.132	.101	1	0.191	0.876
SES	.458	.123	1	0.000(HS)	1.580
Gender	.072	.120	1	0.549	1.074
Type of school	-.180	.121	1	0.137	0.835
Constant	-1.122	.420	1	0.008	

HS = highly significant association between SES and DMFT
S.E = standard error
df = degrees of freedom
OR = odds ratio

DISCUSSION

“We are what we eat”, is an adage that has withstood the tests of time. Today’s world has been adapted to a system of consumption of foods which has several adverse effects on health. Globalization and urbanization have greatly affected eating habits of people and have forced many to consume fancy and high calorie fast foods. Unhealthy eating patterns among children and adolescents have resulted in prevalence of obesity and its associated disorders worldwide. Most of the chronic diseases (modern day diseases) are associated with obesity.

Obesity is a major public health problem not only in developed countries, but also in developing countries.¹⁹ The World Health Organization (WHO) predicts that overweight and obesity may soon replace more traditional public health concerns such as under nutrition and infectious diseases as the most significant cause of poor health.²⁰ Obesity appears to influence the general health as well as the oral health of an individual. Childhood obesity and dental caries are

coincidental in many populations, due to the common confounding risk factors such as diet intake frequency, cariogenic diet, and poor oral health.²¹

Dental caries and obesity share common risk factors such as dietary habits and lifestyle. Hence a relation between dental caries and obesity is biological plausible. Results of this study showed that there was no statistically significant association found between BMI and dental caries experience among 15 year old students in Davangere city. Few studies have shown similar results^{22,23,24} while some studies have shown significant association between obesity and dental caries.^{25,26,27}

The dental caries experience of the female subjects was significantly high compared to male subjects. Similar findings were reported in the study conducted by Norberg.C *et al*¹⁰ and by Honne.T *et al*¹². Higher caries prevalence among females is often explained by one of three factors: 1) earlier eruption of teeth in girls, and longer exposure to the cariogenic oral environment; 2) proximity of women to food supplies and snacking during food preparation; and 3) hormonal influences.²⁸

The caries experience among lower SES class was significantly high when compared to middle SES class. Similar findings were observed in few studies.^{8,29} Higher caries experience among lower SES class children perhaps may be attributed to unhealthy dietary practices, poor oral hygiene practices, lack of awareness about oral health, and unaffordability to the cost of dental care.⁸

The mean DMFT of the subjects with fair oral hygiene status was significantly high when compared to subjects who were having good oral hygiene status which is in agreement with the previous studies.^{30,31,32} The findings of this results can be attributed to the fact that good oral hygiene creates unfavourable environment for microbial colonization which is necessary for caries development.

No significant difference was observed in mean DMFT between the subjects with different brushing frequency. Similarly, no significant difference was found in mean DMFT between the subjects who rinsed their mouth and who didn't rinse their mouth daily. Similar findings were reported in the few studies where no association was found between oral hygiene practices and dental caries experience.^{33,34}

Data regarding dietary habits was collected using open ended questions regarding frequency of consumption of sweets, snacks and soft drinks/beverages. There was a huge variation in the frequency of consumption which ranged from zero to fifteen times per day/week. For the purpose of data analysis, the frequency of intake of sweets, snacks and soft drinks/beverages were stratified into two groups.

Subjects who consumed snacks less than twice a day and those who consumed snacks twice or more than twice a day had more or less similar mean DMFT with no significant difference between the two groups. Consistent results were found in the few studies where there was no significant association between dietary habits and dental caries.^{35,36}

In the present study association between independent variables that is oral hygiene status, socio-economic status, body mass index, gender and type of school with dental caries experience (present/absent) was studied using logistic regression analysis. Results showed that only socio-economic

status was significantly associated with caries experience, while other independent variables were not associated with caries experience.

The findings of this study suggests that BMI alone cannot be considered as a risk indicator of dental caries experience. Perhaps, obesity along with other factors like oral hygiene status, socio-economic status, gender and type of school can contribute to increase caries experience among children.

Although, the relationship between obesity and dental caries is obscure in the present study, few studies have shown a strong relationship between obesity and dental caries. Reasons could be attributed to common risk factors like lifestyle and unhealthy dietary habits for both the diseases. It is desired to conduct studies further to explore and clarify the association between obesity and caries experience and extend such studies further.

This study has few limitations of its own concerned with huge variation among distribution of study subjects between BMI groups. Being cross-sectional study it can at best provide a glimpse of association but in order to have comprehensive information on association between obesity and dental caries one should conduct carefully planned longitudinal studies and analytical studies.

CONCLUSIONS

There was no significant difference in the caries experience of 15 year old subjects belonging to different body mass index. Caries experience was high among obese and non-obese female subjects compared to obese and non-obese male subjects. Caries experience was higher among lower socio-economic status children compared to middle socio-economic status children. Also, caries experience was higher among subjects with fair oral hygiene compared to subjects with good oral hygiene. And there was no significant association between body mass index and dental caries experience.

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