



Association of Body Mass Index, Oral Hygiene and Dietary Factors with Early Childhood Caries and Severe Early Childhood Caries in Hadoti region

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ABSTRACT:

AIM: To evaluate the association of Body Mass Index, Oral Hygiene and Dietary Factors with Early Childhood Caries and Severe Early Childhood Caries

MATERIAL & METHODS: 200 children aged 3-6 years diagnosed with Early Childhood Caries and Severe Early Childhood Caries reporting to the Department of Pediatric and Preventive Dentistry were selected. Height and weight measurements were recorded for all the children who participated in the study. Body Mass Index was calculated and children were divided in four categories – Underweight, Healthy, Overweight, Obese. Oral hygiene associated factors and dietary factors were assessed by a questionnaire. Oral hygiene associated factors and dietary factors of both Early Childhood Caries and Severe Early Childhood Caries children were compared statistically.

RESULTS: Linear regression analysis was used to analyze the co-relation of body mass index, dietary factors, oral hygiene factors with early childhood caries and severe early childhood caries. The test revealed statistically significant difference between the groups.

CONCLUSION: Early Childhood Caries (ECC), Severe Early Childhood Caries (SECC) and all categories of Body Mass Index share common contributing factors including dietary and oral hygiene.

INTRODUCTION

Dental caries is a major public health problem globally and is the most widespread noncommunicable disease. It is also the most prevalent condition included in the 2015 Global Burden of Disease Study.¹

Early Childhood Caries is known to be a multifactorial disease. Sugary food and beverages

can lead to a dysbiotic state of the microbial composition causing caries. Children sleeping with bottles filled with sweetened milk containing several cariogenic sugars are at high risk for developing Early Childhood Caries. As a consequence of drinking during night time, without clearance of sugars, the oral bacteria will produce lactic acid rapidly, demineralizing the enamel. Nowadays, not



only baby bottles, but also several other sweetened juices consumed throughout the day or even at night and continuous intermittent snacking will enhance the risk to develop caries ²

Early childhood caries is defined as “the presence of one or more decayed, missing, or filled tooth surface in any primary tooth in a child 71 months of age or younger.” The severe early childhood caries is the presence of any sign of smooth-surface caries in children < 3 years of age; 1 or more cavity teeth are filled in children from ages 3 through 5; or dmft $\geq$ 4 for age 3, $\geq$ 5 for age 4, or $\geq$ 6 for age 5³

Dietary habits, i.e., when and how the beverage and food is consumed, can modify this risk with frequent consumption of sugars thought to increase risk. The proportion of world’s population affected by dental caries increased dramatically once refined carbohydrates became available to developed and developing nations.⁴

Oral health is an important component of general health affecting their quality of life and well-being. Early childhood caries and severe early childhood caries, if not treated at the beginning, the child’s dental health will be worsen and increase treatment difficulty and cost. This immediately impacts child’s daily activity including difficulties in eating, sleeping, speech, playing.

The premature loss of teeth in the primary dentition of children may cause malocclusion. Tooth loss has negative effects on masticatory ability and nutrient intake, and it increases the risk of malnutrition. Moreover, their physical development and quality of life are affected.⁵ Underweight may be a sign of malnutrition, which can leave a child at risk for altered growth, being immunocompromised, and developing other morbidities and micronutrient deficiencies.⁶

Child obesity has short- and long-term consequences, including increased risk of non-communicable diseases and mortality in childhood and adulthood. While the prevalence of overweight and obesity are generally lowest in early childhood compared to other life stages, many causes of obesity have roots in early childhood.⁷ Overweight and obese individuals are at increased risk for type 2 diabetes, hypertension and cardiovascular disease along with other chronic diseases.⁶ Thus can have a

substantial impact on quality of life and productivity across the lifespan of individuals

Thus, this study aims to describe the association of body mass index, oral hygiene and dietary factors with early childhood caries and severe early childhood caries in hadoti region.

