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Evaluating Relationship between Caries Status and Body Mass in Children and Need for Diet Counseling – A Cross-Sectional Study

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ABSTRACT

Background: Variations in body masses of children are multifactorial complex disease and their dietary patterns are a common underlying etiologic factor in their causation. Recently, a close relationship has been noted between these factors and prevalence of dental caries in children.

Materials: Two hundred children belonging to the age group of 7-10 years of both sexes were studied. In all of them, BMI and caries experience were determined. The 24 h diet was recorded to assess the need for diet counseling. The results were subjected to statistical analysis using the Chi-square test for comparing the relationship between body mass index and dental caries (dmft). The diet score obtained from the dental health diet score chart was analyzed by obtaining the mean.

Results: We observed that there was no statistically significant correlation between variations in body mass and the occurrence of caries. But, 53.3% of the children's diet was found to be inadequate, and 10% was just barely adequate. Hence, these children were given diet counseling.

Conclusion: Although there was no direct significant correlation between body mass index and dental caries, the evaluation of the dietary pattern shows that 63.3% of the children needed diet modification and counseling.

Keywords: Body mass index, Dental caries, Diet, DMFT, Diet counseling

Abbreviations: BMI: Body Mass Index; DMFT INDEX: Decayed Missing Filled Tooth Index; Deft: Decayed Extracted Filled Surfaces Index; DMFS: Decayed Missing Filled Surfaces Index; CDC: Centre For Disease Control And Prevention; MTRR: gene (5-Methyltetrahydrofolatye-homocysteine Methyl-transferase Reductase); ECC: Early Childhood Caries

INTRODUCTION

Dental caries is one of the most prevalent infectious diseases to afflict mankind [1]. Even low levels of dental caries in children are of concern because caries is a lifelong progressive and cumulative disease. The proportion of the world's population affected by dental caries increased dramatically once refined carbohydrates became available to developed and developing nations. The prevalence of nutritional disorders in childhood has dramatically increased over the past three decades [2].

Among the main risk factors for caries, such as cariogenic bacteria and poor oral hygiene, diet has a different role in the etiology of dental caries since there is a dual relationship between diet and dental caries [3]. Dietary habits have potential to be a risk factor for dental caries; on the other side, impaired oral health might cause deficiencies in dietary intake [4].

Anthropometrical measurements were used frequently as an indicator of nutritional status in previous studies that examined the relationship between diet and dental caries. [5] However, the role of diet quality is an important component of nutritional status in the etiology of dental caries has been studied in very few studies. The evaluation of the association between diet quality and dental caries might provide a better distinguish the differences between anti-cariogenic, cariogenic and cario-static foods for a better evaluation of

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understanding for the relationship between nutritional status and dental caries in children [6]. It is important to oral health. The anti-cariogenic foods can increase the pH of the saliva to an alkaline level and prevent enamel from demineralization [7]. For example, dairy products (especially cheese), unrefined plant foods, wholegrain foods and xylitol. The cariogenic foods like sweets, starchy foods and beverages, and products with added sugar contain fermentable carbohydrates that is fermented by microorganisms in the mouth and result in a decrease in pH of the saliva to 5.5 or less that promote formation of caries [8,9]. The cario-static foods do not cause caries since they are not metabolized by microorganisms in the mouth thus salivary pH does not change within 30 min. Protein foods such as egg, meat, fish and poultry; most vegetables; fats and non-carbohydrate sweeteners are the examples of cario-static foods. Another key dietary factor associated with increased risk of caries; particularly in children is the duration of exposure time that fermentable carbohydrates are in direct contact with dental plaque [10,11]. This throws light on the importance of diet counseling in children with dental caries.

Effective diet counseling can improve oral as well as general health of the child. The daily ingestion of a balanced and varied selection of foods from the different food groups, avoidance of sweets that are retained next to tooth enamel and discontinuance of between-meal snacking are the basic elements in achieving a diet that produces few caries [12]. Starting from this point, this study aimed to examine the association between diet and dental caries in school going children by using the dietary intake data, anthropometrical measurements and dental examination. The objective of our study was to find the relationship between BMI, dental caries experience and the need for diet counseling among school going children.

MATERIALS & METHODS

A total number of 200 children belonging to the age group of 7-10 years of both sexes who reported to the Department of Pedodontics and Preventive Children Dentistry, PMS College of Dental Science and Research, Vattapara, Trivandrum, were a part of this study. Comprehensive clinical examination was done and caries experience (DMFT/deft index) was recorded using visible light; mouth mirror and explorer **(Figure 1)**.

