



Evaluation of the Relationship of the Permanent First Molar Enamel Defects And Dental Caries With Delivery Type and Birth Weight In 6- to 12-Year-Old Children in Hamadan

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Abstract

Background: Enamel defects can negatively affect the appearance of the teeth, increase the tooth sensitivity, disrupt the occlusal function, and make the teeth susceptible to caries. The present study was carried out to investigate if the delivery type and birth weight have any effect on the prevalence of tooth caries and enamel defects among a population of children from Hamadan, Iran.

Methods: This cross-sectional study was conducted on a total number of 182 children aged 6-12 years old born from 2006 to 2012. Studied variables were birth weight, birth height, head circumference, gestational age, gender, delivery type, birth order, duration of nocturnal feeding, and nutrition type up to two years old. Developmental defects of enamel index were used to determine the prevalence of enamel defects and decayed, missing, and filled teeth (DMFT) index to study dental caries. The results of tests were analyzed by SPSS software using *t* test, chi-square test, Fisher exact test, Mann-Whitney test, Kruskal-Wallis test and Pearson correlation coefficient.

Results: The overall prevalence of enamel defects was obtained 15.38%. The prevalence was significantly associated with delivery type ($P=0.05$), while no significant association was found between enamel defects and birth weight ($P=0.684$). DMFT index was significantly related to birth weight and delivery type, while duration of nocturnal feeding was the only variable found to be significantly related to DMFT index.

Conclusions: The cesarean section and low birth weight (LBW) may be associated with the developmental defects of enamel (DDE) and dental caries. Nocturnal feeding was another factor that may be associated with dental caries and DDE.

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Background

Dental structure, including enamel, dentine, and cementum, is formed through complex cellular and biochemical developmental pathways and any factor being able to affect or disturb such pathways may reduce the quality of the tooth (1).

Tooth enamel is generated through secretory cells called ameloblasts; a change in the ameloblasts' conditions throughout enamel generation, which is long, highly affects them.

A variation in enamel's occurrence in stable dentition may cause ameloblasts not to function well. Minor irregularities in the colour of the teeth and an absence of the enamel are the consequences of the developmental defects of enamel (DDE) (2). Tooth enamel can be used as a source of information regarding systemic abnormalities

Highlights

- ▶ The overall prevalence of enamel defects was obtained 15.38% in our patients.
- ▶ In this study DMFT index was significantly related to birth weight and delivery type.
- ▶ In this study, duration of nocturnal feeding was significantly related to dmft index.

occurring during developmental stages (3,4). DDE refer to any observable degradation in enamel appearance (5,6). Opacity and hypoplasia are 2 main categories of DDE (6).

It has been documented that, in comparison with normal teeth, those with DDE require 10 times more treatment (7). Besides commercial features of tooth treatment, the

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time when children and parents cannot attend the school and workplace makes the treatment costly (8). Therefore, to decrease the appearance of DDE, risk factors should be targeted in application of community plans (2).

Previous studies have reported a high prevalence of DDE worldwide (9-11). Birth weight and type of delivery are 2 suspicious risk factors for DDE. During vaginal delivery, immunological mediators such as Interleukin-1 (IL-1), IL-6, Tumor necrosis factor alpha (TNF-α), and subsequently prostaglandin E2 are produced, leading to cervical dilatation and labour. In contrast, during Cesarean section the production of these mediators may be disrupted, making the infant vulnerable to microbial pollution and increasing the risk of DDE (12,13). In the first part of the present study, we aimed to investigate the effect of delivery type (vaginal or cesarean section) and birth weight on the enamel defects in the permanent first molar. Although enamel defects can occur in all types of teeth, we concentrated on the permanent first molar because it is the only tooth in which the calcification of the cusps is started almost during delivery.

In the second part of the study, we assessed the prevalence of dental caries among the participants using decayed, missing, and filled teeth (DMFT, dmft), which is a popular index used to assess oral health condition among a particular population.

