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ORIGINAL ARTICLE

Deficiency of Vitamin D and Anemia among Pakistani Children with Early Childhood Caries: A Case-Control Study

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ABSTRACT

Background: Early childhood caries (ECC) are usually seen among malnourished children.
Objective: The main objective of the study was to assess that the children with early-childhood caries have a higher frequency of anemia and low vitamin D as compared to controls.
Material and Methods: A case-control study was conducted between 2020 and 2021. A total of 266 children were enrolled out of which 144 had early childhood caries and 122 were caries-free. Vitamin D, ferritin, and blood count tests were conducted. A questionnaire was filled out by the parents of the children.
Results: The results revealed that 266 children were included in the study (ECC n= 144); the mean age was 40.8 ± 14.1 months. It was observed that those Children who had ECC had low vitamin D and hemoglobin as compared to controls. There was a significant difference between low hemoglobin (<110 g/L) and 25(OH) D < 50 nmol/L (P<0.001).
Conclusion: The study showed that vitamin-D deficiency and anemia are more common among children with early childhood caries. Hence, the cause is still unknown. A complete detailed history of the diet of children with early childhood caries will help to identify the risk factors of vitamin D deficiency and anemia.
Keywords: Anemia, Children, Early childhood Caries, Vitamin D

INTRODUCTION

The definition and diagnostic criteria for Early Childhood Caries are widely disseminated, and included in the 11th edition of the WHO International Classification of Diseases (ICD-11). Hence, the American Academy of Pediatric Dentistry (AAPD) accepted a modified definition of Early Childhood Caries in 1999 (1). According to The American Academy of Pediatric Dentistry (AAPD), Early childhood caries (ECC) is defined as "Caries is a biofilm (plaque)-induced acid demineralization of enamel or dentin, mediated by saliva. The disease of early childhood caries (ECC) is the presence of 1 or more decayed (non-cavitated or cavitated lesions), missing (due to caries), or filled tooth surfaces in any primary tooth of a child 71 months of age or younger" (2). Early childhood caries (ECC) is also known as nursing bottle caries or baby bottle teeth decay, which is still a major public health issue (3). The etiology is unknown as it's unclear whether the change in nutritional status is due to caries which reduces the consumption of nutrient-rich food or other related factors which could be chronic inflammation or infectious diseases (4). Early Childhood Caries may be caused by nutritional deficiencies, especially in those children who belong to lower socioeconomic status (5). Hence a tooth-adherent bacteria named Streptococci mutants metabolize carbohydrates, create acids, and demineralize tooth structure (3). According to the World Health Organization anemia is defined "as hemoglobin (Hgb) level less than 110 g/L in children under the age of 60 months" (6). Iron deficiency anemia is usually identified as microcytic anemia (7). According to Jayakumar A et al, children with ECC had lower hemoglobin, ferritin, and are more likely to have iron-deficiency anemia (IDA) than controls (5). According to studies conducted by Schroth approximately 75% of the children in the ECC group had low levels of hemoglobin levels (8). Deficiency of vitamin D is defined as "when the serum 25(OH)D concentrations are less than 30 nmol/L, its deficiency is related to poor dental health along with hypoplasia of enamel, dental caries, and periodontal disease (9, 10). Children with ECC had significantly lower 25(OH) D than healthy age-matched controls (8). The literature research revealed that no one has looked at it in depth among Pakistani children and that children with early childhood caries are more likely to suffer from anemia and vitamin D insufficiency than children who do not have caries. The main objective of this study is to assess whether children with EEC have more frequency of anemia (Hgb110 g/L) and low serum 25(OH)D (50 nmol/L) and to determine whether there was a difference in the frequency of combined low ferritin and 25(OH)D in those with and without ECC than controls.

MATERIALS AND SUBJECTS

A case-control study was conducted between 2020 and 2021. Cases were taken from the Dental OPD of Sir Syed Medical and Dental, Hospital Karachi. At the time of dental surgery, children with dental caries were recruited from the Hospital and age-matched controls were recruited from the community via social media. A total of 266 children under the age of 72 months were enlisted, out of which 144 had early childhood caries and 122 were caries-free. For cases and controls, blood was taken at the time of the dental procedure. Following laboratory tests were taken such as calcium, albumin, ferritin, hemoglobin, and 25(OH)D levels. A 25(OH)D of less than 50 nmol/L was deemed insufficient, whereas a value of more than 75 nmol/L was deemed ideal; both were employed in these studies. The reference range for Low ferritin levels of 45 pmol/L and low hemoglobin levels of 110 g/L were also judged low (4). Iron deficiency (ID) was described as having low hemoglobin and ferritin levels (7,8). Only those mothers were included in the study that was willing to participate in the study while those who were reluctant to fill out the questionnaire were excluded from the study. A questionnaire was filled out by mothers regarding their socio-economic status, pregnancy, birth, diet, supplements, and dental history of the child. Incomplete questionnaires were discarded. For data analysis, SPSS version 23 was used. Descriptive statistics were calculated for mean, median, and correlations between variables. The deficits for cases and controls were evaluated by using paired t-tests and chi-square tests. A p-value of 0.05 or less was considered significant. The ethical approval was taken from the Ethical review board of Sir Syed College of Medical Sciences for Girls.

RESULTS

The study included a total of 266 children out of which 54.1% were boys and 45.9% were girls. There was no significant difference in age or gender between the two groups; the mean age was 40.8 ± 14.1 months (Table 1). Children with early childhood caries belonging to low socioeconomic status (P<0.001) and their BMI z-scores (P=0.001) were more than those children who were in the

control group. Significant differences were seen between groups for low hemoglobin and low 25(OH)D levels (50 or 75 nmol/L) and iron deficiency or iron deficiency anemia (OR=11.5, P=0.004) (Table 3). In the caries-free control group, none of the children had low hemoglobin and low vitamin-D level.