Bodyweight was measured using a balance beam scale **(Figure 2)** and height was measured using a measuring chart **(Figure 3).** Measurement of children were taken wearing light clothing and without shoes. Body mass index (BMI) was calculated using the formula weight in kilograms (kg) divided by height in meter squared (m^2). The BMI percentile for age and sex were plotted on the growth chart developed by CDC 2000 standards **(Figure 4)**.

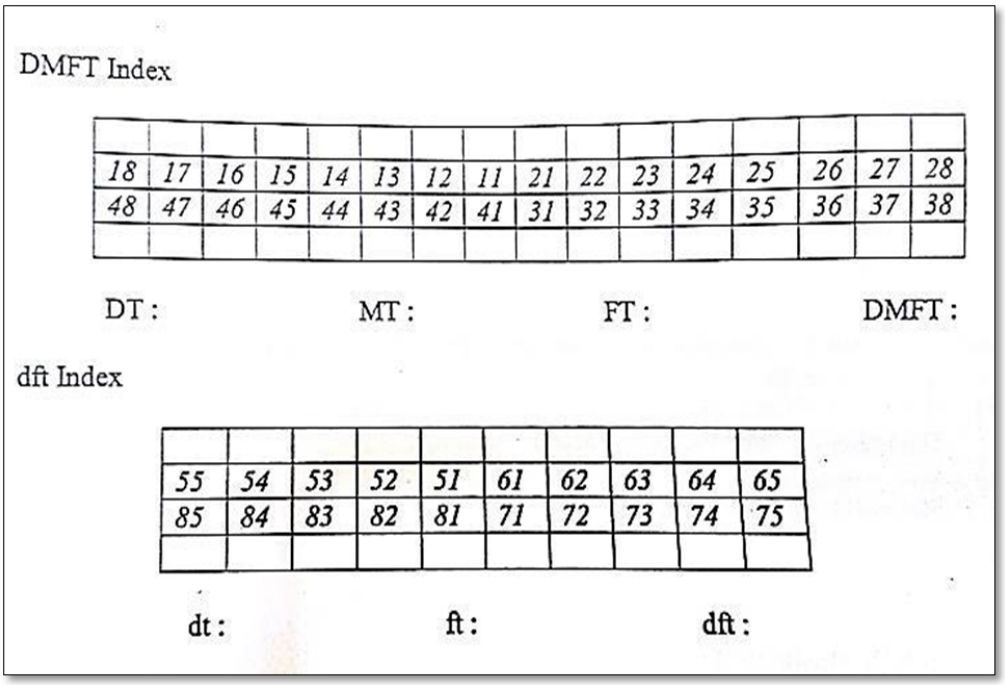

Figure 1. Format for recording caries indices.

Figure 2. Weight being measured using weighing scale.

Figure 3. Height being measured using measuring chart.

A 24 h diet pattern of the child was recorded from the parents of the children to know their child's dietary habits 12 and their sweet and fatty food preferences. Older children completed the questionnaire by themselves while the parents of the younger children were asked to fill the questionnaire. After taking the 24 h diet diary, it was analyzed by obtaining the dental health diet score.