So the present study was set 1) to investigate the prevalence of enamel defects among permanent first molar, 2) to investigate the association between developmental enamel defects and birth weight, 3) to examine the association between developmental enamel defects and type of delivery, and 4) to assess the dental caries among the population of the study using DMFT index and evaluate its relationship with certain factors such as birth weight gender, delivery type, birth order, duration of nocturnal feeding, and nutrition type up to 2 years.

Materials and Methods

Participants

The present cross-sectional study was conducted on a total number of 182 children aged 6-12 years old born in the Fatemieh and Atiyeh hospitals in Hamadan from 2006 to 20012. The reason for selecting this age range was the presence of both primary and permanent teeth in these children.

According to previous studies, the minimum number of participants was calculated at 172 ones; accordingly 400 cases, 200 boys and 200 girls, were randomly selected, contacted, and invited to participate in the study. The inclusion criteria were as follows: 1) being aged 6-12 years, 2) being mentally and physically healthy, 3) being the resident of Hamadan from the birth to the present time (the time of this study), and for ensuring that they uniformly received fluoride from drinking water, and 4) observable permanent first molar. Finally, 182 cases filled

out the consent form and agreed to participate in the study.

Variables of the Study

The hospital records of the children were the main source of the data including birth weight, birth height, head circumference, gestational age, gender, delivery type, birth order, duration of nocturnal feeding, and nutrition type up to 2 years old.

Then the children were invited to attend the dental clinic of Hamadan University of Medical Sciences and be examined in terms of DDE, dmft, and DMFT, as the indices recommended by the WHO to assess oral health of children. DMFT, used for permanent teeth, and dmft, used for primary teeth, were determined using a probe, mirror, and cotton rolls and by counting the number of decayed, missing (due to caries only) and filled teeth. Discoloration, hypoplasia, and opacity were some criteria used to determine DDE.

It is worth mentioning that the examinations were performed by a trained dental student. The first 20 participants were also examined by a university professor to evaluate inter-observer reliability.

Statistical analysis

Data were analyzed by the SPSS software version 20 using certain tests such as chi-square test, independent *t* test, Fisher exact test, Kruskal-Wallis test, and Pearson correlation coefficient.

Results

In the present study, a total number of 182 participants were included, in whom 33 and 28 teeth were diagnosed with hypoplasia and opacity, respectively. Table 1 shows the prevalence of each disorder in the 2 groups. Overall, there were 7 teeth with enamel defects, consisting of 4 cases with hypoplasia, 2 cases with opacity, and one case with both defects, in the vaginal delivery group and 21 ones, consisting of 10 cases with hypoplasia, 7 cases with opacity, and 4 cases with both defects, in the cesarean section group. As demonstrated in Table 1, Fisher exact test was used to assess the association between the type of delivery and the prevalence of various enamel defects, demonstrating a significant relationship between enamel disorders and delivery types ($P=0.05$).

Table 1. The Association Between Enamel Defect and Delivery Type

Enamel Disorder	Delivery Type	
	Vaginal	Cesarean Section
Hypoplasia	4 (5.1 %)	10 (9.6 %)
Opacity	2 (2.6 %)	7 (6.7 %)
Both	1 (1.3 %)	4 (3.8 %)
None	71 (91.0 %)	83 (79.8 %)
Total	78	104

P value = 0.05

The association between dmft and other variables, including birth weight, gender, delivery type, birth order, duration of nocturnal feeding, and nutrition type up to 2 years old are presented in Table 2. As demonstrated, dmft was not significantly associated with certain variables such as birth weight, gender, delivery type, birth order, and nutrition type up to 2 years old. Duration of nocturnal feeding was the only variable that was significantly associated with dmft.

Moreover, Table 3 shows the association between DMFT and other variables of the study. Accordingly, birth weight and delivery type were the only variables significantly associated with DMFT.

Table 4 represents the correlation coefficients of dmft and DMFT with birth weight, head circumference and gestational age. Accordingly, DMFT was significantly correlated with birth height and gestational age.

Table 5 shows the relationship between permanent DMFT and type of delivery. There was a significant relationship between the permanent DMFT and type of delivery ($P < 0.002$).

