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The association between growth factors and blood factors with early childhood caries

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Original Article

Abstract

BACKGROUND AND AIM: Early childhood caries (ECC) is a specific form of rampant dental caries affecting infants and young children. ECC is still a problem that threatens the health of the community and its management is important. It is believed that the majorities of children with ECC also suffer from malnutrition, anemia, low weight and altered physical growth patterns. This study was undertaken to compare blood indices [mean corpuscular volume (MCV), hemoglobin and serum ferritin] in a population of children in Kerman, Iran, and the association between growth factors, blood parameters, and ECC.

METHODS: In this cross-sectional study, 240 children were selected from Afzalipour Hospital of Kerman. The subjects consisted of 2 to 6-year children, who needed blood sampling for different diagnostic reasons. Data were collected through clinical oral examinations, anthropometric measures, blood indices measurement (MCV, hemoglobin and serum ferritin) and structured questionnaire in order to assess demographic characteristics, nutritional habits and the presence or absence of systemic conditions. Data were analyzed using SPSS software.

RESULTS: The mean age of subjects was 50.79 months. Of 240 children included in this study, 124 (52.1%) were girls and the rest (47.9%) were boys. Statistical test revealed that there were statically significant differences in weight as well as the height of children in experimental and control groups ($P < 0.050$). No significant differences were detected in the frequencies of low hematocrit levels between the groups with and without dental caries ($P > 0.050$).

CONCLUSION: No significant association was observed between ECC and blood indices (MCV, hemoglobin and serum ferritin), but the mean height and weight in the caries-free group were significantly higher.

KEYWORDS: Dental Caries; Iron Deficiency; Anemia; Preschool Child; Growth Factors; Blood Factors; Early Childhood Caries

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Dental caries is a transmissible infectious disease and its initiation and progression are affected by various factors.[1] It has been demonstrated that children with higher counts of Streptococcus mutans and Lactobacilli are 5 times more prone to have early childhood caries (ECC) as compared to those with lower counts of these bacterial species.[2]

The American Academy of Pediatric Dentistry (AAPD) has defined ECC as the presence of one or several tooth surfaces (cavitated or non-cavitated) which have been lost or restored due to caries in any of the primary teeth in 71-month or younger children.[3] It has been shown that children of

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families with low socioeconomic status, irrespective of culture and ethnicity, suffer from this condition more than other groups. In general and based on the studies carried out in almost all the countries, varying prevalence rates have been reported in different age groups.

ECC has been reported to be the most common chronic disease in children in the United States. Dental caries is five times more common than asthma and seven times more common than hay fever.[4] Furthermore, the prevalence of ECC in Iran has been reported to be 3-44% in different parts of the country,[5–7] which necessitates further research about the condition and evaluation of techniques to deal with it. The current knowledge on the effects of ECC on the nutritional status of children is not sufficient and it is believed that the majorities of children with ECC also suffer from malnutrition, anemia, low weight and altered physical growth patterns.[8]

Despite the epidemic nature of dental caries and iron deficiency, limited studies are available on the association between these two entities. ECC is still a problem that threatens the health of the community and its management is important. ECC might lead to the malocclusion of permanent teeth, phonetic problems, and low self-confidence. Continuous and unbearable pain in young children, such as a toothache, have serious and sometimes irreversible effects on the growth and development of children.[9] Moreover, caries is more prevalent in deciduous teeth. This phenomenon itself is one of the most important factors in shifting caries to newly erupted permanent teeth.[10] The children's health affects their nutrition, sleep, smile, speech, and socialization. In addition, the facial appearance affects the children's mental health and, subsequently the establishment of social relationships.[11] Furthermore, clinicians have also found that an attractive appearance and social acceptance can help the person in achieving social success.[12] Based on a research, weight gain and other parameters related to the growth and development of children are normal when the teeth are healthy, which might be attributed to the efficacy of mastication and proper nutrition.[13]

ECC predisposes more severe dental conditions in future,[14] and increases the sensitivity of children to somatic pains. Limitations in selecting food, decreased appetite, anorexia and a decrease in food enjoyment are complications that associate dental caries with weight loss, delayed growth and poor development.[15–17] On the other hand, it has been demonstrated that the weight loss is compensated after the dental health has been improved.[18] Therefore, identification of malnutrition risk factors results in a decrease in its occurrence, which in turn improves the children's health-related indices.

