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The Relationship between Gestational Diabetes, Enamel Hypoplasia and DMFT in Children: A Clinical Study in Southern Iran

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Authors' contributions

This work was carried out in collaboration between all authors. All authors read and approved the final manuscript.

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ABSTRACT

Background: Odontogenesis begins from the sixth week of fetal life; meanwhile, the subsequent evolution is very complex and takes a long time. As a part of odontogenesis, amelogenesis can be altered by local and systemic factors. Systemic factors include the change of and reduction in tissue oxygenation, metabolic disorders, gamma ray, fever, infections, as well as vitamin A&D deficiency. There are few investigations demonstrating the effect of gestational diabetes on enamel defects. The current study aims to compare enamel hypoplasia and DMFT (Decayed, Missing, and Filled Teeth) index of children born to diabetic mothers with gestational diabetes with those of healthy mothers.

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Methods: In this retrospective study, 50 children born to diabetic mothers aged between 3 and 12 were selected as the study group and 50 age- matched children with healthy mothers as the control one. The presence of enamel hypoplasia, the involved surfaces and DMFT index were recorded.
The data were collected and analyzed using SPSS software version 15, NPar, Mann-Whitney and Chi-Square tests.
Results: The results obtained from the current study revealed that the prevalence of enamel hypoplasia and mean DMFT index in children of diabetic mothers was significantly higher than in the control group p=0.03.
Conclusion: In this study, the prevalence of enamel hypoplasia and mean DMFT in children of gestational diabetic mothers were significantly higher than that of the controls.

Keywords: Gestational diabetes; enamel hypoplasia; DMFT.

1. INTRODUCTION

Odontogenesis begins from the sixth week of fetal life and the subsequent evolution is very complex and takes a long time [1]. Defects including enamel hypoplasia, amelogenesis imperfecta, dentinogenesis imperfecta, opacity, hypocalcification and Turner's hypoplasia are caused by abnormal odontogenesis [2]. As a part of odontogenesis, amelogenesis can be altered by local and systemic factors [3]. Systemic factors include changing and reduction of tissue oxygenation, metabolic disorders, gamma ray, fever, infections, vitamin A & D deficiency and gestational diabetes [4]. These factors can influence odontogenesis and cause enamel hypoplasia or other amelogenesis defects. One or more teeth may be involved through alterations in the quantity or quality of enamel and these changes are classified from mild to severe ones [3]. Enamel thickness may be normal, while its opacity may increase. In such cases, no clear boundaries with normal adjacent enamel differentiate it from other teeth. Opacity color change ranges from white, cream, yellow or brown. Another kind of hypoplasia presents itself as holes, grooves or areas without enamel [5].

Gestational diabetes is defined as carbohydrate intolerance of variable severity with onset or first recognition during pregnancy. The main cause of the disease pertains to an increase in cellular resistance to insulin. It has heterogeneous clinical symptoms characterized by metabolic and endocrine abnormalities affecting homeostasis. Partial or total insulin deficiency caused profound changes in metabolism of carbohydrates, proteins and lipids [6-8]. The highest risk of involvement includes mothers older than 30 years, family history of diabetes, high blood pressure, mothers with a history of more than 5 pregnancies, abortion or preterm delivery [7]. After delivery, blood sugar returns to normal rate in most cases although 30-50% of them may develop diabetes mellitus type 2 within 10 years [6]. Macrosomia, hypoglycemia, jaundice, cardiac hypertrophy and obesity are the subsequent complications of gestational diabetes [9]. Mothers suffering from such diseases should be evaluated for the persistence of diabetes 6 to 12 weeks after delivery [10].

There exists a dearth of research on the relationship between gestational diabetes and enamel defects, but Afshar and coworkers [11] indicated that mothers' diseases during pregnancy may cause enamel hypoplasia in deciduous teeth of their children. Preterm or low - weight- born children also increased in this group.