Discussion

Unpleasant changes in the appearance of enamel developed before the tooth grows is known as DDE. Such defects have a negative effect on teeth's beauty and can accelerate dental caries (14). Moreover, enamel defects are associated with many factors, including environmental and genetic factors, systemic diseases, nutritional, metabolic, neurologic and allergic factors (15).

The present study was conducted on the 6- to 12-year-old children because in this age range both permanent and primary teeth are present, and previous studies have reported a high prevalence of DDE in this age

Table 3. The Association Between DMFT Index and Other Variables

Variable	State	DMFT		P Value
		Mean	SD	
Birth weight	< 2500 g	2.28	1.50	0.35
	≥ 2500 g	1.62	1.44	
Gender	Female	1.58	1.44	0.25
	Male	1.95	1.500	
Delivery type	Vaginal	1.36	1.31	0.81
	Selective cesarean section	1.85	1.57	
	Cesarean section due to medical reason	2.30	1.46	
Birth order	1	1.65	1.48	0.16
	2	1.82	1.52	
	3	2.07	1.36	
Duration of nocturnal feeding	<1	0.42	1.39	<0.001
	1-2	1.90	1.36	
	>2	1.92	1.47	
Nutrition type up to 2 years old	Breastfeeding	1.78	1.517	0.48
	Others	1.71	1.367	

Table 4. The Correlation Coefficient of dmft and DMFT With Birth Weight, Head Circumference, and Gestational Age

Index	Neonatal Characteristics		
	Birth Height	Head Circumference	Gestational Age
dmft	-0.02	-0.095	-0.032
DMFT	-0.22*	-0.1	-0.22*

*Significant at 0.05 level.

group (16,17). The present study demonstrated a higher prevalence of enamel defects among children with a birth weight lower than 2500 g; however, the difference was not statistically significant. This finding is in agreement with those of Lunardelli and Peres (18). Neurological disorders have prominent risks as follows: shorter pregnancy length and low birth weight (LBW), which are greatly associated. Intraventricular hemorrhage and periventricular leukomalacia are closely linked to prematurity. Moreover, abnormal neurological development occurs because of parameters resulting in birth and LBW. For example, dental or neurological deficits may cause prematurity and LBW stemming from malformations and birth-acquired infections. The study of Wanger showed that children born preterm and with LBW are at substantial risk of DDE (19). More clearly, a significant risk factor for DDE is preterm birth that has been confirmed by various researches (20,21-27). Newborns who are born preterm usually have LBW and neonatal problems like anemia, infections, calcium deficiency, respiratory illnesses, and orotracheal intubation and ventilation. Ameloblastic cell function may be changed by oxygen deprivation. Furthermore, certain health care services, hospitalization and medications like systemic antibiotics should be

Table 2. The Association Between DMFT Index and Other Variables

Variable	State	DMFT		P Value
		Mean	SD	
Birth weight	< 2500 g	3.23	2.13	0.35
	≥ 2500 g	2.94	1.88	
Gender	Female	2.84	1.78	0.25
	Male	3.16	2.07	
Delivery type	Vaginal	2.96	1.88	0.81
	Selective cesarean section	3.15	1.83	
	Cesarean section due to medical reason	2.90	2.14	
Birth order	1	2.78	1.84	0.16
	2	3.22	2.13	
	3	3.37	1.80	
Duration of nocturnal feeding	<1	2.29	1.62	<0.001
	1-2	3.62	1.63	
	>2	4.72	2.23	
Nutrition type up to 2 years old	Breast milk	2.96	1.99	0.48
	Others	3.12	1.73	

Table 5. The Relationship Between Permanent DMFT and Type of Delivery

Variable	State	DMFT		Result of the Kruskal-Wallis Test
		Mean	SD	
Delivery type	Vaginal	1.36	1.31	$\chi^2 = 12.31$ $df = 2$ $P = 0.002$
	Selective cesarean section	1.85	1.57	
	Cesarean section due to medical reason	2.30	1.46	

delivered to the children who are born preterm. The risk of the disease can be improved because these factors may interact with each other and accumulate or have synergistic effects; also, they cannot be distinguished easily (21,26). In the current research, given the relationship between preterm birth, LBW and hospitalization during the first year of life and DDE, it was found that these factors affected the development of the primary dentition.

