Original Article

Association of severe early childhood caries with salivary ferritin

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Abstract

Aim: To evaluate salivary ferritin levels in children with severe early childhood caries (ECC). **Materials and Methods:** One hundred twenty participants were split into a study group that consisted of 60 children with severe ECC (dmft ≥5) and a control group that was free of caries. Both groups were age and gender-matched. Saliva was collected from both groups. Salivary ferritin was assessed using chemiluminescence microparticle immunoassay. The data obtained were statistically analyzed. **Results:** Salivary ferritin levels were higher in children with severe ECC (159.53 ± 18.65 μg/dl) compared to children with no caries (92.16 ± 12.91 μg/dl) and a highly significant statistical difference was seen ($P < 0.001$). **Conclusions:** Salivary ferritin levels were high with children having severe ECC.

Keywords: *Candida albicans*, early childhood caries, iron deficiency anemia, salivary ferritin

Introduction

One of the highest prevailing infectious diseases involving children today is dental caries. Caries in children less than 71 months is known as early childhood caries (ECC) and has been considered as a leading public health epidemic.[1] Severe ECC (S-ECC) is any manifestation of smooth surface caries in children younger than 36 months of age.[2,3] From ages 3 through 5, 1 or more cavitated, missing (due to caries), or filled smooth surfaces in primary maxillary anterior teeth or a decayed, missing, or filled score of ≥4 (age 3), ≥5 (age 4), or ≥6 (age 5)surfaces constitutes S-ECC. ECC has been found to produce detrimental psychological and emotional effects often leading to change of diet and nutrition, unaesthetic appearance, and reduction in social activities and school attendance.[1,3]

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Received: 02-01-2020 **Revised:** 11-03-2020
Accepted: 03-04-2020 **Published:** 25-08-2020

Access this article online

Quick Response Code:

Website: www.jfmpc.com

DOI: 10.4103/jfmpc.jfmpc_9_20

Saliva is a complex fluid present that encompasses the tissues of the oral cavity. It consists of various organic and inorganic substances that are required for host protection and can act as a biomarker for detection of dental caries.[4]

Iron is a vital mineral for the human body; it is crucial to maintain intrinsic iron equilibrium since iron derangement in the body can advance into multiple clinical illnesses. Ferritin is the storage protein for iron, which releases/liberates it in a restrained manner for essential cellular processes.[4] Though ECC has been associated with iron deficiency anemia and serum ferritin,[5] no study has been done to see the association of salivary ferritin (SF) with ECC or S-ECC. Hence, this study was initiated to determine the level of SF in S-ECC patients and to assess its reliability as a biomarker for S-ECC.

Materials and Methods

Study was approved by Review Board of Saveetha Dental College, Chennai, India. The study population consisted of patients visiting the Department of Pediatric Dentistry. Inclusion criteria for the study included children aged 4 years with with

How to cite this article: Rajkumaar J, Mathew MG. Association of severe early childhood caries with salivary ferritin. J Family Med Prim Care 2020;9:3991-3.

S-ECC (decayed, missing or filled ≥5) who never underwent dental treatment and did not take any medicines, which could alter ferritin levels and were not medically compromised. Sixty children with S-ECC who fulfilled the inclusion criteria were included in the study group. The control group consisted of 60 children who were free of caries and were age and gender-matched to the test group.

Parents were explained in both English and local languages about the study in detail and were given a chance to clear their doubts and informed consent was obtained. Until sample selection, the children were asked to avoid consuming food or liquids and doing oral hygiene. Children were asked to accumulate saliva in their mouths and transfer into a plastic vessel, which was then transported to a centrifuge tube. Centrifugation was done at 4°C at 13000 rpm for 20 minutes. SF was estimated using chemiluminescence microparticle immunoassay. Blood samples were collected to determine hematological variables. Data were analyzed using Statistical Package for the Social Sciences (SPSS).

Results

A total of 120 children participated in the study, each group consisting of 60 children. There was no statistically significant difference between groups regarding physical characteristics [Table 1]. The mean age of cases was 4.2 ± 0.9 years and that of controls was 4.1 ± 0.7 years [Table 1]. There was a highly significant statistical difference in SF levels between the study (159.53 ± 18.65 μg/dl) and control groups (92.16 ± 12.91 μg/dl), the data which is presented in Table 2. Table 3 showed that there was significant differences in Hb and mean corpuscular volume (MCV) between two groups.

