Association between DMFT Score and Iron Studies in Children up to 12 Years

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ABSTRACT

Background: Iron deficiency anemia (IDA) is a major health problem in both developing and developed countries. However, it can be diagnosed only by laboratory testing. Severe tooth decay is known to affect the health and well-being of children. The purpose of this research was to determine if dental checkup could be used as a screening test for IDA. Aims and Objectives: The objective of this study is to find: (1) An association of decayed, missing, and filled teeth (DMFT) index with the serum ferritin and hemoglobin (HB) levels and (2) if DMFT index score can be used as a screening test for diagnosis of IDA. Materials and Methods: Children were recruited as a part of a cross-sectional case-control study. They were recruited from the dental and pediatric OPD of MIMER Medical College from April 2016 to June 2016. The study included 119 cases (those with a DMFT score of more than 0) and 47 controls. The study was approved by the college ethical committee. The parents gave an informed consent and the children then underwent a venipuncture. The blood collected was sent to the central laboratory where a complete hemogram and serum ferritin was done. The data collected were analyzed using appropriate technology. Results: The mean age was 8.5 ± 2.5 years. Overall, the mean serum ferritin concentration was 30.82 ± 20.86 ng/ml (range 6–55 ng/ml), and the mean HB level was 12.04 ± 1.24 g/dl (range 11.5–14.5 g/dl). It was found that the cases were much more likely to have lower levels of HB. It was found that there was a moderately significant negative correlation between serum ferritin and the individual scores. Conclusion: Based on the findings from this study, we can conclude that: (1) HB levels are significantly associated with the presence of caries and (2) children with higher DMFT scores tend to have lower serum ferritin levels.

Key words: Childhood caries, dental caries, decayed, missing, and filled teeth score, iron deficiency anemia

INTRODUCTION

Iron is an essential mineral. It is an important constituent of hemoglobin (HB). Its lack is causing a major health problem in developing and developed countries.[1] Deficiency of iron can lead to iron deficiency anemia (IDA). As compared to adults, iron deficiency in children, especially in their early stages of development, may have greater consequences. An iron deficient infant may have neurological symptoms which may affect his learning ability and memory among other malnourishment signs and symptoms. Definite results of iron deficiency can only be determined through laboratory testing. The two tests used to diagnose IDA is testing blood HB levels and testing serum ferritin levels. HB is a protein found in the blood. Iron is important for its formation; hence, it can be used as an indirect indicator for measuring iron levels in the body.
Serum ferritin is a globular protein consisting of 24 protein subunits and is the primary intracellular iron storage protein in both prokaryotes and eukaryotes, which assists in keeping iron in a soluble and non-toxic form. Serum ferritin is the key to this important control of the amount of iron available to the body. Serum ferritin is a protein that stores and releases iron in a controlled fashion. In the setting of anemia, low serum ferritin is the most specific laboratory test for IDA. However, it is less sensitive, since its levels are increased in the blood by infection or any type of chronic inflammation, and these conditions may convert what would be a low level of serum ferritin from lack of iron, into a value in the normal range. For this reason, low serum ferritin levels carry more information than those in the normal range.

Dental caries are breakdown of teeth due to various bacteria. It is a major health problem among children. Since there is pain on chewing, there is loss of appetite, and as a result, the child suffers from various nutritional deficiencies, iron deficiency being one of them. The lifestyle and frequent hospitalization of anemic children raise the prevalence of dental caries as a result of improper oral hygiene and the regular use of specific medications. In a study conducted in among preschool children in Taiwan, the researchers state that 46% and 9% of the children with S-ECC (severe dental caries) were recognized as being iron deficient and anemic, respectively. Thus, children with S-ECC were at greater risk for anemia and iron deficiency.

The decayed, missing, and filled teeth (DMFT) index has been used for more than 70 years and is well-established as the key measure of caries experienced in dental epidemiology. Despite the fact that the relation between the HB level factor and the prevalence of caries has already been investigated, there is actually evidence that minimal data are available regarding the relation between the DMFT index and HB levels.

This study was, therefore, taken up to try and determine if there really is a correlation between IDA and dental caries. The main aim of this research was to determine if dental checkup could be used as a screening test for IDA. This was intended to reduce the amount of skilled labor involved in diagnosis of IDA. It also would reduce the pain and discomfort the child would go through to get diagnosed. In addition, it would ensure the prevention of iron deficiency through simple maintenance of good oral hygiene.

**Aims and Objectives**

The objective of this study is to find:

1. An association of DMFT index with the serum ferritin and HB levels.
2. If DMFT index score can be used as a screening test for diagnosis of IDA.

**MATERIALS AND METHODS**

It was a cross-sectional case-control study. The children were recruited from the dental and the pediatric OPD from BSRT rural hospital. It was a duration of 2 months from April 2016 to June 2016. A total of 166 children were recruited as a part of the study. 119 were cases and 47 were controls. The study was approved by the college board of ethics. The parents or the guardians of all participating children provided an informed consent.

