

Role of Calcium in Development of Early Childhood Dental Caries

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ABSTRACT

Objective: To deduce association of dental caries with hypocalcaemia.

Study Design: Cross-sectional

Place & Duration: Islamic Dental hospital Islamabad, from September 2020 to February 2021.

Materials and Methods: Eighty children were carefully chosen for this study, their ages were between 2-8 years. They were eighty in number and were placed into two groups. In group 1 children with compromised dental health were placed and their number was sixty. In group 2 children with healthy dentition were included and they were twenty in number. The degree of caries was calculated by following the standards given by WHO. For finding the statistically significant association between dental caries and hypocalcaemia Chi-square test was used.

Results: Results have established that dental caries is prevalent in children with hypocalcemia. Chi-square analysis has indicated that in children with hypocalcemia and with hypoplastic tooth surfaces, more non-cavitated and cavitated carious lesions, filled surfaces and missing teeth were found than in children with normal calcium levels and having sound enamel surfaces and well-formed teeth ($p = 0.01$). This cross-sectional study has showed that caries, hypoplastic tooth surfaces, poorly mineralized teeth and early childhood dental caries are strongly correlated.

Conclusion: It can be established seen that caries, hypocalcaemia, hypoplastic tooth surfaces and poorly mineralized teeth are correlated.

Keywords: Decayed, Missed, Filled Teeth (dmft), 25 Hydroxy Vitamin D (25OHD)

INTRODUCTION

Calcium is one of the most important minerals of the human body as it is the part of bony skeleton and teeth. 99% of calcium occurs in bones. Calcium plays an important role in the nerve conduction, muscles and heart contraction⁽¹⁾. Calcium acts as second messenger for certain hormones. It activates clotting factors in plasma. There should be sufficient calcium in the diet of children for their health, growth and proper functioning of bodies. Milk, cheese and yoghurt are the best sources of calcium⁽²⁾. Egg yolk, fish, nuts like almonds and green leafy vegetables like broccoli, spinach also contain sufficient amount of calcium. Children as well as adults should incorporate such foods in their diet so as to fulfill the calcium requirement⁽³⁾. Normal serum calcium levels are 9-10.5 mg/dl⁽⁴⁾. Hypocalcaemia is defined as total serum calcium levels below 8.7 mg/dl^(5,6).

Active form of vitamin D, calcitriol increases the absorption of calcium by inducing the synthesis of special transport protein Calbindin in the intestinal epithelial cells⁽⁷⁾. Parathyroid hormone and Calcitonin are involved in the homeostasis of calcium⁽⁸⁾ and maintain the blood calcium level within a narrow range.

When there is hypocalcaemia, parathyroid hormone stimulates bone resorption, increases calcium reabsorption from distal convoluted tubules of kidney and increases the intestinal absorption of calcium by converting 25 Hydroxy Vitamin D into 1,25 dihydroxy Vitamin D, the active form of vitamin D in kidneys⁽⁹⁾.

Certain diseases, like hypoparathyroidism, rickets and renal osteodystrophy affect the calcium homeostasis⁽¹⁰⁾. Thus blood calcium levels cannot be maintained, which will lead to hypocalcemia. If there is dietary deficiency of vitamin D or calcitriol cannot be synthesized by kidney due to certain pathology then it will also lead to hypocalcemia⁽¹¹⁾. Hypomagnesemia and hyperphosphatemia may also disrupt calcium metabolism and hypocalcemia will be inevitable⁽¹²⁾.

An early symptom of hypocalcaemia is paresthesia around mouth, hands, arms and legs. Lethargy and poor muscle tone may also be seen⁽¹³⁾. Later the bones weaken, the risk of tooth decay and caries also increases. Growth and development of children is compromised⁽¹⁴⁾. Osteoporosis develops in adults. Prolonged vitamin D deficiency, decreased serum calcium levels and

increased parathyroid hormone result in tooth decay and more carious lesions.