In their animal survey, Yara Tersinha et al. [12] evaluated 3 groups of rats. The first one consisted of gestational diabetic mothers supplemented by insulin, and the second group consisted of gestational diabetic mothers without receiving insulin. The last and the control group comprised healthy mothers. Their children's teeth were observed by scanning electron microscopy. They found that enamel hypoplasia was an important clinical problem seen in young rats born to diabetic mothers.

In another study, Silva Sousa et al. [13] analyzed the enamel organ of the mandibular incisors of rats with diabetic mothers. All teeth were evaluated by computer morphometry. There was the thinning of the enamel matrix. They found that enamel hypoplasia was the most common developmental defect observed in the teeth of rats born to gestational diabetic mothers.
In another research conducted by Noren Jorgen [14] more enamel defect was found in children

with gestational diabetic mothers. 30 deciduous teeth were collected, sectioned and then observed under polarized light. There were neonatal lines in 93% of them. Defects were mostly on buccal and lingual surfaces of the teeth.

The location of the enamel defect is a matter of controversy. Mahmudian et al. [15] observed that maxillary central incisors were the most common affected teeth and the defects were more prevalent on buccal surfaces. On the other hand, Ahmadi et al. [16] demonstrated that the most and the least common teeth with enamel hypoplasia were mandibular molars and lower jaw incisors, respectively. AminAbadi et al. [17] reported that the deciduous lateral incisor teeth were the most common teeth with enamel hypoplasia in 3 to 5 year old children, followed by central incisors, canine, first molars and second molars, respectively .

Hong et al. [18] indicated that the risk of dental caries can be increased by enamel hypoplasia.

There are limited studies focusing on DMFT index of children born to mothers with gestational diabetic; accordingly, the present study was conducted to compare the rate of enamel hypoplasia and DMFT of this group compared to a control group.

2. PATIENTS AND METHODS

In the present retrospective cohort study, 50 children and adolescents, with an between 3-12 years, were selected as the study group. These patients were born to mothers with gestational diabetes during 2000-2013 in Hafez and Zeinabieh hospitals, Shiraz, Iran. According to the hospital information, 73 mothers with gestational diabetes were initially called and asked to bring their children for a dental examination in the Oral Medicine Department of Shiraz Dentistry School. Some of them did not accept our invitation; moreover, a lot of children did not cooperate with us in terms of the required clinical examination. Additionally, children with the history of systemic disease, deciduous tooth infection (as a cause Turner enamel hypoplasia) or trauma to the jaw were excluded from the study.

The study protocol was approved by the local ethics committee of Shiraz University of Medical Sciences, Shiraz, Iran. Eventually, 50 children were selected as the case group and 50 age-matched persons with healthy mothers, as the control group. The controls were children visiting Shiraz Dentistry School for routine dental care. Dental examinations were performed by an oral medicine specialist and a senior dental student using proper light, dental mirror and explorer. Any dental anomalies and changes in the enamel were recorded. The location and involved surface were recorded in cases with enamel hypoplasia.

In order to evaluate the DMFT index the researchers recorded all decayed, extracted or filled teeth in both deciduous and permanent teeth using SPSS software version 15 Chicago, Illinois including NPar, Mann-Whitney, and Chi-Square tests. The collected data were statistically analyzed.

3. RESULTS

In the present study we had 50 children born to mothers with gestational diabetes as our study group (mean age of 5.3) and 50 age -matched children with healthy mothers as the control one (mean age of 5.9.). After clinical examination of both primary and permanent teeth we found enamel hypoplasia in 25 cases (50%) of the study group. Examining them, we found defects in one tooth of 7 children, in two teeth of 12 children, and in 3 teeth of 6 children. However, in the control group, enamel hypoplasia was seen in 10 (20%) participants. While no one suffered from more than 2 enamel defect, six of them had one tooth and 4 of them had 2 teeth with enamel hypoplasia. There was a statistically significant difference between the two groups (p=0.003) and a high relationship between gestational diabet-es and enamel hypoplasia in children (Table1).