MATERIALS & METHODOLOGY

A cross-sectional study was conducted. Ethical approval for the conduct of the study was obtained from the ethical committee of Daswani Dental College & Research Centre, Kota (RAJ). Two hundred children aged three to six years, who needed treatment for early childhood caries and severe early childhood caries were included in the study. Their Body Mass Index and DMFT (decayed, missing, filled teeth) score were recorded. Oral hygiene associated factors and dietary factors were assessed by a questionnaire. Informed consent was obtained from the accompanying parent after explaining the procedure.

The method of allocation of patients in the group was as follows:

Group I - 100 children who needed treatment for early childhood caries

Group II - 100 children who needed treatment for severe early childhood caries

These groups were further divided into 4 subgroups according to Body Mass Index

I] Early childhood caries

Group I a: Underweight children

Group I b: Healthy children

Group I c: Overweight children

Group I d: Obese children

II] Severe early childhood caries

Group II a: Underweight children

Group II b: Healthy children

Group II c: Overweight children

Group II d: Obese children

Children of age 3-6 having early childhood caries and severe early childhood caries were included in the study. Patients who were not willing to participate and those who were medically compromised were excluded from the study.

MATERIALS USED

- Kidney tray
- Mouth mirror



- Dental Probe
- Tweezers
- Explorer
- Mouth masks
- Disposable gloves
- Weight machine
- Measuring tape

PROCEDURE

Body mass index measurement- Height and weight measurements were recorded for all the children who participated in the study. Weight of each child on barefoot with light clothing was measured to the nearest 0.1 kg using a portable glass digital electronic personal weighing scale which was calibrated before use. Each child was instructed to stand still, with mass equally distributed between feet, until the scale reading stabilized. The reading was then recorded. Height was measured to the nearest 0.1 cm using a mobile stadiometer. For the calculation of BMI, the following formula was used. $BMI = \text{Weight in kg} / \text{Height in m}^2$

The value obtained was then plotted on age- and gender-specific percentile curves given by the Centers for Disease Control and Prevention, and children were categorized into four groups based on their BMI percentiles as follows:

- Underweight group - children with BMI for age < 5th percentile
 - Normal group - children with BMI for age ≥ 5 th percentile and < 85th percentile
 - Overweight group - children with BMI for age ≥ 85 th percentile and < 95th percentile
 - Obese group - children with BMI ≥ 95 th percentile
- Body mass index was calculated. Children with early childhood caries and severe early childhood

caries were allocated in underweight, healthy, overweight and obese groups.

Dental caries assessment - The examination for dental caries was carried out on the dental chair, and the caries were recorded based on the WHO criteria (1997); decayed, missing, and filled teeth (dmft) scores were used to calculate caries experience.

Questionnaire

The children received dental examinations, and their parents completed a structured self-administered questionnaire regarding Oral hygiene associated factors and dietary factors. Five items measuring the caries preventive behaviours of parents and their children were employed. The preventive behaviours of parents and their children was established by reporting brushing frequency, nighttime brushing, usage of toothpaste, semi-annual dental visits and fluoride varnish application. Five items measuring children's consumption frequencies of Sugar Sweetened Beverages and snacks were taken from study conducted by Lin YC⁵ et al. Children's SSB and snack consumption was measured based on their parents' reports. The number of times that the children consumed the following items was reported: sugar sweetened beverages, salty snacks (potato chips), sweet snacks (e.g., cake, candies), drinking sweetened milk at night, eating biscuits.

Statistical analysis

The data was entered in Microsoft Office, Excel worksheets, and analyzed using software IBM SPSS v. 20.0 (IBM Statistics, SPSS, Chicago, IL, USA). Linear regression analysis was used to analyze the co-relation of body mass index, dietary factors, oral hygiene factors with early childhood caries and severe early childhood caries. Statistical significance was determined at $p < 0.005$

RESULTS:

Table 1 shows underweight, healthy, overweight and obese patient's having early childhood caries and severe early childhood caries.

	Underweight	Healthy	Overweight	Obese
ECC	43(21.5%)	34(17%)	13(6.5%)	10(5%)
SECC	35(17.5%)	47(23.5%)	8(4%)	10(5%)



Table 2 shows association of oral hygiene factors in underweight, healthy, overweight and obese patients having early childhood caries and severe early childhood caries.

