Early Childhood Caries: Prevalance and its association with Body Weight and Anemia in Preschool children of rural areas of central India.

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Abstract

Background - Early childhood caries (ECC) is a public health problem among preschool children. One of the most common condition seen in children with ECC is malnutrition.

Objectives - This study investigated the prevalence of ECC and its association with body weight and anemia among preschool children in rural area of central India.

Materials and methods - 1332 children of age 2 - 5 years from the rural area of central India were evaluated. Anthropometric measurements and clinical tests were used to assess the nutritional status of the children.

Results - It was found that 45.1 % children were diagnosed with SECC and 9.15% and 46.08 % amongst them were anemic and iron deficient, respectively this was done based on the criteria established by the World Health Organization. 44.93% of children with SECC were classified as underweight, based on national standards for the body mass index. Multivariable logistic regression analysis was used to determine the relationship between the caries status of the children and anemia ($p < 0.05$).

Conclusion - Clinicians and dentists should provide treatment to improve both the oral hygiene and the nutritional status of children with SECC, as SECC is strongly associated with anemia (5.75-fold)

Introduction

Early childhood caries (ECC) is defined as the dental decay that affects the primary dentition in children of age younger than 6 years [1]. It is a condition faced by infants, toddlers and preschool children in developing as well as developed countries [2]. Severe forms of ECC generally have a strong impact on children's growth and development, and well-being [3], and can also have a negative impact on social and economic effects on parents and society [4]

In India, a fluctuant prevalence rate of ECC was found over the years. It varied from 55.5% in 1940 to 68% in 1960. [5] Despite the preventive measures and awareness, the prevalence rate of ECC is steadily increasing in our country. One of the significant studies conducted by Kuriakose et al 2015, the results showed an increased caries prevalence of 54%. Amongst preschool children of Trivandrum district [6]

In a recent systematic review several explanations about the relationship between ECC, malnutrition and anemia has been mentioned. [7] According to the author's the low hemoglobin (Hb) levels in S-ECC children may be attributed to the body's inflammatory response to chronic pulpitis which triggers a series of events that ultimately leads to production of cytokines which in turn may inhibit erythropoiesis and thus reduce the level of Hb in blood. [8,9] Secondly, pain experienced by S-ECC children may lead to altered eating habits resulting in anemic conditions due to poor diet. ECC leads to destruction of primary dentition causing oral pain that can interfere with eating and sleeping resulting in a child being underweight [10] and stunted [11]. However, most of the evidence on the relationship between ECC, malnutrition and anemia is inconclusive.

There is very limited data regarding the prevalence of ECC in rural population around central India population and also on the relationship between these three public health issues that have shared etiological factors. In order to design cost-effective and efficient interventions using the common risk factor approach, and targeting at-risk children in parts of the world where the problems are most concentrated it is very important to understand these relationships.

Aims and Objectives – To determine the prevalence of Early Childhood Caries amongst the children going school in the rural area of central India and its association with anaemia and body weight.

Materials and Methods

Study design – Descriptive cross-sectional study

Source population – Children from various Anganwadi centres and government aided day care-centres in the rural areas of Nagpur district in Maharashtra

Study population – Children of <60 months of age from various Anganwadi centres and government aided day care-centres in the rural areas of Nagpur district in Maharashtra.

Study setting - various Anganwadi centres and government aided day care-centres in the rural areas of Nagpur district in Maharashtra

Study period – for a period of two months from 2019 October – 2019 December
Sample size and sampling technique – The study group consisted of 1332 school going children obtained using simple random sampling.

Ethical clearance

The study was carried forward after ethical clearance from the institute. This study was conducted after obtaining parent's/ guardian's informed written consent, child's assent about study protocol in the vernacular language that is best understood by them.

Inclusion criteria

- School going Children of <60 months of age
- All the children from these pre-schools who were co-operative in the age of 2-5 years and accompanied by their parents.

Exclusion criteria

- Children with developmental enamel defects
- Children with systemic diseases

Dental examination and diagnosis

Diagnosis of SECC was based according to the diagnostic criteria established by the American Academy of Pediatric Dentistry [1]. Oral examination was done by single examiner to determine the defs scores. There was no history of prior dental treatments, including extractions, restorations, and endodontics of any participant.

Demographic information

A questionnaire was provided to parent or caregiver of each child that recorded the demographic and socioeconomic data.

Anthropometric measurements

The body weight and height of each child were recorded, and the body mass index (BMI) was calculated (in kg/m^2). The children were classified as obese, overweight, normal weight, or underweight.

