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Original Research Article

Correlation of socioeconomic, nutritional, and hematological status in early childhood caries among pre-schoolers - a case-control study

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ABSTRACT

Background: Early childhood caries (ECC) is a widespread dental disease influenced by diet, nutritional status, and socioeconomic factors. Prevalence varies globally, with high rates in East Asia and India. There is limited research existing regarding ECC's link to nutritional assessments (e.g., BMI, biochemical indicators) and low iron levels and anemia. Psychosocial evaluations, such as socioeconomic status (SES), remain underutilized. This study compares these relationships among preschoolers in the Raichur district.
Methods: The study involved 296 preschool children (2-5 years) equally divided into those with and without ECC. A trained pedodontist conducted clinical oral exams using Gruebbel's deft index, with a deft score ≥1 indicating ECC. Nutritional status was assessed via BMI measurements, while socioeconomic status was evaluated using Kuppuswamy's 2023 SES Scale. Hematological assessment involved measuring hemoglobin levels using a digital meter after finger-prick blood collection. Standardized tools ensured accuracy in all assessments for comprehensive data collection.
Results: This study indicated that comparing BMI, SES, and hemoglobin levels between caries-free and ECC-affected children revealed significant differences. Children at risk of being overweight had higher ECC prevalence, while normal-weight children were mostly caries-free (p=0.001). Lower SES was strongly associated with ECC, with 75.7% of ECC cases in the lower class, while upper-class children were largely caries-free. Hemoglobin analysis showed ECC linked to lower hemoglobin levels (7-9 g/dl), whereas caries-free children had higher levels (12 g/dl).
Conclusions: The current study found that ECC is significantly linked to lower socioeconomic status, poor nutrition, and reduced hemoglobin levels among Raichur preschool children.

Keywords: Socioeconomic status, BMI, Hemoglobin, Early childhood caries

INTRODUCTION

Early childhood caries (ECC) remains a common disease among children globally, impacting their dental health and overall well-being.[1] The prevalence of ECC differs by location, with the highest rates observed in East Asia (36-85%), followed by India (44%) and South India (40.6%) among children under three years old.[2]

ECC is a complex bio-social disease interconnected with various biological and social elements, including diet, sociodemographic variables, biochemical imbalances, and physiological changes. The diet not only influences the development of caries but also impacts a child's nutritional status and overall growth and development.[3] Nutritional status refers to the body receiving the necessary nutrients and protection it requires, which is evident in physical and biochemical indicators.[4] Nutritional assessment is a method used to gather data on an individual's nutritional

status. There are five primary methods for evaluating nutritional status known as "ABCDE," including anthropometric, biochemical, clinical, dietary, and environmental or psychosocial evaluations.[5,6] The World Health Organization (WHO) uses anthropometric measurements like body mass index (BMI) to assess children's nutritional status, and their growth standards serve as a widely accepted reference for tracking growth and development.[7] Biochemical findings monitor the concentration of metabolites such as folates and iron using blood.[6,8] There has been limited research on the relationship between severe early childhood caries (S-ECC) and micronutrients. A study in Canada found a link between low iron levels in children and a high incidence of cavities. In the study, 11% of children were found to be anemic and 6% were lacking in iron.[9] The assessment of environmental and psychosocial factors in children, which includes evaluating economic conditions, social status, job status, and living conditions, is infrequently implemented.[10]

Studies focusing on ECC and its associations with nutritional status and socioeconomic status are conflicted. There is a lack of comprehensive data on the relationship between BMI and early childhood caries ECC, and research in this area is still in its early stages. Therefore, the present study was conducted to determine the relationship of ECC with nutritional, socioeconomic, and haematological status among pre-schoolers in the Raichur district.

METHODS

The study was designed according to strengthening the reporting of observational studies in epidemiology (STROBE) guidelines and started by obtaining approval from the Institutional Ethics Committee (AME/DC/777/24-25) of AME's Dental College and Hospital, Raichur, Karnataka, India. Prior to the start of the study, permission from the school authorities and written informed consent from the parents or other legally accepted representatives of the children were obtained.

The current study is a case-control study conducted in the Department of Paediatric and Preventive Dentistry of AME's Dental College and Hospital, Raichur from December 2023 to August 2024. The study utilized data from the "Department of School Education—Karnataka" to determine the number of schools, which were then chosen from the provided list. The sample size was calculated using G Power statistical software (3.1.9.7, Franz Faul, Universitat Kiel, Germany).

The study involved 296 preschool children aged between 2 years and 5 years, including both genders. Among them, 148 children had no caries, while 148 children were diagnosed with early childhood caries (ECC). Children with any medical conditions that could impact their oral health or nutritional intake, those with disabilities or syndromes affecting the oral cavity, those on long-term medication, and parents or children who did not want to participate were excluded from the study. Data was collected using oral examination, body mass index calculations, blood samples, and a questionnaire while ensuring the confidentiality of all information gathered during the study.