Oral hygiene factors		Early childhood caries		Severe early childhood caries		
		Once a day	Twice a day	Once a day	Twice a day	
1.Brushing teeth	Underweight	37(86%)	6(14%)	29(83%)	6(17%)	(r) =0.6430 pvalue 0.0241
	Healthy	32(94%)	2(6%)	40(85%)	7(15%)	
	Overweight	12(92%)	1(8%)	8(100%)	0(0%)	
	Obese	9(90%)	1(10%)	9(90%)	1(10%)	
		YES	NO	YES	NO	
2. Brushing teeth at night	Underweight	11(26%)	32(74%)	6(17%)	29(83%)	(r) =0.6255 pvalue 0.0296
	Healthy	3(9%)	31(91%)	8(17%)	39(83%)	
	Overweight	0(0%)	13(100%)	1(12.5%)	7(87.5%)	
	Obese	2(20%)	8(80%)	1(10%)	9(90%)	
3. Brushing with toothpastes	Underweight	34(79%)	9(21%)	24(69%)	11(31%)	(r) =0.5091 pvalue 0.0210
	Healthy	29(85%)	5(15%)	39(83%)	8(17%)	
	Overweight	9(69%)	4(31%)	8(100%)	0(0%)	
	Obese	8(80%)	2(20%)	10(100%)	0(0%)	
4. Semiannual dental visits	Underweight	2(5%)	41(95%)	4(11%)	31(89%)	(r) =0.6537 pvalue 0.0211
	Healthy	0(0%)	34(100%)	3(6%)	44(94%)	
	Overweight	2(15%)	11(85%)	0(0%)	8(100%)	
	Obese	0(0%)	10(100%)	0(0%)	10(100%)	
5. Fluoride varnish application	Underweight	1(2%)	42(98%)	1(2%)	34(98%)	(r) =0.6745 pvalue 0.0161
	Healthy	0(0%)	34(100%)	2(4%)	45(96%)	
	Overweight	0(0%)	13(100%)	1(12.5%)	7(87.5%)	
	Obese	0(0%)	10(100%)	0(0%)	10(100%)	
		(r) = 0.7334 pvalue0.0001		(r) = 0.6006 pvalue0.0004		

Table 3 shows association of dietary factors in underweight, healthy, overweight and obese patients having early childhood caries and severe early childhood caries.

Dietary factors		Early childhood caries		Severe early childhood caries		
		Regularly	Ocassionally	Regularly	Ocassionally	
1. Frequency of sugar sweetened packaged beverages	Underweight	38(88%)	5(12%)	29(83%)	6(17%)	(r) = 0.6168 pvalue 0.0327
	Healthy	30(88%)	4(12%)	46(98%)	1(2%)	
	Overweight	12(92%)	1(8%)	8(100%)	0(0%)	
	Obese	9(90%)	1(10%)	9(90%)	1(10%)	
2. Frequency of salty snacks - potato chips	Underweight	30(70%)	13(30%)	25(71%)	10(29%)	(r) = 0.6454 pvalue 0.0234
	Healthy	32(94%)	2(6%)	47(100%)	0(0%)	
	Overweight	13(100%)	0(0%)	8(100%)	0(0%)	
	Obese	10(100%)	0(0%)	9(90%)	1(10%)	
3. Frequency of sweet snacks -	Underweight	39(91%)	4(9%)	33(94%)	2(6%)	(r) = 0.6398 pvalue 0.0251
	Healthy	29(85%)	5(15%)	42(89%)	5(11%)	
	Overweight	12(92%)	1(8%)	8(100%)	0(0%)	
	Obese	10(100%)	0(0%)	8(80%)	2(20%)	



candy, cake						
4. Frequency of drinking sweetened milk at night	Underweight	40(93%)	3(7%)	35(100%)	0(0%)	(r) = 0.6432 pvalue 0.0241
	Healthy	28(82%)	6(18%)	46(98%)	1(2%)	
	Overweight	13(100%)	0(0%)	8(100%)	0(0%)	
	Obese	9(90%)	1(10%)	9(90%)	1(10%)	
5. Frequency of eating biscuits	Underweight	41(95%)	2(5%)	35(100%)	0(0%)	(r) = 0.6407 pvalue 0.0248
	Healthy	31(91%)	3(9%)	42(89%)	5(11%)	
	Overweight	13(100%)	0(0%)	7(87.5%)	1(12.5%)	
	Obese	9(90%)	1(10%)	8(80%)	2(20%)	
		(r) = 0.7341 pvalue0.0001		(r)= 0.5804 pvalue0.0008		