The present study was undertaken to evaluate growth and blood factors in children with ECC.[19] Therefore, the possible role of some factors relevant to malnutrition in this type of dental caries would be elucidated.

Methods

This cross-sectional study was undertaken using clinical examination. A checklist, including demographic characteristics (age, sex) and the presence or absence of systemic conditions, was completed by an examiner (a trained pedodontist) on 240 children. All the 2 to 6-year children in the pediatric department of Afzalipour Hospital of Kerman, south-east of Iran, who needed blood sampling for different diagnostic reasons, were included in this study through random sampling. The parents were asked about children's feeding pattern during infancy and birth weight. The ethical code (K/88/07) was allocated to this study by the Oral Diseases Research Center of Kerman. The parents signed an informed consent form for the participation of their children in the study.

Children with ECC were compared with a control group of caries-free children. Two groups of children were included in this study. The inclusion criteria were as follows: no specific physical or systemic condition related

to ECC or iron deficiency as reported by the parents, absence of severe renal insufficiency and hypothyroidism (anemia is one of the complications of these two medical conditions), an age range of 2 to 6 years. Children with systemic disease, severe renal insufficiency and hypothyroidism were excluded.

The children underwent a clinical examination under a 100-W light using disposable dental mirrors and explorers and placed in one of the following groups. G1: caries-free, G2: decalcification on the maxillary incisors, G3: cavity on the maxillary incisors, and G4: decalcification on some maxillary incisors and cavities on some others.[20]

The clinical evaluation of the nutritional status involves several tests to correctly determine the presence of malnutrition. The clinical parameters of children including height, weight and the upper mid-arm circumference (MAC) were measured. The MAC was measured on the right side. A tape measure, with no capacity to be stretched, was used for such measurement. To this end, the examiner measured the distance between the acromion process of the scapula and the elbow, determined the middle point, and then measured the circumference of the arm at this point without exerting any pressure on the arm.[21] The most important blood tests that might indicate iron deficiency are hemoglobin, ferritin sodium and to a lesser extent mean corpuscular volume (MCV),[22] which were evaluated in the present study. Based on a definition by World Health Organization (WHO), a hemoglobin level under 11 or a hematocrit value under 33% in 6 to 59-month children, and hemoglobin levels under 11.5 or hematocrit levels under 34% in 5 to 11-year children indicate anemia.[23] If iron deficiency anemia is assessed based on serum ferritin levels, at ages under 5 and ages between 5 to 15 years, ferritin levels under 12 and 15 are considered abnormal, respectively.[24]

Data were analyzed using SPSS software (version 20, IBM Corporation, Armonk, NY, USA). Mean ± standard deviation (SD) and number (percentage) were used for data description. Analysis of variance (ANOVA), Student's independent t-test, and chi-square or Fisher's exact tests were used for data analysis. Statistical significance was set at $P < 0.050$.

Results

A total of 240 children were included in this cross-sectional study. 124 subjects (52.1%) were girls and the rest (47.9%) were boys. Table 1 shows frequency distribution of the children according to sex, feeding pattern, caries status, birth weight, and blood parameters. Demographic characteristics and selected blood tests between ECC and control groups have been shown in table 2. ANOVA test outcomes showed that only the mean height in the caries-free group was significantly higher than that in other groups (Table 3).

Table 1. Distribution of the children according to sex, feeding pattern, caries, birth weight, and blood parameters

Parameter		n (%)
Sex	Female	124 (51.7)
	Male	116 (48.3)
Feeding pattern	Breastfeeding	166 (69.2)
	Bottle feeding	36 (15.0)
	Both	38 (15.8)
Blood test	Normal	84 (35.0)
	Decreased	156 (65.0)
Weight at birth time	Normal	220 (91.7)
	Low birth weight	20 (8.3)
Caries	Caries free	83 (34.6)
	Decalcification of anterior upper teeth	18 (7.5)
	Cavity on anterior upper teeth	126 (52.5)
	Decalcification in some teeth and cavity in others	13 (5.4)