If hypocalcaemia is present at the time of tooth development then there will be poor mineralization of the tooth and it might be shown as enamel hypoplasia⁽¹⁵⁾. Dentinal tubular defects may appear, the occlusal surfaces of posterior teeth may show abnormally deep fissures. The anatomy of the pulp chamber may also be disrupted with large chambers and raised pulp horns accompanied by thin layer of enamel^(6, 8). The dentinoenamel junction may also show defective mineralization. Such teeth are more prone to caries. Because of defective mineralization and enamel hypoplasia, the bacteria which cause caries accumulate in that region and cause visible dissolution of enamel which later on develops carious defect⁽¹⁶⁾.

There should be some definitive regime for improving the health of growing children and increasing their awareness about dairy consumption, so that deficiency of calcium can be avoided.

The aim of the present study is to investigate the correlation of hypocalcaemia with caries in deciduous teeth. Our hypothesis is that hypocalcaemia is present in children with multiple carious teeth.

MATERIALS AND METHOD

This study was a transverse or cross-sectional. After being approved by Ethical Review Committee of Islamic Dental hospital Islamabad, study was commenced and its duration was extended for six months i.e. September 2020 to February 2021.

Children, sixty in number, with multiple carious lesions were designated as group 1 and twenty children without caries and healthy dentition were named as group 2. Depending on frequency of dental caries and the allocated research time we calculated the size of the sample. Probability sampling technique was used for collecting samples.

For determining the extent of dental caries in children we used dmft guide, according to this d stands for decayed teeth, m for missed and f for filled teeth in the mouth of child patients

The score was calculated by adding the number of decayed, missed and filled teeth in the oral cavity of each child. The dmft score 0 showed that all the teeth present in oral cavity were sound

and healthy and the score more than 4 showed that large number of caries teeth were present in oral cavity.

For determining serum calcium levels of the children blood sampling was done. To prevent the blood samples from being wasted, they were stored in the lab freezers at -70 °C.

Our data was analyzed by using SPSS 21. Chi-square test was applied.

RESULTS

Results revealed a strong correlation hypocalcaemia and dental caries in primary dentition. There were 43 male children and 37 female children in this study. Patients' mean age was 5 years and 3 months.

Table 1: Descriptive Statistics of calcium Levels

Levels of Calcium mg/dl	Frequency	Percent	Group 2 Caries free	Group 1 With caries
Calcium (8.7-7.9)	57	71.2	0	57
Calcium (8.7-9)	13	16.3	11	2
Optimal Calcium (9-10.5)	10	12.5	9	1
Total	80	100.0	20	60

Table 2: Frequency Distribution of Calcium Levels in study subjects:

Group	N	Calcium level mg/dl Min.	Calcium level mg/dl Max.	Mean	Std. Deviation +
1	60	7.9	8.7	8.2	0.35
2	20	8.9	10.5	9.75	0.52

Table 3: Caries Levels found in Study Subjects

Caries levels	Frequency	Percent
No Caries (0)	20	25.0
Slight Caries(0.5-1)	2	2.5
Decayed and carious Teeth (1- 2)	7	8.8
Missed and Decayed Teeth (2-3)	12	15.0
Excessive Caries (3- 4)	39	48.8
Total	80	100.0

Table 4: Association of Calcium levels with caries levels

Levels of calcium mg/dl	Caries					p value
	No Caries	Slight Caries	Decayed Teeth	Missed and Decayed Teeth	Excessive Caries	
Calcium (<8.7)	1	2	4	11	39	0.001
Calcium (8.7-9)	10	0	2	1	0	
Optimal Calcium (9-10.5)	9	0	1	0	0	
Total	20	2	7	12	39	

In table I, descriptive statistics of calcium levels is given according to the groups we made on the basis of caries, group one consists of children with caries and the second one consists of children without caries. In table II, calcium level in study subjects is divided into three groups, in the first one the calcium levels are less than 8.7 mg/dl i.e. hypocalcaemia, in the second group the calcium levels are in between 8.7-9mg/dl and in the third group the calcium levels are between 9-10.5mg/dl. In table III, caries level in study subjects is grouped into five categories and they are given a specific score depending on the severity of the caries, from 0 to 4. In table IV, Chi- square analysis has showed that dental caries in primary dentition has significant association with calcium levels as shown by p value less than 0.001.