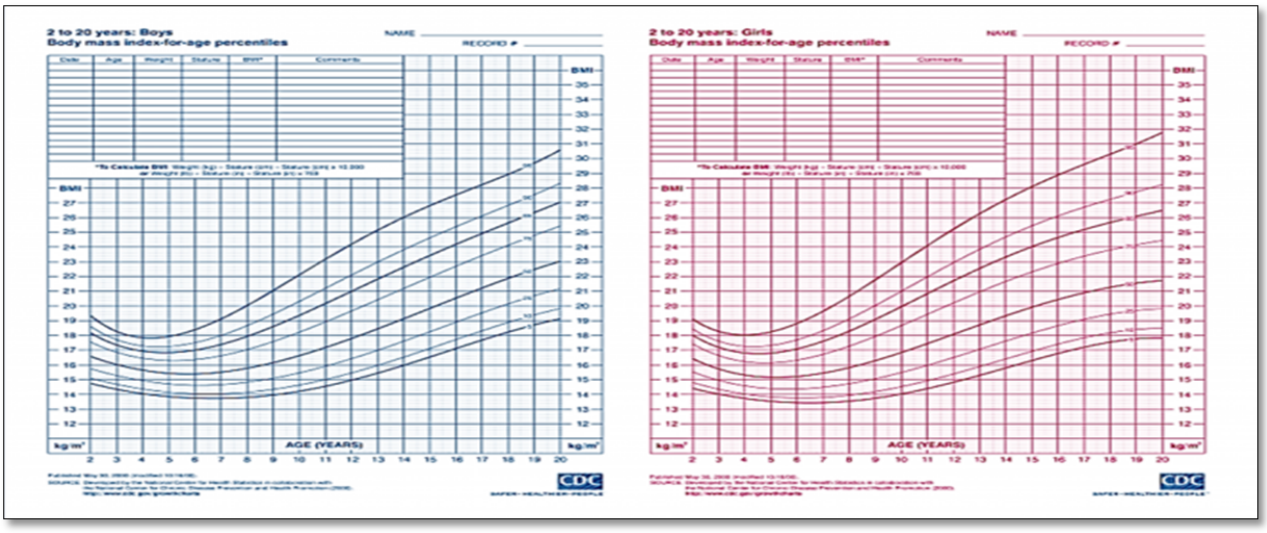

Figure 4. BMI percentile for age and sex where plotted on the growth chart developed by CDC-standards 2000.

The dental health diet score gives points earned as a result of an adequate intake of food from each of the food groups plus points for ingesting foods especially recommended because they are the best sources of the ten nutrients essential for achieving and maintaining dental health. From this sum points are subtracted for frequent ingestion of foods that are overtly sweet – whose sweetness is derived from added refined sugar or concentrated natural sugars. The difference is the dental health diet score.

For calculating Dental Health Diet Score we must record the time when the meal or snacks were eaten, the amount ingested (in household measures), how the food was prepared, and the number of teaspoons of sugar added. The foods in the diary that have been sweetened with added sugar or are concentrated natural sweets (honey, raisins, figs, and so forth) must be circled and later classified into one or more of the appropriate food groups. For each serving of these foods listed in the food intake dairy, place a check mark in the appropriate food group block. Add the number of checks and multiply by the number shown **(Table 1)**. The maximum number of point's credit for the milk and meat groups is 24 each and for the fruit vegetable and bread-cereal groups are 24 each. Add the points. The sum is the Food Group Score (96 is the highest score). In the Nutrient Evaluation Chart **(Table 2)** are listed the foods that are good sources of the nutrients essential for good health in general and dental oral health in particular (56 is a perfect score).

Table 1. Food Group Score Table (Highest Possible Score is 96).

Food	RDA	No. of servings	Points
Milk	3	X 8	
Meat	2	X 12	
Fruits and vegetables	1	X 6	
Vitamin C	1	X 6	
Others	2	X 6	
Breads and cereals	4	X 6	

Table 2. Nutrient Score Table.

Mark one score for each nutrient consumed				
Protein and vitamin A	**Iron**	**Folic acid**	**Riboflavin**	**Vitamin C**
Chees, dried peas, dried beans, eggs, fish, meat, milk, apricot, butter, carrot, liver, spinach	Beef, eggs, liver, green leafy vegetables	Cereals, spinach, yeast	Broccoli, chicken breasts, eggs, milk, mushrooms	Grapefruit, green peppers, oranges, strawberries, tomatoes, calcium and phosphorus–cheese, eggs, green leafy vegetables, milk

List the sweets and sugar-sweetened foods **(Table 3)** and the frequency with which they are consumed in a typical day. Classify each sweet into either the liquid, solid and sticky, or slowly dissolving category. Place a check mark in the frequency column for each item as long as they are eaten at least 20 minutes apart. Add the number of checks.

The food taken by the child was divided into 3 groups the food group, the nutrient group and sweet group. Each type of food has a predicted score value given in the table, with the help of which food score, nutrient score and sweet score was calculated. The dental health diet score was finally obtained using the formula: **Dental Health Diet Score = Food Score + Nutrient Score – Sweet Score**.

After calculating the score it was compared to the standard score chart **(Table 4)** which assessed the need for diet counseling. The children who required diet counseling were given the same in the next appointment.

Table 3. Sweet score table.

Liquid: (x 5)	**Solid and sticky: (x 10)**	**Slowly dissolving: (x 15)**
Soft drinks, fruit drinks, cocoa, sugar and honey in beverages, ice cream, flavored yoghurt, pudding , custard	Cake, doughnuts, sweet rolls, pastry, canned fruit in syrup, bananas, cookies, chocolate candy, caramel, chewing gum, dried fruit, marshmallows, jelly jam	hard candies, breathe mints, antacid tablets, cough drops

Table 4. Assessment of dental health diet score.

