Association of Salivary Zinc Levels to Dental Caries and Body Mass Index. A Comparative Study

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Background and objectives*: Role of salivary zinc to dental caries and body weight has not been studied extensively in children. The aim of the present study was to evaluate the relationship between salivary zinc and caries in overweight/ obese Indian children.* ***Study design****: One hundred and sixty children aged 8-12 years of both genders were divided into two groups of eighty each based on their body mass index into normal weight and overweight/obese. Each child was assessed for their caries experience in primary and permanent dentition. Unstimulated salivary samples were collected from each child to estimate zinc levels by atomic absorption spectrophotometer. Data was subjected to statistical analysis.* ***Results:*** *The mean caries score among the overweight/obese children was 2.2±3.9 and 0.7±1.5 in the primary and permanent dentition respectively compared to the 2.0±2.6 and 0.2±0.5 respectively among normal weight children. Mean salivary zinc levels in overweight/obese children were 0.36±0.27 ppm compared to normal weight children of 0.81±0.46 ppm.* ***Conclusion:*** *Overweight/obese children demonstrated significantly lower salivary zinc levels and higher caries experience in permanent dentition. Salivary zinc levels showed a positive but weak association to caries in permanent dentition in both groups. Salivary zinc levels showed a negative non-significant correlation to caries in primary dentition among the children with higher BMI.*

Keywords *: Salivary zinc , BMI , Caries*

INTRODUCTION

Overweight/obesity has surged in alarming proportion in the pediatric population. The prevalence of childhood obesity has tripled in the last three decades.[1] Higher body mass index (BMI) has been associated with increased caries experience in children. Increased consumption of sweet and fatty foods, sugary snacks and soda drinks have commonly contributed to increasing prevalence of caries and higher BMI among children.[2,3]

The macro caloric food consumption has led to micronutrient deficiencies in children. One of the specific micronutrient deficiencies is zinc deficiency. Zinc is a stable mineral trace element and has shown to have an effect on the mineralization of teeth. Zinc plays a major role in maintenance of health and part of metabolism of many enzymes and proteins. Zinc is present in the body tissues like plasma, blood and saliva .[4] In pediatric population saliva collection is easy and repeatable compared to blood plasma. Very few studies have explored the role of zinc to caries and body mass index in children. Further there is discordance in the findings.[5,6] Thus the aim of the present study was to evaluate the relationship between salivary zinc and caries in overweight/ obese Indian children.

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MATERIALS AND METHOD

The present study was conducted in the department of Pediatric Dentistry. Ethical clearance and permission for the conduct of the research was obtained from the institutions ethical review board. Prior permission was taken from the head of the institutions of schools and parents of children who were included in the study. Prior written informed consent was obtained from the parents. The sample size was estimated using the Gpower software v 3.1.9.2. Considering the effect size to be measured at 50% for two tailed hypothesis, power of the study at 85% and the margin of error at 5%, the total sample size needed is 156, which was rounded off to 160. So, each group comprised of 80 samples. A total number of 500 children belonging to the age group of 8-12 years of both sexes were screened and their body mass index was determined. Of these eighty children with normal weight and eighty children who were overweight/obese were selected for the study. Each child's caries experience was recorded and salivary samples were collected for evaluation of zinc.

Cooperative healthy children aged 8-12 years of both sexes with parental consent were included for the study. Children with any systemic disease, with unstable mental condition, whose parents do not give their consent to the examination, children under medication and those with exaggerated gag reflex, were not included in the study.

A single trained and calibrated examiner performed a comprehensive clinical examination with the assistance of one recorder. The caries experience (DMFS/dfs index) was recorded using visible light; mouth mirror and CPI probe [7]. All the teeth were examined for coronal surface caries and restorations. The number of decayed, missing and filled surfaces (dmfs/DMFS) in the coronal portion of each tooth was determined. Both primary and permanent dentitions were included.

Body weight was measured using a balanced beam scale and height was measured using stadiometer. Children were measured wearing light clothing and without shoes. Body mass index (BMI) was calculated using the formula weight in kilograms (Kg) divided by height in meter square (m2). The BMI percentile for age and sex were plotted on the growth chart developed by CDC 2000 standards. [8]

Each child was made to sit in Coachman position [9] and unstimulated whole saliva was collected in a sterile graduated cup in the morning between 10 and 11:30 am over a period of 5 minutes. It was ensured that the child did not eat or drink anything for 1 hour prior to the saliva collection. The collected saliva was transferred to eppendorf tubes® and placed in an ice box 4°C and transported immediately to the laboratory. The salivary zinc was estimated using the atomic absorption spectrophotometer.[10] The obtained data was subjected to statistical analysis using Statistical Package for Social Sciences [SPSS] for Windows Version 22.0 Released 2013. Armonk, NY: IBM Corp. Mann Whitney U Test was used to compare the mean values of different study variables between two groups. Spearman's correlation statistic test was used to establish the relationship between Zinc, dmfs, DMFS & BMI in both the groups. The level of significance was set at $P<0.05$.