Biochemical measurements

Blood samples were collected from each participant and were analyzed by the Medical laboratory, for anemia-related parameters including an evaluation of red blood cell (RBC) count, concentration of Hgb, hematocrit (Hct) value mean corpuscular volume (MCV), mean corpuscular hemoglobin concentration (MCHC), mean corpuscular hemoglobin (MCH), serum iron, transferrin (TSF) saturation. total ironbinding capacity (TIBC)

Statistical analysis

SPSS statistical software (version 21.0, USA) was used for data analysis. Statistical analyses included both descriptive and analytical tests. Descriptive data are presented as the number/percent of distributions in a tabular format. Biochemical measures were described as the median and standard deviation (SD) of the results of the blood analysis. Examinations of the relationships between the defs scores and participants' iron deficiency/anemia/growth impairment status were performed using a Chi-square analysis and statistical significance was set at $P < 0.05$. Multivariate logistic analysis was used to estimate the independent effects of the malnutrition status in the children.

Results

Of the total 1332 children, 6.9% were of 1–2 years, 24.4% were 3 years old, 38.1% were 4 years old, and 30.6% were of 5 years of age. Out of the children examined, 47.5 % were male and rest female children. 45.1 % children were having decayed teeth. Table 1 shows the distribution of sample according to decayed teeth.

No of decayed teeth	Count	Percentage
Nil	731	54.87
1-5	439	32.95
6-10	127	9.5
>10	35	2.6

Dental diagnosis

The mean standard deviation of decayed, missing, or filled teeth was 12.46 ±4.23, while that of the defs scores was 35.68 ±14.75.

Anthropometric measurement

The BMI for 271(45.09%) of the participants were within the optimal ranges for their respective categories of age and gender, based on the International Standards. (Table 2)

Body mass Index	Count	Percentage
Underweight	270	44.93
Optimal	271	45.09
Overweight	48	7.98
Obese	12	1.9

Biochemical measurements

The median, mean, and SD of the biochemical measurements are listed in Table 3. The results of blood analysis are shown as the median, mean SD. Standard ranges of RBC, Hgb, and MCV test results are described according to age-specific thresholds (from 6 months to 6 years), and the ranges of the serum iron concentration and the TIBC tests are described according to gender specific thresholds, each based on the International Standards. The definitions of iron deficiency and anemia according to age- and gender-specific thresholds were used based on standards established by the World Health Organization (WHO) [12].

Anemia was defined as an Hgb concentration below 11 g/dL or an Hct value below 33% for children aged 6 -59 months or an Hgb concentration below 11.5 g/dL or an Hct value below 34%

for children aged 5-11 years. TSF was calculated as (serum iron/TIBC) X 100%, while iron deficiency was defined as TSF saturation below 16%.

All of the anemia-related measurements were below the standard ranges as shown in Table 3, 289 of the children (48.08%) were iron-deficient [12]. 78 (12.97%) had an MCV below the reference range (minimum: 74.9 fmol), and were diagnosed with iron deficiency anemia. The test results of RBC count, Hct value, and Hgb concentration were below the reference range in 85(14.14), 88 (14.64), and 108 (17.97) of the children, respectively, and all the children within these groups were diagnosed as having anemia. As shown in Table 3, 55(9.15%) and 277(46.08) were diagnosed as being both anemic and iron-deficient based on the WHO definitions [12].

Anemia Related Measures			
Parameters	Mean (SD)	Median (Range)	Standard Range
Serum iron (mg/dL)	63.32 (33.67)	61.00 (9.00 - 246.60)	Male: 45 - 182
TIBC (mg/dL)	390.17 (251.71)	364.60 (229.30-2774.40	Female: 28 - 170
TSF (%)	17.54 (9.68)	16.49 (2.81 - 75.27)	Male: 257 - 421
MCV (fmol)	79.40 (5.29)	80.4 (59.50 - 88.90)	Female: 254 - 450
MCH (Pg)	27.08 (2.13)	27.40 (19.00 - 30.40)	16%
MCHC (g/dL)	34.07 (0.74)	34.10 (34.10 - 36.40)	74.9 -84.6
RBC (X 10^6 /mL)	4.70 (0.42)	4.66 (3.66 -6.12)	25.2- 29.1
Hct (%)	37.15 (2.60)	37.10 (30.8-47.70)	32.6- 35.1
Hgb (g/dL)	12.60 (0.92)	12.7 (10.3-15.20)	4.28- 5.05

Chi-square analysis of associations between the defs score and malnutrition status (anemia/iron deficiency/underweight)

A defs score ≥ 35 was significantly associated with anemia (7.32%, $p < 0.021$) (Table 4). Although no significant differences were observed in malnutrition and iron-deficiency status, 28.8% of the children with defs scores ≥ 35 were underweight, whereas 16.63 % of the children with defs scores < 35 were underweight.