Clinical oral assessment

A single trained pedodontist performed a detailed clinical oral examination, while an assistant was present to document the results. "Gruebbel's deft index" was used to assess the level of caries in the study. The kids underwent dental examinations while seated in school chairs under regular lighting. A sterilized mouth mirror, tongue blade, and no. 23 explorer were used to examine their teeth. Cotton swabs and gauze were used to control moisture and remove plaque if needed. The deft index was employed to identify dental caries, with a deft score of 0 indicating no cavities, and a score of 1 or higher indicating ECC.

Nutritional status assessment

BMI was calculated to assess nutritional status and it involved measuring the children in minimal clothing and bare feet, on a flat, hard surface. Height was to be measured with a portable stadiometer to the nearest 0.1 cm, and weight with an electronic floor scale to the nearest 0.1 kg, calibrated at least every 6 months to ensure accuracy and reliability. BMI for children was determined using a BMI percentile calculator formula in the metric system, provided by the Centres for Disease Control and Prevention for children and teenagers.

Socioeconomic status assessment

The 2023 version of Kuppuswamy's SES Scale was employed to evaluate the SES of parents by inquiring about their occupation, educational background, and monthly earnings. This assessment helped determine the parents' SES.

Hematological status assessment

After disinfecting the blood drawing site with surgical spirit, the examiner collected blood samples from the left middle finger considering its capillary pad, and then measured the hemoglobin levels using a digital hemoglobin meter (fully automatic hemo spark hemoglobin testing meter by Sensa Core) right beside the chair.

RESULTS

The present study determined the association between SES, nutritional status, and haemoglobin values with ECC among 2 to 5-year-old preschool children in the Raichur district. A total of 296 children of both genders who met the inclusion criteria were included in this study. The 296

children were split into two groups 148 caries-free children and 148 children with ECC.

A Chi-squared test was done to compare the BMI between the two study groups, and there was a significant difference in the distribution of BMI between caries-free children and children with ECC (p=0.001) as represented in Table 1. More children who tend to be at risk of being overweight have ECC. More children who tend to be of normal weight significantly were caries-free.

Table 1: Comparison of BMI.

Caries free			Caries		
BMI (kg/m^2)	No. of children	Percent	BMI (kg/m^2)	No. of children	Percent
12.0	2	1.4	20	31	21
16.0	90	60.8	23	14	9.5
17.0	2	1.4	24	29	19.6
18.0	35	23.6	25	43	29.1
20.0	2	1.4	26	13	8.8
25.0	17	11.5	28	18	12.2
Total	148	100.0	Total	148	100.0

The modified version of Kuppuswamy's SES scale (2023) was used to assess the SES. A Chi-squared test was done to compare the different socioeconomic classes with caries-free children and children with ECC, as represented in Table 2.

Table 2: Comparison of socioeconomic status.

Socioeconomic status	Caries		Caries free	
	No. of children	Mean percent	No. of children	Mean percent
Upper	0	0.0	5	3.378378
Upper middle	0	0.0	51	34.45946
Lower middle	12	8.1	1	0.675676
Upper lower	13	8.8	0	0
Lower	112	75.7	0	0
Total	148	100.0	148	100.0

Among the caries-free children, 3.3% were upper class, 34.4% were in the upper middle and 0.6% were in the lower middle. Of children with ECC, 8.1% were lower middle, 8.8% were in the upper lower class, and 75.7% were in the lower class. A statistically significant difference was observed in the distribution of social class between the two study groups, with children with ECC associated with lower socioeconomic class and children belonging to the upper class being significantly caries-free (p=0.001).

A Chi-squared test was done to compare the different hemoglobin levels of caries-free children and children with ECC, as represented in Table 3. The hemoglobin analysis highlighted an apparent association between higher hemoglobin levels and lower caries incidence. For instance, 65.5% of individuals in the caries-free group had hemoglobin levels of 12 g/dl, whereas, in the caries group, 53.4% had hemoglobin levels of 9 g/dl. Individuals with ECC had lower hemoglobin levels (7-9 g/dl), indicating a possible link between ECC and lower hemoglobin.

Table 3: Comparison of Hb level.

Hb level (/mmHg)	Caries		Caries free	
	No. of children	Mean percent	No. of children	Mean percent
7.0	1	0.7	3	2.0
8.0	50	33.8	0	0
9.0	79	53.4	7	4.7
10	0	0.0	4	2.7
11	0	0.0	28	18.9
12.0	3	2.0	97	65.5
13.0	15	10.1	9	6.1
Total	148	100.0	148	100.0

DISCUSSION

Nutrition and socioeconomic status are the two etiological factors that are comparable to dental caries and changes in body weight. The adoption of a contemporary diet of processed foods has led to an increase in dental caries and obesity in many Asian countries, including India. These conditions have an effect on the nutritional status and general health of children.[11]

In the current study, the prevalence of ECC was 44.7%, which is similar to the 49.6% incidence of ECC noted by Ganesh et al in a systematic analysis of 54 Indian studies published in 2019.[2] In this study, the prevalence of ECC was lower than that of the African population (66.2%) and higher than that of North America (31.7%).[12] This disparity could be explained by the SES of the industrialized nations with higher SES, where the prevalence is low. Compared to nations with lesser socioeconomic status, developed nations have better dental health care and preventative measures along with a healthy diet which leads to optimal BMI of the children.

