ORIGINAL RESEARCH

Is there any Association between Dental Caries and Body Mass Index among 8–10 Years Pediatric Clinic Attenders in Chandigarh Area? A Correlation Study

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Abstract

Aim: To evaluate the correlation between dental caries and obesity in 8–10 years school children of Chandigarh, India.

Materials and methods: Around 100 children of the age range of 8–10 years who attended the Pediatrics OPD of Dr Harvansh Singh Judge Institute of Dental Sciences & Hospital, Chandigarh, India were selected.

Four groups were made group I—25 healthy teeth and nonobese (HNO) children, group II—25 carious teeth and nonobese (CNO) children, group III—25 healthy teeth and obese (HO) children, and group IV—carious teeth and obese (CO) children. Caries score was recorded after careful examination. Stadiometer and balanced beam scale were used to measure height (m) and weight (kg), and body mass index (BMI) (kg/m^2) was calculated. One-way analysis of variance (ANOVA) and Mann–Whitney *U* tests were used to assess the data outcome.

Results: The overall mean BMI was 26.2 [standard deviation (SD) = 5.2). Nonparametric test was performed using Poisson regression which showed no significant association between BMI and decayed, missing, and filled teeth/decayed, extracted, or filled (DMFdef) ($p = 0.807$). The severity of dental caries was evaluated by using a multivariate logistic regression analysis to see the association between dental caries as a binary dependent variable (low and high), and BMI as the independent variable. Statistically insignificant results were obtained ($p = 0.841$).

Conclusion: The study conducted by us showed no association between caries and obesity but the long-term effect of caries on general health cannot be ignored. The proper measures which are taken to improve oral health can indirectly alter the risk factors for obesity thus improving both oral and general health of an individual.

Keywords: Body mass index, Child, Dental caries, Obesity.

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Introduction

Obesity is considered a multifactorial disease that has serious effects on the overall health of an individual. The global prevalence of childhood obesity varies from 8 to 30%.[1] According to The Indian Council of Medical Research (ICMR) study in 2015 the prevalence rate of obesity was 11.8–31.3% and this rate increase to 40% by 2021 according to Venkatrao study, 2021[2] which is quite a high showing that it is a most neglected public health problem.

The prevalence of caries in India according to a meta-analysis by Janakiram et al., 2018[3] in the age range of 5–12 years was reported to be 49%, which increased from 15 years onward to 60%. The mean from 5–12 years was 2.36 but for 15 years it was 3.331.

Both caries and obesity have a common etiology which is related to dietary habits, lifestyle factors and socioeconomic, genetic, and environmental factors. Therefore, it seems all the more logical to say that obesity and dental caries have a possible correlation between themselves.

Many studies had been conducted worldwide to investigate the correlation between caries and body mass index (BMI). However, controversial and inconclusive results have been found every time. Various studies conducted by Honne et.al 2012,[4] Basha et al., [5] and Mohamed et al.,[6] showed that caries and BMI are directly related to each other. No correlation was seen between caries and BMI in the studies by D'Mello et.al,[7] Wu et al.,[8] Chakravarthy et al.,[9] and Swaminathan et al.[10] While the systematic reviews of studies published from 1984 to 2004 by Kantovitz et al.,[11] review by Silva et al.,[12] took studies published from 2005 to 2012 and articles published from 2011 to 2017 were reviewed by Chen et al.,2018[13] showed an inconclusive relationship between obesity and dental caries. The reason might be that both of the conditions have a complex and multifactorial etiology and contributing factors. The other reason could be that the data was inconsistent.[6]

Although there have been inconclusive results seen regarding the association between caries and BMI, this relation has not been evaluated in Chandigarh children, and ICMR studies from 2008 to 2010 done to see the prevalence rate of obesity in three states Tamil Naidu,

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Maharashtra, Jharkhand, and a union territory, that is, Chandigarh, observed the highest prevalence of obesity amongst Chandigarh children (14.6%).[14] Therefore, this study was done to see whether caries and obesity are correlated with each other or not in Chandigarh school children aged 8–10 years.

Materials and Methods

Study Design

A cross-sectional and descriptive study was conducted among 100 children aged 8–10 years who visited the dental clinics of Dr Harvansh Singh Judge Institute of Dental Sciences & Hospital, Chandigarh, India. The study was approved by the PU Research Committee and granted by PURSE grant with sanction no 2252/IDS. The sample size was calculated based on the difference in mean BMI for carious (20.71) and noncarious children (16.68) from previous studies.[4,5,7,8] The sample size calculated was 23 patients per group at a power of 95% and a confidence interval of 95%. To compensate for dropouts, we decided to include 25 patients per group.