Score	Result	Interpretation
72 – 96	Excellent	Counseling not required
64 – 72	Adequate	Educate the patient
56 – 64	Barely Adequate	Counseling required
56 Or Less	Not Adequate	Counseling with diet modifications

RESULTS

BMI percentile of 200 children examined comprised of 126 boys and 74 girls. 102 (58.4%) children were having normal weight for age and sex, 56 (28 %) were underweight, 42 (21%) were overweight that are at risk of being obese in future. None of the children who participated in the study came under malnourished or obese category in this study **(Figures 5 and 6)**.

The average DMFT for overweight children was 4.9 and for children with normal weight were 4.8 whereas, underweight children had higher mean DMFT (5.1). There is higher increase in caries experience among underweight children compared to children with normal body weight, and overweight, but these differences were not statistically significant (p= 0.951) **(Figure 7)**.

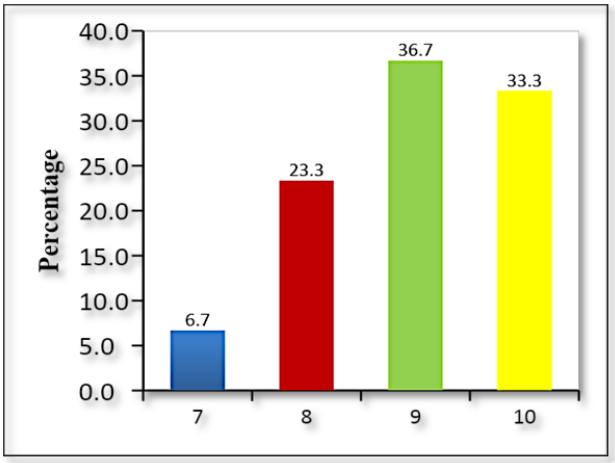

Figure 5. Percentage distribution by age.

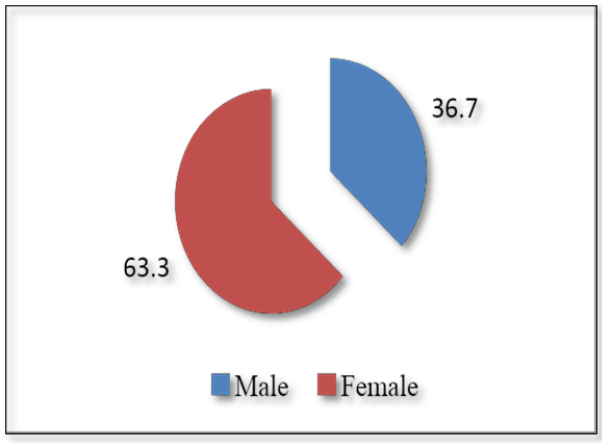

Figure 6. Percentage distribution by sex**.**

The mean dental health diet score revealed that 10 (23.3%) children had an excellent diet and 26 (13.3%) children had adequate diet. Whereas, 20 (10%) children had a barely adequate diet and 106 (53.3%) children had an inadequate diet. This showed that out of 200 children who participated in the study, 126 children (63.3%) needed diet modifications and counseling **(Figure 8)**.

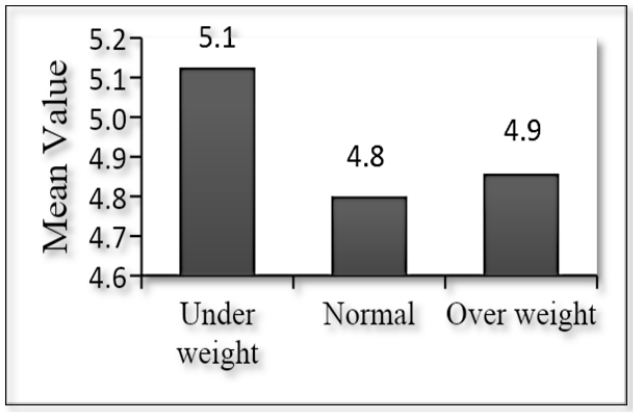

Figure 7. Graph comparing BMI and DMFT of children.

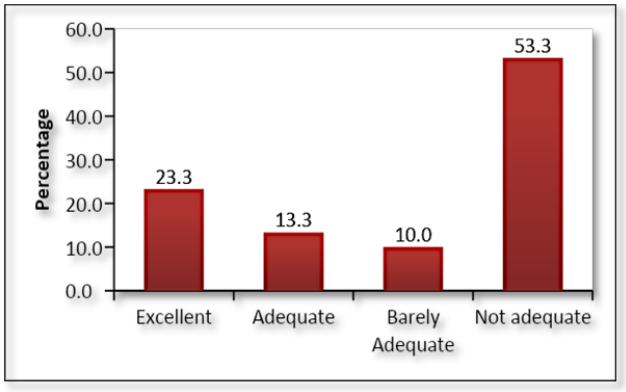

Figure 8. Mean representation of dental health diet score of children.