RESULTS

The mean age of children in both the groups did not differ and was 10.1 years for normal weight and for overweight/ obese children was 10.2 years respectively. Normal weight group consisted of thirty seven males and forty three females and overweight/obese group consisted of thirty eight males and forty two males (Table 1). The mean caries score were higher among the overweight/obese children in both the primary and permanent dentition. However it was significantly higher only in permanent dentition (Table 2). The overweight/obese children showed significantly lower mean salivary zinc levels (0.36ppm, $p\leq0.001$) compared to normal weight children (0.81ppm). Salivary zinc levels showed a positive but weak association to caries in permanent dentition in both normal and overweight/obese children. In the primary dentition salivary zinc levels showed a negative correlation to caries among the children with higher BMI, however it was not significant. (Table 3)

Table 1: Age and Gender Distribution

	Age (Mean and SD)	Gender Male n (%)	Female n (%)
Normal weight	10.1 ± 1.1	37 (46.3%)	43 (53.8%)
Overweight/obese	10.2 ± 1.4	38 (47.5%)	42 (52.5%)
P-Value	0.67[a]	0.87[b]	

a. Chi Square test

b. Independent Student t test

DISCUSSION

Zinc is an essential metallic element in many biochemical reactions. It also functions as an efficient antioxidant .[11] In research with adult subjects, low concentrations of zinc were proved to be associated with higher abdominal fat .[12] It has been observed in obese mice that zinc dependent adipokinase Zn-a2-glycoprotein (ZAG) stimulates energy expenditure in skeletal muscle and brown adipose tissue, resulting in reduction in body weight, glycaemia, triglycerides, and non-esterified fatty acids. Its level is lower in subcutaneous and visceral adipose tissue and livers of obese humans, and interestingly does not appear to be related to insulin resistance .[13] In obese individuals, low ZAG gene expression may play an important role in the development of obesity, which is associated with low serum adiponectin and high plasma leptin levels.[14]

The present study found significantly lower levels of salivary zinc among overweight/obese children compared to children with normal BMI. Similar results were observed by Azab et al [5] in obese Egyptian children. Another study found significantly lower zinc concentration in plasma and erythrocytes among 7-14 year obese children compared to controls.[15] However contrasting results were found by other authors.[16,17] Alsaadi and colleagues found increased levels of salivary zinc in overweight children of Baghdad aged 6-11 years.[6] Comparision of serum and salivary zinc levels among obese and control adults showed lower levels of zinc among obese individuals compared to controls, which was not significant. Serum levels of zinc were higher among both the groups compared to salivary zinc concentration. Further serum zinc levels were significantly higher in adult obese males than females when compared with the control group. [18] A recent large epidemiological study on children and adolescents aged 6-19 years found a negative association between blood zinc levels and obesity. [19]

Table 2: Mean caries experience, salivary zinc levels and BMI among the children

Variables	Group	N	Mean	SD	Mean Rank	Z	P-Value
dmfs	Normal weight	80	2.0	2.6	85.6	-1.496	0.14
	Over weight/obese	80	2.2	3.9	75.4		
DMFS	Normal weight	80	0.2	0.5	74.7	-2.445	0.02*
	Over weight/obese	80	0.7	1.5	86.3		
Salivary Zinc	Normal weight	80	0.81	0.46	105.9	-6.949	<0.001*
	Over weight/obese	80	0.36	0.27	55.1		
BMI	Normal weight	80	16.54	1.91	41.6	-10.619	<0.001*
	Over weight/obese	80	23.24	2.81	119.4		

*P ≤ 0.05

Table 3: Correlation between salivary zinc levels to caries experience and BMI among the children

Group	Variable	Values	dmfs	DMFS	BMI
Normal weight	Salivary Zinc	Rho	0.04	0.23	0.03
		P-Value	0.71	0.05#	0.79
Overweight /obese	Salivary Zinc	Rho	-0.09	0.19	-0.07
		P-Value	0.45	0.09	0.54

Borderline significance
*P ≤ 0.05

The relationship between dental caries and obesity has been studied extensively. The positive association of obesity to dental caries in permanent teeth has been reported by Hilger *et al*.[20] Similar findings were observed by Willerhausen *et al* [21] and Mohammadi *et al* [22] in the primary dentition. A recent systematic review and meta-analysis found significantly more caries was found among overweight and obese children in both primary and permanent teeth in high income countries, but not in low and middle income countries.[23] In the present study overweight/obese children had higher caries score in both the dentitions, however was significantly higher in permanent dentition only.

Salivary zinc levels showed a weak but positive correlation to caries in permanent dentition irrespective of the BMI. Further a negative correlation was observed between salivary zinc level and caries in primary dentition, however it was not significant. Another study on pre-schoolers showed a lower level of salivary Zn in children with early childhood caries (0.0772 ± 0.0371 ppm) than that of the caries-free children (0.1051 ± 0.0157 ppm) and the difference was highly significant. An inverse relationship was observed between salivary Zinc levels and dental caries.[24] Duggal *et al* stated that there might be no association between salivary Zn levels and dental caries. [25] Further very few studies have evaluated the role of salivary zinc and caries in children with different BMI; thus we are unable to compare the results of the present study.

With growing interest in childhood obesity and micronutrient zinc deficiency, epidemiological studies with larger sample size of children and adolescents would be imperative. However, in individual capacity the probability of conducting such a research is hampered due to cost factor, funding and invasive methods of blood sample collection. Saliva is an easy, readily available, repeatable, noninvasive diagnostic fluid for assessment of many elements and minerals. In pediatric population collection of salivary sample induces little or no discomfort and proves as a fear-free method of collection when compared to blood sample collection. The present study had a few limitations; cross sectional design, dietary intake was not assessed. Future studies could probably involve other variables like dietary assessment, taste status and longitudinal study design.

CONCLUSION

Significant lower concentration of salivary zinc was associated with higher BMI. Children with higher BMI had significantly higher caries experience in permanent dentition. The relationship between salivary zinc concentration and caries warrants further research.

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Author contributions:

A.S conceived the ideas; collected the data, analysed the data and lead the writing. P.S analyzed the data and edited the manuscript

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Dr Sharma has nothing to disclose

Dr Subramaniam has nothing to disclose

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