Table 1: Socio-demographic characteristics of children

Variables	Mean	Study groups				p-value
		Controls		Cases		
		N (%)	CI 95%	N (%)	CI 95%	
Age	40.8± 1.41	39.3± 16.3	36.4, 42.3	42 11.8	40.1,43.9	0.1
Gender					0.40,0.57	0.4
Male	136	66(54.1)	0.44, 0.63	70(48.6)	0.43,0.60	0.03
Female	130	56(45.9)	0.37, 0.55	74(51.4)	0.63,1.01	0.5
Weight(z-score)	0.67± 1.14	0.51± 1.11	0.31, 0.71	0.82	-	.001*
Height(z-score)	0.16 ±1.19	0.20± 1.18	- 0.01, 0.42	1.15	0.01,0.30	.001*
BMI (z-score)	0.84± 1.39	0.54± 1.32	0.30, 0.78	0.11	0.87,1.34	
Household income		34(28.1)	0.20, 0.37	1.21	0.56,073	
low		87(71.9)	0.63, 0.80	1.10	0.27,0.44	
high				1.40		
				85(64.4)		
				47(35.6)		

BMI Body Mass Index;
CI confidence interval;
*Significant values

Table 2: Group-wise laboratory investigations

Variables	Study groups				p-value
	Controls		Cases		
	N (%)	95% CI	N (%)	95% CI	
25(OH)D<50nmol/L	14/121(11.66%)	0.06, 0.19	29/141(20.6%)	0.14, 0.28	.001*
25(OH)D<75nmol/L	52/121 (43%)	0.34, 0.52	84/141(59.6%)	0.51, 0.68	0.007
Low Hemoglobin<110g/L	5/114 (4.4%)	0.01, 0.10	64/140(45.7%)	0.37, 0.54	.001*
Low Ferritin<45pmol/L	24/118 (20.3%)	0.13, 0.29	45/140(32.1%)	0.25, 0.41	.001*
Low MCV<75fl	18/114 (15.8%)	0.10, 0.24	23/140(16.4%)	0.11, 0.24	.001*
Iron deficiency	3/114 (2.6%)	0.01, 0.07	26/140(18.6%)	0.13,0.26	.001*
Iron deficiency anemia	7/114 (6.1%)	0.03, 0.12	34/140(24.3%)	0.17, 0.32	.001*

CI confidence interval;
MCV mean corpuscular volume;
*Significant values

DISCUSSION

The results of the study revealed that children with ECC had low levels of vitamin D and anemia, but controls did not. Vitamin D has a significant role when it comes to oral health. The results of the study revealed that children with early childhood caries belonging to low socioeconomic status have a significant association as compared to controls (P<0.001) and have a lack of awareness regarding oral hygiene. Similar results were seen in a study conducted by Angelopoulou et al. in which it was also observed that children from low-socioeconomic families have more food insecurity and have more chances of early childhood caries (11). Anemia and vitamin D deficiencies could be possibly due to a poor nutrient-rich diet. Children with early childhood caries had low ferritin and lower vitamin D status which is also explained by a lack of vitamin D-rich foods like fortified milk, margarine, or fatty fish, as well as a lack of supplement use. In a meta-analysis, vitamin D supplementation is given in the form of vitamin D2, D3, and irradiation was found to reduce the risk of dental caries in children (12). Vitamin D metabolite plays a pivot role in tooth production during the early years of children as a result of which healthy permanent teeth are formed. Literature has shown that maternal vitamin D level has a greater impact on primary teeth than children's vitamin D status at the time of dental caries in childhood (13,14). For this study, we don't have any information regarding the status of maternal vitamin D during pregnancy (15). The results of the study revealed that there is a strong association between vitamin D, Iron, and caries. Similar results were seen in a study conducted by Jin et al., in which 67 percent of children under the age of 24 months had iron deficiency anemia along with vitamin D deficiency (25(OH)D 50 nmol/L) and 53 percent of children with iron deficiency (defined as ferritin 27 pmol/L) had vitamin D deficiency, as compared to 29 percent of healthy controls (16). A study conducted in Pakistan by Saba et al. revealed that those children who suffer from an iron deficiency usually have more chances to become vitamin D deficient. As these two are essential nutrients that help in the growth and development of children unfortunately it has been neglected. The metabolism of vitamin D is responsible for the formation of red blood cells and it's still unknown how vitamin D and iron are related to the cause of EEC. Enamel production may be affected by a lack of vitamin D or calcium in the diet (18). Various studies have shown that there is a link between low intake of vitamin D or calcium and enamel formation abnormalities (19,20, 21). Approximately around, 1 billion people have a vitamin-D deficiency which plays an important role in the absorption of phosphorus and calcium through the intestine. As we are familiar with the fact that calcium and phosphorus both are responsible for the mineralization of the teeth (19). In utero vitamin-D deficiency leads to enamel hypoplasia as a result of which various defects of enamel are clinically diagnosed. Further, these defects increase the chances of colonization of bacteria ultimately leading to dental caries (21). This study helped to look at vitamin D deficiency and anemia among those children who have early childhood caries. Hence the main outcome of the study was well-analyzed due to a reasonable amount of information obtained from the research participants. The main limitation of this study was that many other laboratory tests that were beneficial for analysis were not conducted, such as serum iron, iron saturation, and CRP.

CONCLUSION

The study concludes that children with early childhood caries usually have anemia and

vitamin-D deficiencies; in such conditions, a detailed history of diet and counseling sessions should be conducted with the parents of children with a diagnosis of early childhood caries regarding intake of essential nutrients such as iron, vitamin D, and calcium. Hence there is a dire need to address these issues by developing certain preventive strategies.

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