Inclusion Criteria

Children aged 8–10 years who gave written consent for participating in the study were selected.

Exclusion Criteria

The exclusion criteria included children with systemic diseases like children undergoing chemotherapy and radiotherapy, and any syndromal children. Children whose parents did not sign the consent form were not selected for the study.

Participants' Screening and Recruitment

An experienced pediatric dentist conducted the oral examination according to World Health Organization (WHO) (1997) criteria. Since the age-group selected is mixed dentition, so decayed, missing, and filled teeth (DMF), decayed, extracted, or filled (def) index was recorded. The DMF and def index were recorded according to WHO criteria. The visual and tactile method was used to record caries without using radiographs. The intraexaminer calibration was done with respect to the caries diagnostic criteria. The κ-value came out to be 0.82 with $p < 0.005$ for caries which is statistically significant. The prevalence of caries was calculated as children having (def ≥ 1). The severity of the caries category was determined by the 50th percentiles of caries index distribution (def ≥ 4 and def ≤ 4).

Anthropometric Measurement

The body weight was recorded using a standard beam balance scale. The patients were wearing a light dresses and were barefoot while recording the weight. The balance was calibrated at the beginning of each weighing. The body height was recorded to the nearest 0.5 cm with no shoes, heels, and the head touching the scale. One person and one assistant were deputed to note all the readings, so as to avoid any error. BMI was calculated using the standard formula.

Only obese children with BMI (30.0–40) and normal children with BMI (18.5–24.9) were selected for the study.

Study Design

The study design was cross-sectional and descriptive. Four groups were made out of children examined.

- Group I: Healthy teeth and nonobese (HNO) included 25 subjects with no caries and nonobese (BMI ≤ 30).
- Group II: Carious teeth and nonobese (CNO) included 25 subjects with caries and nonobese (BMI ≤ 30).
- Group III: Healthy teeth and obese (HO) included 25 subjects with no caries and obese (BMI ≥ 30).
- Group IV: Carious teeth and obese (CO) included 25 subjects with caries and obese (BMI ≥ 30).

Statistical Analysis

Collected data were tabulated and the Statistical Package for the Social Sciences software package was used to analyze it. Data were analyzed by inferential and descriptive statistics. Descriptive statistics include frequency distribution of all the subjects in different groups along with mean and standard deviation (SD) for DMF and BMI. The comparison of frequencies of demographic variables between children with or without caries was done by using the Chi-squared test. Inferential statistical analysis included the student *t*-test and analysis of variance (ANOVA) test. To see the difference in BMI between caries groups and caries-free groups. Student *t*-test was used.

The parametric data were expressed as means and SD and ANOVA test was carried out to determine the significant differences in parametric data (BI%) between tested groups. To find statistically significant differences in nonparametric data between tested groups Mann–Whitney *U* test was used in the study. The correlation between clinical parameters (caries) and obesity parameters (BMI) was done by Spearman's rank correlation analysis. To find the influence of different factors affecting DMFdef; a multivariate regression analysis was carried out. The $p < 0.05$ was regarded as statistically significant.

Results

A total of 100 subjects in the age range of 8–10 years constituted the final sample.

Around 56% of the subjects were males and 44% were females as shown in Table 1. Almost equal% of obese children were seen

Table 1: Characteristics of participating children

	HNO	*CNO*	*HO*	*CO*	*Total*	
	Count with%	*Count with%*	*Count with%*	*Count with%*	*Count with%*	*p-value*
Gender						0.808
Males	14 (25%)	16 (28.6%)	13 (23.2%)	13 (23.2%)	56 (100%)	
Females	11 (25%)	9 (20.5%)	12 (27.3%)	12 (27.3%)	44 (100%)	
Age						<0.001
8 years	2 (25%)	0 (0%)	6 (75%)	0 (0%)	8 (100%)	
9 years	8 (16.3%)	18 (36.6%)	0 (0%)	23 (46.9%)	49 (100%)	
10 years	15 (34.9%)	7 (16.3%)	19 (44.2%)	2 (4.7%)	43 (100%)	

CO, carious teeth & obese; CNO, carious teeth & nonobese; HO, healthy teeth & obese; HNO, healthy teeth non obese

among males (26%) and females (24%) with statistically insignificant results ($p = 0.808$). Caries experience was significantly different with respect to age in all four groups ($p < 0.001$).

Table 2 represents the anthropometric status of the children. A statistically significant difference was seen between different groups in relation to BMI and weight ($p < 0.001$), but the result was not statistically significant in relation to BMI and height ($p = 0.465$). The mean BMI was found to be 26.3 + 5.2.