DISCUSSION

Dental caries primarily affects the quality of life of children. Among the many multifactorial etiological factors, diet has been identified as a particular risk factor for caries development in children [1,6]. This study examined the dual relationship between nutritional status including diet quality and anthropometrical measurements and dental caries in preschool children.

Nutritional status has a profound effect on caries. Two components of nutritional status, both dietary intake and anthropometrical measurements were assessed in this study in terms of the risk of early childhood caries. The association between anthropometrical measurements, mainly BMI and dental caries was examined in previous studies and conflicting results were provided [13,14]. In this study, underweight children had a slightly higher percentage of caries compared with normal counterparts whereas overweight and obese children had slightly lower. Similar finding were reported by Kopycka-Kedzierawski et al. [15] suggested that overweight may be associated with decreased rates of caries in children aged 2-18 years. Likewise, in a sample of 1951 in Philippine children aged 11-13 years, Benzian et al. [16] also reported that there was a significant inverse association between caries and BMI and particularly between odontogenic infections and below-normal BMI. A cross-sectional study conducted by Alkarimi et al. [17] in Saudi Arabian children age 6-8 years old suggested an inverse linear association between dental caries and anthropometric outcomes. A recent Chinese study among 744 8-year-old children also reported a weak negative association between caries severity and weight status. Contradicting these studies, Willerhausen et al. [18] found a significant positive association between weight and primary caries after adjusting for age in 1290 pupils aged 6-11 years. Similarly, it has been reported that the greatest proportion of dental caries was found in the group of obese subjects in a sample of 413 children. The heterogeneities between studies might be attributed to: 1) disparity of sample size. Most previous study sample sizes were less than 1,000. Nevertheless, our findings agreed with the results from national surveys in US; 2) no uniformity of the criteria for BMI classification across studies. Some studies used the CDC centiles, other studies employed the international age and gender appropriate data sets recommended by the IOTF or WHO 3) different indices and definitions of caries. For example, some studies reported dmft, whereas others reported dmfs (decayed, missing, filled, surfaces); 4) variation in the confounders used for adjustment such as sex, race/ethnicity, socioeconomic and nutritional status [19].

From the evaluation, in our study it was observed that 63.3% of the total children who participated in the study showed the need for diet modifications and counseling. In most of the children while calculating the diet score we observed that the fall in the diet score was not mainly due to the increased sweet score but it was mostly due to the lack in nutrient score. This was a major finding, that dental caries or increased dmft in children who took part in our study was not majorly due to the increase in consumption of sugar containing foods but due to the lack of proper nutritional foods. Thus here the diet counseling we provided was emphasized on the importance of adequate nutrients to the growing child and the impact of malnourishment on the general as well as oral health of the child. Years before Alvarez et al. [20] in 1995 conducted a longitudinal study to evaluate the relationship between nutritional status and oral health only to conclude that a single, moderate malnutrition episode occurring in infancy (<1 y of age) is associated with increased dental caries later in life, possibly as a consequence of a deleterious effect on the formation of tooth enamel early in life. A cross-sectional study by Antunes et al. [21] in 2017 also suggest an association between underweight and ECC; in addition they suggested that MTRR gene is a common genetic risk factor for ECC and underweight. Psoter et al. [13] in 2005 reviewed the relation between malnutrition and dental caries and observed that Enamel hypoplasia, salivary glandular hypo function and saliva compositional changes may be mechanisms through which malnutrition is associated with caries, while altered eruption timing may create a challenge in the analysis of age-specific caries rates. Folayan et al. [22] in 2019 observed that the frequency of sugar consumption was not a significant risk indicator when malnutrition was included as an explanatory variable for ECC in the study population. In contrast to all these supporting studies, the study by Roswitha et al. [23] in 2012 stated that definite conclusions upon an association between dental caries and weight status in high caries risk schoolchildren cannot be drawn.

LIMITATIONS

Regarding the comparison of BMI and DMFT, more conclusive results could have been attained with a larger sample size. Other multifactorial aspects of dental caries like socioeconomic status, poor or inadequate oral hygiene was not evaluated in this study.

CONCLUSION

In our population, although there was no direct significant correlation between body mass index and dental caries, the evaluation of the dietary pattern shows that 63.3% of the children needed diet modification and counseling.

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