In the current study, the most common teeth with enamel hypoplasia were maxillary canines (24%) and central incisors (14%). On clinical examination no defect was observed for mandibular primary incisors and molars. The most involved teeth in the control group were maxillary incisors (16%) followed by maxillary first molars, mandibular second molars and maxillary canines. Other teeth did not demonstrate any abnormalities. Enamel hypo-plasia was more prevalent on buccal surfaces of the teeth in both groups. In cases with multiple teeth involvement the central incisor defects were located more apically than laterals and canines.

Table 1. The number of teeth with enamel hypoplasia and DMFT of children of gestational diabetic mothers (case group) and children of healthy mothers (control group)

	Mean rank		Std. deviation		Median	
	Case group	Control group	Case group	Control group	Case group	Control group
The numbers of teeth with hypoplasia	59.14	41.86	1.125	0.607	0.50	0.28
DMFT	58.33	42.67	3.046	1.99	1.50	0

DMFT index were also evaluated in both groups. The means are given in Table 2.

Table 2. Details of DMFT in both children of gestational diabetic mothers (case group) and children of healthy mothers (control group)

	Case group		Control group	
	Mean	SD	Mean	SD
D	1.90	2.47	0.88	1.23
M	0	1.030	0	0.768
F	0	0.830	0	1.030
DMFT	2.70	3.046	1.22	1.99

4. DISCUSSION

The relationship between gestational diabetes of mothers and enamel hypoplasia and DMFT of their children were addressed in this study.

Enamel hypoplasia, known as a defect in the teeth, is caused by insufficient matrix formation. In such cases the enamel is thin but hard. Sometimes the entire crown is involved and in many cases it can be seen as a pit or fissure [19].

Enamel hypoplasia may increase the rate of caries development in many cases.

The results of our study support the relationship between gestational diabetes of mothers and enamel hypoplasia in their children. This finding is consistent with that of the study conducted by Afshar et al. Silva-Sousa et al. and Noren [11,13-14] However, since in the study carried out by Noren, there was no control group for comparison, no relationship was found between enamel hypoplasia and the gestational diabetes of mothers.

In the present research, a significant relationship was observed between gestational diabetes of mothers and the number of teeth with enamel hypoplasia in their children. This suggests that children born to diabetic mothers are more likely to have affected teeth than children from healthy mothers. Unfortunately, no similar investigations were found in the literature to compare our findings.

As mentioned above, in this study, the most common affected tooth in both groups were maxillary canines. In this respect our findings differ from that of other scholars. This might be explained by the fact that, while Mahmodian et al. [15] and Ahmadi et al. [16] worked on permanent teeth, we focused on deciduous teeth and hence such a difference between the findings can be justified. Amin Abady [17] found that the most common affected teeth were lateral deciduous incisors and canines were considered the third in terms of frequency.

Our study revealed that buccal surfaces were the most affected site of the teeth, which was consistent with the results obtained by Mahmodian and colleagues [15]. Noren found buccal and lingual surfaces being the most affected [14].

DMFT index of our case group was higher than that of the control one. However, the mean DMFT in children with gestational diabetic mothers was not mentioned in other studies. According to Hong et al. [18] enamel hypoplasia is a risk factor for dental caries, so the higher rate of DMFT index can be explained in such patients. Lewit [20] and colleagues reported that the mean range of DMFT in 5-17 years old children of the United States was about 1.6. Souza [21] and coworkers found that the mean rate of DMFT was about 3.6, while in this study the DMFT of the control group was similar to the report given by Lewit et al. [20] in the USA, it differs from the DMFT reported by Souza et al. [21].

5. CONCLUSION

In this study the prevalence of enamel hypoplasia and mean DMFT in children born to mothers with gestational diabetic was

significantly higher than that of the control group. This result showed that a mother's disease can influence odontogenesis. Further study on a larger group is necessary to confirm this finding.

CONSENT

It is not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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