We found a significant association between the prevalence of DDE and the type of delivery, so that the prevalence was higher in the cesarean delivery group. These results are in agreement with those of previous studies such as Wanger (19), Zheng et al (28), and Aine et al (5). Calcium deficiency in these children can be the reason why the prevalence of DDE is higher among them. Moreover, cesarean delivery is normally accompanied by a disturbance in the production of immunological mediators such as IL-1, IL-6, TNF- α , and prostaglandin E2, making the child vulnerable to microbial infections and leading to enamel defects (12,13).

In the present study, we also assessed the association between dental caries and various variables such as birth weight, gender, delivery type, birth order, duration of nocturnal feeding, and nutrition type up to 2 years old. DMFT and dmft were the indices used to assess dental caries among the participants.

The results demonstrated no significant association between dmft and birth weight, gender, type of delivery, birth order, and the type of nutrition up to 2 years old, but dmft was significantly associated with duration of nocturnal feeding, which is consistent with those of Poureslami & Adhami (29) and Hematyar & Masnavi (30). However, Abedini et al (31) did not find a significant association between these 2 variables, which can be due to the consumption of sugary compounds in the daytime as the auxiliary food, resulting in a lower tendency to nocturnal feeding. Furthermore, DMFT was not significantly associated with gender, birth order, nutrition up to 2 years old, and the duration of nocturnal feeding. In contrast, there was a significant association between DMFT and the type of delivery. Similarly, DMFT was significantly correlated with birth weight and birth height, i.e., 2 important fetal development factors. The results are in agreement with those observed in previous studies (32,33). Preterm birth along with substantially LBW have been known as the risk factors for birth disorders and defects, associated with a high prevalence of infant mortality. Odontogenesis begins at about 6

weeks of embryonic life from the germination stage, and then passes through the cell proliferation, histopathology, morphodifferentiation, mineralization, and maturation stages, and then enters the growth stage in the occlusion. This evolutionary process is very complex and long, such that the growth of primary teeth and some permanent teeth will continue after the birth. Some biological or pathological factors can disturb this evolutionary process and change the natural shape, number, and composition of the teeth, making them vulnerable to dental caries (34). DDE with a similar appearance are not necessarily caused by similar etiological agents. In contrast, the same etiological factors can produce different defects at different stages of tooth development. Enamel defects may also result from a combination of factors. It has been proposed that there are over 90 different factors that may be responsible for DDE (35). Most of the available evidence on the etiology of enamel defects have been obtained from animal studies and case reports of children with systemic disorders; however, sound evidence for their involvement are equivocal. Only a few of these factors have been confirmed as being directly responsible for developmental defects. The possible etiological factors for DDE in the permanent teeth can be broadly divided into 2 main categories: those with a localized (trauma, localized infection and irradiation) distribution and those with a generalized (genetic disorders, or by environmental factors) distribution (36).

Given the findings of the current study and similar studies, regardless of the cause of LBW and also its associated problems, it is suggested that in future studies, the potential causes of enamel disorders and also diseases due to LBW be examined.

Conclusions

The cesarean section and LBW may be associated with the DDE and dental caries. Nocturnal feeding was another factor potentially associated with dental caries and DDE.

Authors' Contribution

All authors have contributed to the conception and design of the study. RR supervised the conduct of the experiment. BA and MA contributed to the data collection. The statistical analyses and interpretation of data were carried out by BA. MA and RR drafted the manuscript. All the authors critically revised the manuscript for intellectual content and finally and approved the final version of the manuscript.

Ethical Statement

All steps of the study were approved by the Ethics Committee of

Hamadan University of Medical Sciences. The parents of children filled out the consent form for their children participation in the study.

Conflict of Interest Disclosures

The authors declare no competing interests with regards to the authorship and/or publication of this article.

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