The caries prevalence in this study was 50% and out of that 48% had severe caries as shown in Table 3. The mean DMF index for HO, CO, HNO, and CNO, which was 0.00 ± 0.0, 4.04 ± 2.26, 0.00 ± 0.00, and 3.64 + 1.8, respectively with *p*-value < 0.001 and the def for HO, CO, HNO, and CNO were 0.00 ± 0.00, 3.12 ± 1.16, 0.00 ± 0.00, and 3.44 ± 1.08, respectively with $p < 0.001$. Mean numbers of decayed teeth (D) was higher in obese carious children (4.04 + 2.26) than the nonobese carious group (3.64 + 1.86).

Table 4 shows the relationship between BMI and dental caries in multiple regression analysis with total DMFdef as the dependent variable and BMI as the independent variable. A statistically insignificant association was seen between BMI and caries (*p*-value = 0.790).

Table 5 shows the distribution of caries experience of children in all four groups. Almost equal % of children with severe caries were seen in groups II and IV children (52.1 and 47.9%, respectively).

Table 6 shows a nonparametric correlation between BMI and caries using Spearman's ρ test and it was seen that the results were

Table 2: Anthropometric status of study subjects

	All children	*HNO*	*CNO*	*HO*	*CO*		*Children with differing severities of caries*		
Variables	*Mean ± SD*	*Mean ± SD*	*Mean ± SD*	*Mean ± SD*	*Mean ± SD*	*p-value*	*def ≤ 4*	*def ≥4*	*p-value*
Height (cm)	139 ± 6.68	140 ± 5.3	141 ± 5.2	139 ± 8.4	138 ± 7.2	0.465	140 ± 4.44	139 ± 6.3	0.754
Weight (kg)	42.5 ± 3.7	42.5 ± 3.7	43.5 ± 3.8	61.3 ± 6.9	61.2 ± 7.08	<0.001	62.5 ± 3.55	51.4 ± 10.9	0.180
BMI	26.6 ± 5.2	21.5 ± 1.5	21.6 ± 1.9	31.13 ± 1.0	32.08 ± 1.8	<0.001	31.7 ± 2.12	26.3 ± 5.5	0.343

CO, carious teeth & obese; CNO, carious teeth & non obese; HO, healthy teeth & obese; HNO, healthy teeth non obese

Table 3: Mean DMFdef and prevalence of dental caries

Parameter	*Prevalence of caries def ≥ 1*	*Prevalence of severe caries def ≥ 4*	*DMF*	*p-value*	*def*	*p-value*
All	50%	48%		<0.001		<0.001
HNO	0%	0%	0.00 ± 0.00		0.00 ± 0.000	
CNO	50%	47.9%	4.04 ± 2.26		3.12 ± 1.166	
HO	0%	0%	0.00 ± 0.00		0.00 ± 0.00	
CO	50%	%	3.64 ± 1.86		3.44 ± 1.083	

Table 4: Multiple regression analysis of total DMFdef (dependant variable) with BMI (independent variable) among 100 children (coefficients[a])

Variable	*R-value*	*R 2 change*	*95% CI*	*p-value*	*β-coefficient*	*Standard error*
BMI (constant)	0.027	0.001	−0.130 ± 0.171	0.790	0.027	0.076

a, dependant variable: total DMFdef; CI, confidence interval

Table 5: Distribution of groups according to caries experience of participating children

	Caries experience		*Children with differing severities of caries*	
Group	*def = 0*	*def ≥ 1*	*def ≤ 4*	*def ≥ 4*
HNO	25 (50%)	0 (0.0%)	25 (48.1%)	0 (0.0%)
CNO	0 (0%)	25 (50.0%)	0 (0.0%)	25 (52.1%)
HO	25 (50%)	0 (0.0%)	25 (48.1%)	0 (0.0%)
CO	0 (0%)	25 (50.0%)	2 (3.8%)	23 (47.9%)

Table 6: Nonparametric correlation between BMI and caries using Spearman's ρ

			DMF	*def*	*Total DMFdef*	*(D + d) total decayed teeth*	*BMI*
Spearman's ρ	BMI	Correlation coefficient	0.040	0.031	0.042	0.146	1.00
		Significance	0.690	0.758	0.681	0.149	
	Total DMFdef	Correlation coefficient	0.985	0.932	1.00	0.924	0.042
		Significance	0.00	0.00		0.00	0.681
	(D + d) total decayed teeth	Correlation coefficient	0.915	0.904	0.852	1.00	0.146
		Significance	0.00	0.000	0.000		0.149

Correlation significant at the 0.01 level

statistically not significant (p = 0.681) showing that obesity and caries are not associated with each other in our study.