DISCUSSION

This transverse, cross-sectional study was conducted to find out the correlation between hypocalcaemia and caries in young children. There were 80 children between age 3-8 years who participated in this study. Among total 80 study subjects 60

children (group 1) were with compromised dental health and had carious lesions and 20 children(group 2) had healthy dentition, without caries.

In this study we had examined the association of calcium levels with different levels of dental caries in children. This study has revealed that hypocalcaemia is strongly correlated to extent of dental caries in childhood.

Present study revealed that dental caries was more prevalent in children who had enamel and dentine defects. This conclusion is also in accordance with a study conducted on dental caries in preschool children by Carvalho et al who concluded that children with hypoplastic enamel had more carious teeth⁽¹⁷⁾. Paixão-Gonçalves et al in 2019, also established that children with enamel defects had more chances of having dental caries⁽¹⁸⁾.

Hypocalcaemia leads to enamel hypoplasia and poor mineralization of teeth which are predisposing factors to dental caries. In a study by Reed et al in 2020, it is suggested that there is a possible correlation of maternal calcium status with tooth mineralization and development, it also suggests that children of mothers having normal blood calcium level had sound enamel, well mineralized teeth that can withstand dental caries⁽¹⁶⁾. In another study conducted by Reed S.G. Forrest et al in 2011, it has been concluded that calcium deficiency is the cause of enamel hypoplasia and dental caries.

A study conducted by Mohsenipour et al 2017, in Iran have found that abnormalities relating to tooth development and calcification were seen in children suffering from hypocalcaemia, their findings also coincides with our results⁽⁶⁾.

R.J. Schroth et al, 2015, showed that vitamin D and calcium deficiency is seen in patients with multiple carious lesions. We have also inferred the same conclusion⁽¹⁰⁾.

Atmokotomo et al, 2019, did an intervention on rat's pups and observed the effect of blood calcium levels on the tooth development and found a marked difference in their teeth morphology. Those who had optimum calcium levels also had well-mineralized teeth, amount of calcium in their teeth was also higher as compare to those whose calcium levels were reduced⁽¹⁹⁾.

Poor oral hygiene, consumption of fizzy drinks are the predisposing factors causing the dissolution of enamel layer which later on develops into dental caries. We cannot fully explain all the factors associated with dental caries which exist with hypocalcaemia. Advance research works are required to assist our findings.

Thus, hypocalcaemia at the time of tooth formation is the major element causing defective mineralization and enamel hypoplasia, which are major risk factors for dental caries. Children of developing countries like Pakistan are suffering from nutritional deficiencies, calcium being one of these deficient nutrients, which increases the chances of enamel hypoplasia and predisposes them to caries. Our study might be informative in providing bases for decreasing the prevalence of dental caries in our country.

There should be some educational symposiums in schools and colleges so that our public can be made aware of healthy eating habits. In particular, calcium and vitamin D intake of our young children should be increased in the form of dairy products or supplementation so that the general health of our population can be improved⁽²⁰⁾. Serum calcium levels should be checked as a part children health promotion programs. In this way, incidences of hypocalcaemia can be reduced.

It is necessary to add calcium rich diet in our children s' daily meal plan in this way they will be having strong bones and teeth which will decrease the incidence of dental caries.

CONCLUSION

Our study concludes that normal calcium levels in children have a major role in improved dental health and also for better tooth mineralization. It is therefore suggested that by improving children's calcium levels we can also have our population with better dentition and strong bones.

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