Table 4. Analysis of dental status and anemia/irondeficiency/malnutrition status in children with severe early childhood caries (n = 601).

Clinical Category	≥ 35 defs		< 35 defs		Chi Square test
	N	%	N	%	P value
Body Mass Index					
Underweight	170	28.28	100	16.63	0.145
Optimal	173	28.78	98	16.30	
Overweight	19	3.16	29	4.82	
Obese	5	0.8	7	1.1	
Anemia					0.021*
Yes	44	7.32	11	1.83	
No	325	54.07	221	36.77	
Iron Deficiency					0.168
Yes	174	28.95	103	17.13	
No	156	25.95	168	27.95	

Multivariable logistic regression analysis of associations between defs score and anemia

Multivariable logistic regression showed that defs scores ≥35 significantly correlated with anemia while adjusting for age, gender and BMI for confounding factors. Children with a defs score ≥ 35 were shown to be at a 5.75-fold higher risk for anemia, compared with those with defs scores < 35 (95%CI =1.39-69.34; p=0.041)

Discussion

The present study described the prevalence of ECC amongst preschool children of rural population around Nagpur city and its association with body weight and anemia. Children with ECC were found to be at risk for anemia and iron deficiency. 9.15% were diagnosed with anemia, and 46.08% were diagnosed with iron deficiency [12]. Multivariable logistic regression was used to find the status of caries. It was found that (defs score ≥ 35) was independently associated with anemia. Only one study has investigated the status of anemia and iron deficiency in children with ECC [6]. RS Tang et al. (2012) reported a lesser prevalence of anemia (11%, Hgb < 110 g/L) and lower prevalence of iron deficiency (18%, serum ferritin < 10 mg/L) in children with ECC than were observed in the children with ECC in our study [9]. Although the prevalence of anemia reported by Kuriakose et al. (2015) was higher than that obtained from our results, consideration should be given to the differences between the methodologies and sample size used in the two studies. Moreover, present study uses the definitions and standards of anemia and iron deficiency established by the WHO criteria.

Anemia can be caused by several factors, including dietary factors, genetic (congenital) factors, environmental factors [14,15], and inflammatory processes. Children with ECC may have higher rates of anemia and iron deficiency for various reasons. Children with ECC may consume cow's milk excessively, which reduces the absorption of iron [16]. In addition, children with ECC have untreated caries that often cause pain or discomfort, and they may thus have difficulty in chewing certain iron- and vitamin C rich foods, such as red meat and citrus fruits, respectively [17]. Furthermore, children with SECC may suffer from acute or chronic inflammation, resulting from pulpitis and periapical abscess and fistula, and such inflammatory complications may induce the production of cytokines that suppresses the synthesis of Hgb [12]. In present study, children with anemia suffered a greater amount of injury to their teeth according to their defs scores, compared with the children without anemia. Such greater injury is likely to have a greater effect on their health, based on the preceding status. In our study, 30% of participants were underweight (30/101). A recent study showed that the prevalence rate of underweight children with SECC was 4% [9]. Other studies report that children with SECC are significantly shorter and possess lower average weights than children with complete dental rehabilitation [10,11]. Poor sleep quality resulting from dental pain may contribute to decreases in the production of glucosteroids, which may also impair growth [12]. Although 46% of our participants had iron deficiencies, almost none had calcium levels below the reference range. The concentration of serum iron is often influenced by dietary factors [17,18], and iron absorption can be depressed by excessive calcium intake. Prolonged breastfeeding and the early introduction or increased consumption of cow's milk was associated with an increased risk of iron deficiency in children in Australia, Canada, New Zealand, and the United Kingdom [18]

Limitations

The study design was cross-sectional, which does not allow for the determination of true cause and effect. It was extremely challenging to find caries free age matched controls to participate in the study. The study sample was small; hence the findings of the study need to be confirmed in large sample groups.

Despite the limitations, the clinical importance of this study is that S-ECC has been identified as a risk marker for IDA. The results suggest, however, that physicians and dentists treating young children should consider that S-ECC is a risk marker for anemia. For physicians, nutritional deficiencies should alert them to the possibility that S-ECC is present and is a possible explanation for the deficiencies in their patients. For dentists, children presenting with S-ECC should be considered at risk for nutritional deficiencies that may affect long-term health and well-being.

Conclusion

ECC may be a contributing factor for iron deficiency, anemia, and impaired weight gain in young children. ECC (defs score $\geq$ 35) may represent a risk factor for anemia in preschool children. Further studies are needed to examine lifestyle and socioeconomic risk factors that may be associated with the malnourished status of these children. Preventive strategies should be developed to reduce the risk of anemia, iron deficiency, and impaired weight gain in children with ECC.

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