Table 2. Demographic characteristics and selected laboratory tests among 2 to 6-year Iranian children

Characteristic	Caries	
	No (n = 83)	Yes (n = 159)
Ferritin (ng/ml) (mean ± SD)	34.63 ± 19.16	34.39 ± 24.93
Hb (g/dl) (mean ± SD)	12.37 ± 1.02	12.50 ± 2.48
Height (cm) (mean ± SD)	99.53 ± 14.15	96.94 ± 9.97
MAC (mean ± SD)	15.09 ± 2.74	14.98 ± 1.66
MCV (mean ± SD)	77.61 ± 4.59	76.80 ± 5.64
Weight (kg) (mean ± SD)	16.34 ± 4.24	15.22 ± 3.29
Age (month) (mean ± SD)	51.87 ± 16.45	50.23 ± 14.42

SD: Standard deviation; Hb: Hemoglobin; MAC: Mid-arm circumference; MCV: Mean corpuscular volume

The 4 groups were converted to two groups, with and without caries, and re-analyzed. Student's independent t-test analysis showed that only the mean weight of children who had no caries was significantly higher than children with any type of caries.

In addition, Fisher's exact test did not exhibit any significant differences in the frequencies of low hematocrit values and low birth weight between the different age groups with caries. Similarly, chi-square test did not show any significant differences in the frequencies of low hematocrit values and low birth weight between the two groups (Table 4).

Based on the results, the mean height of caries-free children was significantly higher than the children with caries. The mean weight of caries-free children was significantly higher than that of children with caries. There were no significant differences in the frequencies of low hematocrit levels between groups with and without caries. The frequencies of low birth weight were not significantly different between groups with different caries rates. There were no significant differences in the frequencies of low birth rates between groups with and without caries.

Discussion

At present, there are insufficient data on the relationship between caries and iron deficiency. Meanwhile, the available data are contradictory. In this study, children with ECC and caries-free children were included to evaluate the relationship between MCV, hemoglobin, and serum ferritin levels and dental caries. Height, weight and MAC of all participants were measured.

To date, only a limited number of studies have assessed the nutritional status of young children with ECC. In a study, the clinical criterion used for the diagnosis of ECC was the presence of smooth surface caries on 4 maxillary incisors.[25] In the present study, the clinical criterion for the diagnosis of ECC was the presence of smooth surface caries with cavities or decalcification on 4 maxillary incisors. Initial studies have shown that children with ECC might have lower mean weight, compared to caries-free children.

Table3. The comparison of measured parameter between four groups according to caries stages

Parameter	Caries free (n = 83)	Decalcification of anterior upper teeth (n = 18)	Cavity on anterior upper teeth (n = 126)	Decalcification in some teeth and cavity in others (n = 13)	P*
Weight (kg) (mean ± SD)	16.34 ± 4.25	14.07 ± 2.33	15.41 ± 3.26	15.03 ± 4.47	0.060
Height (cm) (mean ± SD)	99.54 ± 14.15	93.28 ± 11.99	97.98 ± 9.43	91.65± 10.32	0.040
MAC	15.09 ± 2.74	14.36 ± 0.92	15.08 ± 1.66	15.00 ± 2.11	0.570
Hb (g/dl) (mean ± SD)	12.38 ± 1.02	12.52 ± 1.04	12.27 ± 1.12	12.46 ± 0.95	0.710
Ferritin (ng/ml) (mean ± SD)	34.63 ± 19.10	24.39 ± 13.93	35.62 ± 26.51	38.66 ± 18.78	0.240
MCV	77.61 ± 4.59	77.92 ± 6.28	76.58 ± 5.74	77.47 ± 3.87	0.480

*Analysis of variance (ANOVA)

SD: Standard deviation; MAC: Mid-arm circumference; Hb: Hemoglobin; MCV: Mean corpuscular volume

Table 4. The comparison of measured parameters between two groups [with and without ECC (early childhood caries)]