In the current study, there was a significant difference between the mean BMI scores of children with ECC and those without caries, which were 16±1.24 and 24±1.72, respectively (p=0.001), indicating that children with ECC have a greater BMI than children without caries. Similar to our study, Bangash et al (20.34±3.75) found that children with ECC in Peshawar had higher BMI values.[13] In contrast, Gaur and Nayak et al found that children with ECC in Karnataka had a low BMI score (15.49±1.87).

Eating foods that are high in refined carbohydrates may be the likely cause of obesity and overweight linked to dental caries. According to a study by Vázquez-Nava et al, children who eat fermentable carbohydrates have a 2.34-fold higher chance of acquiring dental caries than children who do not.[14] Research conducted in Karnataka's Udupi District by Sharma and Hegde and in Bhopal by Reddy et al discovered a link between childhood obesity and dental caries and found that children who favored eating fatty and sweet foods had higher body weights and more dental caries.[15] ECC and obesity are likely caused by the children being fed cariogenic and obesogenic foods, which are foods heavy in fat and sugar. But, contrary to the results of our study, dental caries was associated with underweight and malnutrition in the studies conducted by Vania et al in Italy and Oliveira et al in London.[16,17]

To provide optimal nutrition to the growing child state and central governments have taken various measures. Under the Integrated Child Development Scheme, the state offers a number of initiatives to enhance the nutritional status and general well-being of the children. Balwadis, preschool education, supplemental nutrition, vaccinations, health examinations, the Chief Minister Nutritious Meal Program, and others are among the programs. It is majorly beneficial to the low socioeconomic class children where nutritional foods are easily available in government and aided schools.

ECC and variance in BMI are also influenced by SES. In India, socioeconomic class is categorized using Kuppuswamy's scale and its revisions. A modified version of Kuppuswamy's SES Scale (2023) was used in this study to assess SES. There was a statistically significant difference between the two research groups' social class distributions, with children with ECC being linked to the lower socioeconomic class (p=0.001).

Similar results as our study were observed by Sharadha and Ashwin in Mumbai, Chopra et al in Haryana, and Abbass et al in Egypt, who found that dental caries was more common in lower socioeconomic groups. According to Sridevi et al in Sangili, children from lower middle-class families had a threefold increased risk of getting ECC. The high occurrence of dental caries in children from low-income families may be influenced by low parental education levels, which may also have an effect on oral cleanliness and eating habits. Children are therefore given more cariogenic foods, such as sweets and refined carbs, which may raise their body weight status and the occurrence of dental caries. The poor family income is linked to dental care neglect, which raises the incidence of dental cavities. An unhealthy lifestyle is also associated with a lower economic position.

Haemoglobin is a crucial component of red blood cells and is often used as a nutritional measurement to assess an individual's health, particularly in relation to anemia. Low hemoglobin levels can lead to fatigue, weakness, and other health issues that can affect a child's growth and development. Although Hb level is not a precise measure of nutritional status, it is the greatest way to test nutritional value through a variety of particular blood studies. Because the technique may be done chairside and less blood must be drawn, it is seen as acceptable. The mean values for the ECC and caries-free groups in this study were 9±1.6 gm% and 12±1.8 gm%, respectively. These findings imply that the amount of iron in children's diets was insufficient to maintain the necessary hemoglobin levels.

Shaoul et al reported a substantial and compatible correlation between low hemoglobin levels and widespread dental caries in young infants.[18] Similar to the results of our study children with widespread dental caries had significantly lower haemoglobin levels than the control group.

There are several plausible explanations for the connection between the development of ECC and a child's iron levels. An inflammatory oral tissue response linked to pulp involvement or dentoalveolar abscess, a consequence of dental caries, could be a likely cause of the low hemoglobin levels commonly observed in young infants. Progressive ECC-associated inflammation sets off a series of events that ultimately lead to the production of cytokines, which may further impair erythropoiesis and reduce blood hemoglobin levels.[19] Lowered hemoglobin levels are common in many chronic illnesses and can progress to "anemia of chronic disease" in extreme cases. One of these disorders' symptoms might be ECC.

In the present study, we found that increased BMI score, lower SES, and lower haemoglobin level are associated with increased risk of ECC.

The study's findings are limited by geographical and cultural constraints, as they focus on a specific population in India, which may not be applicable to other regions with different dietary habits, healthcare systems, and cultural practices. Additionally, the lack of longitudinal data prevents an understanding of how factors like BMI, SES, and hemoglobin levels influence the progression of early childhood caries (ECC) over time. Furthermore, the reliance on self-reported data for dietary habits, oral hygiene practices, and SES introduces potential recall and reporting biases, affecting the accuracy and reliability of the findings.

CONCLUSION

The study on the correlation of socioeconomic, nutritional, and hematological status in ECC among preschoolers in Raichur District concluded that there is a significant association between these factors and the prevalence of ECC. Specifically, children from lower socioeconomic backgrounds, with poor nutritional status, and lower hemoglobin levels were found to be at a higher risk for developing ECC.

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