The inclusion and exclusion criteria were as follows: Inclusion criteria included children in the age group of 5–12 years. They had no chronic illnesses, allowed for an intraoral examination and blood collection, and had the consent of the parents or guardians to participate in the study. Exclusion criteria were the children with acute or chronic illnesses, systemic diseases, psychiatric or neurological disorders, or other factors that precluded oral examinations or any known blood dyscrasias or known hemoglobinopathies. Those who had undergone an abdominal surgery or with any malignancies were also excluded along with those taking iron or vitamin supplements or undergoing dental procedures or who had taken blood transfusion in the recent past.

Controls were defined as those whose DMFT score was 0. They were mainly recruited from the pediatric OPD and few from the dental OPD. Those with a DMFT score 1 and higher were taken as cases. These were the children coming to the dental OPD for a checkup.

Parents and caregivers were asked questions pertaining to the nutritional habits of the child, status of the child’s oral hygiene, and dental habits. 3 ml blood was collected from all participants. This was analyzed for HB and serum ferritin. The HB was analyzed by fully automated cell counter analyzer, whereas serum ferritin was estimated by enzyme-linked immunosorbent assay technique. Normal laboratory reference values were adopted to determine if the child had adequate or low levels of HB (12.0–14.5 g/dl) and serum ferritin (6–55 ng/ml). HB was used as an indicator for iron status as the protein relies on iron to function. It was
also recognized as an indicator for anemia. Serum ferritin was also used as an indicator for the iron status. The blood iron level is directly correlated with blood serum ferritin level, making it an appropriate measure of blood iron.

The dental examination was performed at hospital bedside in pediatric ward and dental OPD of MIMER Medical College and BSRT rural hospital using a disposable plane mouth mirror, probe, and penlight. Cotton rolls were used to remove any plaque or debris, where necessary. Teeth less than two-thirds of the crown erupted were excluded. To assess the caries experience, the decayed, extracted teeth due to caries, and filled primary teeth (DMFT) index was used. A tooth was diagnosed as decayed if its color had changed and if there was any evidence of cavitated or non-cavitated dental primary caries or recurrent caries adjacent to already filled teeth. The M component included extracted teeth and decayed teeth indicated for extraction due to caries, and the F component included restored teeth with caries. White spots were not considered decayed. It was not practical to take radiographs.

The results were entered into an excel sheet (Microsoft) and appropriate statistical tests were applied.

**OBSERVATIONS AND RESULTS**

A total of 166 children were recruited; 119 with a DMFT score of more than 0 and 47 children with a DMFT score of 0. The mean age was 8.5 ± 2.5 years. There was no significant difference in the mean age or sex between the groups. Overall, the mean serum ferritin concentration was 30.8 ± 20.86 ng/ml (range 6–55 ng/ml), and the mean HB level was 12.04 ± 1.24 g/dl (range 11.5–14.5 g/dl). Children were categorized into cases and controls and also into those who were iron deficient and those who were not based on the data obtained. Figure 1 illustrates the same.

From Figure 1, it is seen that children with a DMFT score more than 0 (cases) were more likely to have lower levels of HB. Similarly, out of 65 children with HB <12 g/dl, 54 were cases, that is, 83% of the total children with HB <12 g/dl were cases.

According to Table 1, unpaired test analysis revealed that serum ferritin levels did not differ significantly. However, children with a DMFT score more than 0 had significantly lower HB levels.

Figure 2 is given below shows the distribution of cases according to individual DMFT scores >0.

The value was found to be 7.32 \( (P = 3.84) \) when Chi-square test was applied to Table 2. This showed that the HB levels were significantly associated with the DMFT scores.

The correlation coefficient was found to be \( r = -0.232 \). This showed that HB did not have significant correlation to the DMFT scores.

Negative correlation can be seen between DMFT scores and serum ferritin [Figure 3]. This correlation

![Table 1: Distribution of study population with respect to HB and serum ferritin](image)

![Figure 1: Bar graph showing the no. of children with Haemoglobin less than 12g/dl and those with Haemoglobin more than 12g/dl in cases and controls](image)

![Figure 2: Distribution of cases according to individual DMFT score as shown in number and in %](image)
were much more likely to have lower levels of HB.

Children fell in the cases. It was found that there was no correlation between DMFT scores and HB, which did not show any correlation. Table 4 shows the correlation between individual DMFT score and serum ferritin. The score is zero, when ferritin concentration is most.

**DISCUSSION**

Until recently, very little research had been conducted to find an association between IDA and dental caries (DMFT scores). This study was conducted to establish the likelihood of iron deficiency in children with dental caries. A total of 119 cases and 47 controls were recruited and this study was conducted over a period of 2 months.