Discussion

In our study, a comparison was done between caries prevalence and mean DMFdefbetween the four groups. The logistic regression model showed that BMI and caries were not correlated with each other. Before discussing the results of this study, it is appropriate to enlist the limitations of this study. The major limitation of the study was the small population size taken, as this could not make the results of the association between caries and obesity more generalized. Another limitation was the method used for caries detection was visual examination as per WHO guidelines, therefore, underreporting of the caries was done. So, the use of bitewing radiographs and the International caries detection & assessment system should be used to prevent underreporting. Other limitations included the nature of the study used which was cross-sectional and no information was gathered on dietary habits.

Dental caries is a multifactorial disease. Both obesity and caries share a common risk factor that is, diet. A controversial correlation has always been seen whenever a link between caries and obesity has been founded. A systematic review of studies done by Kantovitz et al.[11] and Silva et al.,[12] showed no correlation between BMI and dental caries. Our study results were similar to the studies done by Tambelini et al.,[15] Chen et al.,[16] on preschool children, Moreira et al.,[17] Wu et al.,[8] D'Mello et al.,[7] and Yen et al.[18] However the studies were done by Willershausen et al.,[19] Honne et al.,[4] Chakravarthy et al.,[9] Alswat et al.,[20] and Mohammed et al.,[6] were not in agreement to the results of our study. The reason could be that our study was done in a developing country like India as compared to other studies done in developed countries. This could have led to differences in dietary patterns and better preventive fluoride programs adopted in developed countries which led to fewer caries but caused obesity. Another reason could be due to excessive intake of foods rich in fat which causes less influence on caries and less sugary intake.[21]

Till now only one study has been conducted by Chakravarthy et al.,[9] to find the association between height and dental caries so that a deep association of caries with obesity is looked into. Our results were not in association with Chakravarthy et al.,[9] who showed significant association as compared to ours where the results were statistically insignificant (p = 0.856).

Decayed, missing and filled teeth (DMF) and decayed, extracted, or filled (def) index were higher in the CNO group (4,3) and CO children (3,3) as compared to normal weight children (0,0) and HO (0,0). But the results did not show a significant association between caries and obesity (p = 0.681). The results were in disagreement with studies were done by Bailleul-Forestier et al.,[22] where the obese group's average DMFT was 6.9 compared to 4.3 in the NO group, and significant results were seen between obesity and caries. Another study by Tuomi et al.,[23] done in Sweden showed a DMFT index value over nine for obese children than nonobese children. This difference may be due to differences in study design.

The overall prevalence rate of caries in our study was 50% (Table 3) which was in accordance to the prevalence rate of studies done by Yen et al.,[17] which was 73%.

Till the date, studies have been carried out where the association was seen only between carious teeth and obese children but ours is the first study where we have divided children into obese and nonobese children and further they were divided into children with healthy teeth and children with carious teeth, making four groups (HNO, CNO, CO, and HO) where the relation between obesity and caries was seen more thoroughly.

Although, it was seen that the caries prevalence rate was high in the Chandigarh population still caries and obesity were not associated with each other. The reason could be that Chandigarh is having a high literacy rate, so the people were aware of the fluoridated toothpaste, and use of fluorides and the children were taking a high fat-rich diet which makes the children obese but cause little influence on caries progression than a diet rich in sugars. This could add to the reason for the lack of any link between dental caries and obesity.

Obesity at present is considered an important nutritional disorder and is considered a risk factor for many diseases which are chronic in nature like diabetes, cancers, etc. Both caries and obesity share common risk factors therefore, preventive strategies which reduce the impact of risk factors should be opted so that there is a decline in the overall rate of prevalence of obesity and caries.

Pediatric dentists play an important role to alter the risk factors of caries and obesity by guiding and motivating the children for the adoption of good dietary habits. Oral health programs should be conducted to teach them the correct method, and frequency of toothbrushing followed by providing them knowledge of fluoridated toothpaste. Regular monitoring of general health which includes height, and weight measurements should be included in the dental examination protocol to reduce dental caries risk.

Conclusion

In conclusion, the findings of our study showed no association between dental caries and BMI among Chandigarh schoolchildren. Further research involving a large sample size with the radiographic investigation should be done so that the correlation between obesity and dental caries is evaluated.

Based on the results, the pediatric dentist should be able to identify the children who are at high-risk of developing chronic diseases and also help in spreading awareness of the importance of a healthy diet, and correct oral hygiene techniques which will improve both general and oral health of the child. Frequent education and motivation of children as well as their parents can bring improvement in their oral and general health.

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