Parameter	Caries		P*
	No (n = 83)	Yes (n = 157)	
Weight (kg) (mean ± SD)	16.35 ± 4.25	15.23 ± 3.29	0.040
Height (cm) (mean ± SD)	99.54 ± 14.16	96.91 ± 9.99	0.130
MAC	15.09 ± 2.75	14.99 ± 1.64	0.740
Hb (g/dl) (mean ± SD)	12.38 ± 1.02	12.31 ± 1.10	0.660
Ferritin (ng/ml) (mean ± SD)	34.63 ± 19.16	34.58 ± 25.01	0.980
MCV	77.61 ± 4.59	76.81 ± 5.66	0.260

*Student's independent t-test

SD: Standard deviation; Hb: Hemoglobin; MAC: Mid-arm circumference; MCV: Mean corpuscular volume

Therefore, it has been suggested that these children might not have received adequate calories.[26,27] In this study, only the weight of children, who were caries-free, was significantly higher than that in children with caries.

Thomas and Primosch compared the weight of children with ECC, with the reference norms for children, and concluded that children with ECC had no noticeable weight loss.[27] The limitation of that study and similar studies is the fact that they have used only the children's weight as a criterion for the evaluation of their nutritional status, which is not sufficient for the evaluation of the clinical nature of nutrition. On the other hand, Bagherian and Sadeghi evaluated the relationship between body mass index (BMI) and dental caries in preschool children, where they showed a higher rate of dental caries in overweight children. They attributed this problem to the possible relationship between a higher intake of high-calorie foodstuffs deficient in nutritive materials by these children.[28] Several studies support these findings.[29-32]

Similar to our results, Gaur and Nayak suggested that severe ECC negatively influenced the children weights. Awareness and parents' education may help in improving their weights.[33] Clarke et al.[22] evaluated the nutritional status of children with ECC using different clinical criteria. The clinical measurements consisted of height, weight and MAC. In addition, they evaluated the blood samples of the subjects for hemoglobin, MCV and serum albumin and ferritin levels. These measurements were compared with those in a control group. The results of the study suggested that ECC might be a risk maker for iron deficiency anemia. In their study, 80% of the subjects exhibited low serum levels of ferritin and in 28% of children, the hemoglobin levels were lower than the standard levels. Interestingly, after rendering dental treatments to children with ECC, their ferritin and hemoglobin levels were improved.[22]

Shaoul et al. showed a significant relationship between ECC and low serum levels of ferritin.[34] However, the mechanism of the relationship between iron deficiency and dental caries is unknown. Several hypotheses have been proposed in this regard to date. A hypothesis, based on a study by Gaur and Nayak,[33] suggests that a decrease in hemoglobin levels can be associated with inflammatory responses in the human body. The inflammatory responses in ECC might result in the production of cytokines that inhibit the synthesis of erythrocytes and decrease hemoglobin levels. A decrease in hemoglobin levels is common in many chronic diseases. Furthermore, severe ECC (S-ECC) is known as a chronic disease.

Schroth et al. reported that children with ECC have altered dietary habits that can predispose them to nutritional deficiencies such as iron deficiency.[3] Fretham hypothesized that iron deficiency in children leads to a decrease in mental capacities, a decrease in motor skills and an increase in anxiety levels. Early diagnosis of such

deficiency, for example by detecting ECC in children, might result in the early initiation of treatment.[35] Unlike these studies, our result did not depict any association between ECC and blood parameters.

One of the shortcomings of the present study was the inability to match the samples completely. Although a consistent age range was considered for all the samples and the subjects were evaluated separately in relation to their sex, socioeconomic matching was not possible. S-ECC is more prevalent in children with lower socioeconomic status[36] and it is more difficult to find caries-free subjects in these socioeconomic levels. According to the important role of various factors in the induction of S-ECC, such as family income and the parents' educational levels, it is not possible to extend the results of this study to the whole community. Despite the limitations of this study, our results added the association investigation between ECC and blood parameters and developmental indices to the literature and provided additional evidence for the complexity of this relationship.

Conclusion

No significant associations between ECC and blood parameters were observed. However, lower height and weight were significant determinants of caries experience. Finally, it is suggested that height, weight, and diet of children with ECC should be more precisely evaluated periodically.

Conflict of Interests

Authors have no conflict of interest.

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