DISCUSSION

Early childhood oral health is now considered as an integral part of general health of young children. Poor oral health can have detrimental effect on children's quality of life and on their school performance. Children and adolescents with oral health problems are more likely to feel inferior, shy, unhappy, sad, or depressed and are less likely to be friendly.⁸

Our study shows the prevalence of underweight, healthy, overweight and obese children having ECC and SECC. Out of 200 children 21.5% were Underweight, 17% Healthy, 6.5% Overweight, 5% Obese having ECC. Also 17.5% were Underweight, 23.5% Healthy, 4% Overweight, 5% Obese having SECC. Vázquez-Nava et al⁹ (2010) also observed obesity appears to be associated with dental caries in the primary dentition of preschool 4 to 5 years old children.

Higher carbohydrate intake has also been shown to increase the risk for obesity.⁴ Childhood obesity is one of the most serious and alarming of public health challenges today. In the past 40 years, the number of children with obesity worldwide has increased 10-fold. Thus, there are now about 124 million children and adolescents in the world with obesity.¹⁰ Obesity and ECC are multifactorial diseases including related factors such as nutrition, snacking habits, beverages and also oral hygiene habits.

Our study reveals that 90% of Obese children were regularly consuming sugar-sweetened packaged beverages, also 92% of Overweight

children who were regular consumers were found to have ECC. All SECC Overweight children were consistently consuming sugar-sweetened packaged beverages. Healthy and Overweight children with SECC showed maximum consumption of salty snacks while in ECC Overweight and Obese children were maximum. Overweight SECC were maximum while in ECC Obese children showed highest consumption of sweet snacks -candy, cake. Hasnain et al¹¹ in 2013 stated that majority of the mother said their children preferred confectionaries like cakes, biscuit, and chocolates the most. Children who were frequently eating crispy snacks and savory were at higher risk of caries than caries-free children.

Our study showed that maximum Underweight children having SECC were eating biscuits while in ECC Overweight kids were. M Costacurta et al¹² (2014) also showed that using sugary drinks, frequency of sugar consumption were risk factors for obesity and ECC. Another study conducted by Skafida et al¹³ (2018) also showed that children under five years old were at greater risk of ECC if they drink soft drinks, eat cakes and chocolate regularly.

Our study revealed that maximum Underweight as well as Overweight children having SECC were drinking sweetened milk at night while in ECC overweight kids were. Woodward et al¹⁴ (2020) showed that the rate of ECC in children who drank milk with added sugar every day and over 300 mL/day were higher than that of children without this habit.



According to findings of our study, all the dietary factors i.e regular consumption of sugar sweetened beverages, salty snacks, sweet snacks, sweetened milk at night and biscuits and are statistically significant. Our study reveals important insights into the dietary habits of children in the Hadoti region, particularly concerning their regular consumption of sugary foods. This includes sweets, biscuits, and sticky foods, regardless of whether the children fall into the underweight or obese categories. The frequent intake of these sugary and sticky foods contributes significantly to dental issues. As a result, the Hadoti region experiences a high prevalence of Early Childhood Caries (ECC) and Severe Early Childhood Caries (SECC). ECC and SECC are types of tooth decay that affect young children and can lead to severe dental problems if not addressed. The study underscores the need for improved dietary practices and dental care to reduce the incidence of these conditions.

In addition to dietary considerations, preventing caries involves maintaining proper oral hygiene, including regular cleaning of teeth, the spaces between them, and the tongue, along with the application of fluoride compounds, typically through oral hygiene products. Fluoride compounds play a crucial role in strengthening the body's hard tissues.¹⁵

It is recommended to brush teeth at least twice daily, with a pause after the second brushing to allow natural cleansing processes to occur overnight. Overbrushing, improper technique, or using a toothbrush with bristles that are too firm can potentially damage enamel or gums. Effective tooth brushing typically takes about 2 minutes, ensuring thorough cleaning of all tooth surfaces and activating fluoride ions.¹⁶

Our study showed that Overweight SECC children (100%) had maximum tendency of brushing teeth once a day than Overweight ECC (92%). Overweight ECC children (100%) had maximum tendency of brushing teeth at night than Obese SECC (90%).