We analyzed all our cases and controls and found that the cases (those with DMFT scores higher than 0) were much more likely to have lower levels of HB. Our analysis was predominantly similar to a study published by Canadian workers. They found that, of the total anemic children, 92% were those with S-ECC, while our results showed that 83% of anemic children fell in the cases. It was found that there was a moderately significant negative correlation between serum ferritin and the individual scores [Figure 3]. The similar correlation was not seen between HB and DMFT scores. Serum ferritin is a more specific indicator for iron levels in the body. One of the reasons for low levels of iron in children with higher DMFT scores is because of poor absorption of nutrition from the gut due to incomplete mastication. Incomplete mastication is due to pain that is experienced on chewing. However, serum ferritin cannot be used as a definite indicator of IDA in the presence of inflammation. Children with higher DMFT scores may have chronic inflammation, leading to higher serum ferritin scores.

However, when Chi-square test was applied to Table 2, it was found that HB was significantly associated with DMFT scores. This meant that cases with scores higher than 0 were more likely to have HB levels >12.

While the results were not found to be statistically significant, it was found that there was an association between HB levels and DMFT scores. The results were congruent with other similar studies. However, this study was not without certain limitations. The study was conducted in a rural hospital and an assumption was made that the participants came from a lower socioeconomic class. The collection of blood also proved to be a challenge because the child often cried and was uncooperative. Controls with a DMFT score of 0 were difficult to find. A smaller sample size may have also affected the results. Further study with a larger sample size and longer time period may be necessary to get statistically significant results.

**Table 2:** Distribution of cases and controls with respect to HB levels

<table>
<thead>
<tr>
<th>HB Status</th>
<th>&lt;12 g/dl</th>
<th>&gt;12 g/dl</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cases</td>
<td>11 (23.40)</td>
<td>36 (76.6)</td>
<td>47</td>
</tr>
<tr>
<td>Controls</td>
<td>54 (45.38)</td>
<td>63 (54.62)</td>
<td>119</td>
</tr>
<tr>
<td>Total</td>
<td>65</td>
<td>99</td>
<td>166</td>
</tr>
</tbody>
</table>

**Table 3:** The association between individual DMFT scores and HB

<table>
<thead>
<tr>
<th>DMFT Score</th>
<th>HB (mean in g/dl)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>12.57</td>
</tr>
<tr>
<td>1</td>
<td>11.26</td>
</tr>
<tr>
<td>2</td>
<td>12.36</td>
</tr>
<tr>
<td>3</td>
<td>12.56</td>
</tr>
<tr>
<td>4</td>
<td>11.87</td>
</tr>
<tr>
<td>5</td>
<td>11.57</td>
</tr>
<tr>
<td>6</td>
<td>12.38</td>
</tr>
<tr>
<td>7</td>
<td>12.04</td>
</tr>
<tr>
<td>8+</td>
<td>11.68</td>
</tr>
</tbody>
</table>

**Table 4:** The association between individual DMFT score and serum ferritin

<table>
<thead>
<tr>
<th>DMFT Score</th>
<th>Serum ferritin (mean in ng/ml)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>37.04</td>
</tr>
<tr>
<td>1</td>
<td>36.99</td>
</tr>
<tr>
<td>2</td>
<td>34.36</td>
</tr>
<tr>
<td>3</td>
<td>29.79</td>
</tr>
<tr>
<td>4</td>
<td>29.65</td>
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<tr>
<td>5</td>
<td>25.65</td>
</tr>
<tr>
<td>6</td>
<td>27.4</td>
</tr>
<tr>
<td>7</td>
<td>29.38</td>
</tr>
<tr>
<td>8+</td>
<td>22.49</td>
</tr>
</tbody>
</table>

DMFT: Decayed, missing, and filled teeth
CONCLUSION

Based on the findings from this study, we can conclude that:
1. HB levels are significantly associated with the presence of caries.
2. Children with higher DMFT scores tend to have lower serum ferritin levels.
3. While further research is required to prove DMFT score can be used as a screening test for IDA, children with high DMFT scores should be closely monitored for signs of IDA and treated accordingly.
4. The children with dental caries must be given foods rich in iron.

The dentists and pediatricians must be aware of this relationship between dental caries and IDA and must treat their patients accordingly.

SUMMARY

This study was conducted at MIMER Medical College and BSRT rural hospital, Talegaon Dabhade, over a period of 2 months from April 2016 to June 2016. The purpose of the study was to find an association between iron DMFT scores and HB and serum ferritin levels in children up to 12 years of age. The aim was to see if DMFT scores could be used for diagnosing IDA in children. It was a case-control cross-sectional study. A total of 166 children were recruited as a part of the study. The mean age was 8.5 ± 2.5 years. 119 children had a DMFT score more than 0 (cases), while 47 had a score of 0 (controls). The children had to undergo a dental examination following which 3 ml blood was drawn and sent to the laboratory for analysis. It was found that there was a moderately significant negative correlation between serum ferritin and individual scores. Children with scores more than 0 were also more likely to have HB levels <12. This study, therefore, concluded that, while further research would be required to prove that DMFT score could be used as a screening test for IDA, there was a significant relationship between individual scores and serum ferritin and that children with greater DMFT scores would have to be closely monitored for signs of iron deficiency.

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REFERENCES


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