Table 1: Sample distribution in the study and control group

Parameter	Study group	Control Group	*P*
Age (Years)	4.2±0.9	4.1±0.7	0.712
Sex	Male - 34 (56.7) Female - 26 (43.4)	Male - 32 (53.4) Female - 28 (46.7)	0.795
Weight (Kg)	15.2±2.4	15.8±2.9	0.678
dmft	9 (5-17)	0	<0.001

Table 2: Salivary ferritin values in the study and control group

Parameter	Study group	Control Group	*P*
Salivary Ferritin	159.53±18.65 μg/dl	92.16±12.91 μg/dl	<0.001

Table 3: Comparison of blood variables between study and control group

Blood variables	S-ECC	Controls	*P*
Hb (g/dl)	9.6±1.2	13.2±1.8	<0.001
MCV (μm³)	71.2±4.7	89±7.9	<0.001
PCV (%)	33.4±2.1	36.2±1.9	0.482
MCHC (g/dl)	31.8±2.6	34.2±1.4	0.423

Hb: Hemoglobin; MCV: Mean corpuscular volume; PCV: Packed cell volume; MCHC: Mean corpuscular hemoglobin concentration

Discussion

An increase in ECC was seen in many countries and significantly affected the socially disadvantaged populations.[1] The association of ECC with various other health problems such as malnutrition, gastrointestinal disorders, pain, and insomnia has made it a major public health problem.[6,7] The use of saliva as a biomarker for ECC is becoming popular as it is noninvasive, safe, and easy to handle and transport, easy to collect, and economical.[4]

Iron is an essential element, which is required for several biological processes. Iron deficiency is the most common and widespread form of nutritional deficiency worldwide, estimating that one third of world population could be suffering from iron deficiency anemia (IDA).[8] However, the relationship between ECC and anemia is controversial. Sadeghi *et al*.[9] and Clarke *et al*.[10] found an inverse relationship between ECC and SF. This was in contrast to Schroth *et al*.[11] who found significantly low serum levels in children with S-ECC. However, a systematic review by Hashemi *et al*.[7] concluded that ECC is a risk factor for anemia, thus connecting two major public health problems. The results of blood variables in our study suggest that children in the study could be suffering from IDA, which could be due to tooth pain, which could have restricted dietary consumption.

The role of SF with caries has not yet been explored. Jagannathan *et al*.[5] stated that SF is a prognostic marker for IDA. This could be due to the fact that conservation of iron for iron-deficient anemic patients was occurring through iron-dependent enzymatic functions. The incidence of oral candidiasis has been found to be markedly increased in iron deficiency anemia patients as the oral epithelial cells are susceptible to damage by *Candida albicans (C. albicans)*, a fungus which has been associated with ECC. *C. albicans* uses ferritin as an iron source, which could be the reason for high SF levels in SECC but not in the control group. High ferritin levels in cells of the oral epithelium are directly associated to destruction caused by *C. albicans*.[5,12,13] Recent studies have shown that iron is at the center of interaction for *C.albicans* and ferritin plays a key role in it.[14] *C. albicans* has shown multiple approaches to acquire iron from the host and ferritin has promoted the process.[15] Children with high *C. albicans* count have five times higher chance to develop ECC compared to those without *C. albicans*,[16] suggesting potent cariogenic characteristics, which lead to the development and progression of S-ECC.[17] A recent study has shown that microbial accumulation occurs on preformed crowns, which can lead to development of new carious lesions.[18] Various studies have shown that iron deficiency can be a risk factor for ECC.[19,20] Iron has a cariostatic effect[20] but the lack of iron due to anemia and *C. albicans* could hinder the outcome. Thus, *C. albicans* could be a link in the relationship between ECC and IDA and help in solving these two conditions. Hence, the importance of oral hygiene and proper nutrition should be taught to parents and children by not only dentists

but also by primary care physicians and pediatricians. Children with S-ECC often find difficulty in eating due to pain, which leads to malnutrition and even lead to failure to grow and thrive.

This study explored the levels of SF in children with S-ECC. The exact mechanism in which ferritin rises is still not clear. However, the results of this study might suggest that *C. albicans* may play a role in the association between ECC and IDA. This has never been reported before and only research in this direction in the future will help us to understand this better.

Conclusions

The results of our study highlight that a relationship exists between SF and S-ECC. Dental caries experience was directly proportional to SF levels. Within the limitations of our study, we can conclude that a relationship exists between SF and S-ECC. Further studies will be needed to understand the mechanisms that determine high SF levels.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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