The American Academy of Pediatrics (AAP), American Academy of Pediatric Dentistry (AAPD), and American Dental Association (ADA) recommend fluoride toothpaste

for all children and limit the amount of toothpaste used by children aged < 3 years to a "smear" the size of a grain of rice.^{17,18,19} Our study showed that Maximum Overweight and Obese SECC children were brushing teeth with toothpastes. Healthy ECC children were maximum brushing with toothpastes.

In this context, there's a keen interest in straightforward treatments to impede cavity progression once tooth decay begins. Fluoride stands out as a highly effective means of caries prevention.²⁰ The widespread decline in caries rates in many developed nations is largely credited to fluoride use. Fluoride's effectiveness stems from its physical and chemical actions, particularly its role in replacing hydroxyapatite with fluoride ions during enamel mineralization. This process results in the formation of fluorapatite, enhancing enamel hardness and acid resistance, thereby reducing plaque formation²¹ and the likelihood of developing caries. our study showed that Healthy, Overweight and Obese ECC children (100%) were maximum for not applying fluoride varnish while in SECC Obese children were maximum.

Delayed initial dental visits contribute to poor dental health in young children. Both the American Academy of Pediatric Dentistry (AAPD) and the American Dental Association (ADA) recommend a child's first dental visit within six months of the eruption of their first primary tooth and no later than 12 months of age^{22,23}, although other sources suggest an optimal timeframe of 12 to 18 months for this initial visit.^{24,25} In contrast our study showed that Overweight and Obese SECC (100%) were not attending semi-annual dental visits. In ECC Healthy and Obese children were not attending semi-annual dental visits.

Based on the study's findings, oral hygiene factors i.e. brushing teeth once a day, not brushing teeth at night, brushing teeth with toothpastes, not taking semi-annual dental visits and not applying fluoride varnish were statistically significant. Children in the Hadoti region demonstrate good practices when it comes to brushing their teeth with toothpaste. However, there is a notable gap in dental health awareness among the parents in this region. Specifically, parents are generally not well-informed about the importance of



regular dental check-ups. They also lack awareness about preventive treatments, such as the application of dental varnish, which helps to prevent caries. Additionally, there seems to be a lack of interest in seeking dental treatment overall. This suggests that while children may be following good oral hygiene practices, the support and education needed from parents and caregivers are insufficient to ensure comprehensive dental health for the family.

Thus, reduced cariogenic diet, brushing of teeth, fluoride varnish application and regular dental visits are evidenced as oral health behaviour's that prevent dental caries.⁵

The conclusions drawn from this report should be considered within the context of several limitations. Firstly, the data relies on self-reported measures from parents, which may introduce potential reporting biases. Second, the question about the amount of toothpaste used is not mentioned. Lastly, the specific type of toothpaste—whether fluoride or non-fluoride—is not specified. This underscores the necessity for enhanced health education targeting parents, particularly concerning the benefits of fluoride toothpaste, alongside the recommendation for supervised or parental involvement in toothbrushing routines.

CONCLUSION

To conclude Early Childhood Caries (ECC), Severe Early Childhood Caries (SECC) and all categories of Body Mass Index share common contributing factors including dietary and oral hygiene, so it requires multidirectional approach to tackle. Firstly focusing on prevention that is reducing the frequency of cariogenic diet and promoting healthy lifestyle. Educating parents and caregivers about the importance of nutrition and limiting sugary foods and beverages can positively impact children's overall health and oral hygiene.

Secondly, emphasizing the significance of good oral hygiene practices, such as regular brushing with fluoride toothpaste and at night is crucial in preventing dental caries and promoting oral health from an early age. Also addressing the dental visits at an early age will prevent further issues. By addressing these interconnected factors through comprehensive strategies, we can work

towards improving the oral health outcomes of ECC and SECC children, ultimately promoting their overall well-being and quality of life.

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