Original Research Article

The Association Between Mode of Delivery and Maternal Factors and Dental Caries in Children

Çocuklarda Doğum Şekli, Maternal Faktörler ve Diş Çürüğü Arasındaki İlişki

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ABSTRACT

Introduction: The risk factors of early childhood caries has been associated with mode of delivery, maternal factors, parental attitudes and awareness and dietary habits. The aim of this study is to evaluate the relationship between mode of delivery, maternal factors and dental caries in young children.

Material and Methods: A total of 150 parents and their children aged between 2-12 years old who attended for dental treatment to Baskent University Faculty of Dentistry Department of Pedodontics were included in this study. This was designed as cross sectional questionnaire study. Mothers were asked to fill a 13 item questionnaire on the day when their children and themselves received a regular dental check-up at the hospital. The severity of caries experience of children and their mother's was measured using dmft index, the number of decayed, missing, and filled teeth for deciduous dentition; and DMFT index for permanent dentition. Hypoplasia was diagnosed based on the Modified Index of Developmental Defects of Enamel when the loss of surface integrity of the enamel was observed. Besides the descriptive statistical methods the Mann Whitney U, Fisher's Exact Chi-Square test, Spearman's rho correlation analysis was used. Significance was evaluated at confidence level p <0.05.

Results: The mean age+sd of children was 7.41±2.27 year. The mean df index value was 4.33±4.13 and mean DMFT index value was 0.45±1.29 in children and 7.91±5.17 in their mothers. Hypoplasia was seen on only 10 teeth in 89 teeth (11.3%). 44% born by vaginal delivery and 56% born by Caesarean section. There was a significant correlation between mothers DMFT index value and children's dft index value in positive direction (r:0.174, p:0.033; p<0.05). There was no significant difference between children's dft and DMFT index value and breastfeeding, cupfeeding and bottlefeeding type and duration (p>0.05). There was no relationship between child's dft and DMFT index values and birth time, mode of delivery, birth weight (p>0.05). The incidence of hypoplasia in children born to preterm (21.4%) was higher than the incidence of hypoplasia in children born in time (9.3%) but this difference was not statistically significant (p>0.05). Also no significance was found between the incidence of hypoplasia and birth weight (p> 0.05).

Conclusion: Mothers are role models for their children and should be aware of their child's caries experience which is associated with their untreated caries and tooth loss.

Keywords: Dental caries; Maternal factors; Mode of delivery

ÖZET

Amaç: Erken çocukluk çağı çürüklerinin risk faktörleri; doğum şekli, maternal faktörler, ailelerin tutumları ve farkındalıkları ve beslenme alışkanlıkları ile ilişkilendirilmiştir. Bu çalışmanın amacı, küçük çocuklarda doğum şekli, maternal faktörler ve diş çürükleri arasındaki ilişkiyi değerlendirmektir.

Gereç ve Yöntem: Bu çalışmaya Başkent Üniversitesi Diş Hekimliği Fakültesi Pedodonti Anabilim Dalı'na diş tedavisi için başvuran toplam 150 aile ve 2-12 yaş arasındaki çocukları dahil edildi. Annelerden 13 soruluk bir anket doldurmaları istendi. Çocukların ve annelerinin çürük prevalansı dmft indeksi ve DMFT indeksi kullanılarak ölçüldü. Hipoplazi, Modifiye Gelişimsel Mine Defektleri İndeksine göre teşhis edildi. Tanımlayıcı istatistiksel yöntemlerin yanı sıra Mann Whitney U testi, Fisher's Exact Ki-Kare testi kullanıldı. Anlamlılık p<0.05 güven düzeyinde değerlendirildi.

Bulgular: Çocukların yaş ortalaması 7.41 ± 2.27 yıldı. Ortalama df indeksi değeri 4.33 ± 4.13, ortalama DMFT indeksi değeri çocuklarda 0.45 ± 1,29, annelerinde 7.91 ± 5.17 idi. Sadece 10 dişte (%11.3) hipoplazi görüldü. Annelerin DMFT indeks değeri ile çocukların dft indeks değeri arasında pozitif yönde anlamlı bir korelasyon vardı (r: 0.174, p: 0.033; p <0.05). Çocukların dft ve DMFT indeks değerleri ile emzirme, kupa ile besleme ve biberonla besleme türü ve süresi arasında anlamlı bir fark yoktu (p> 0.05). Çocuğun dft ve DMFT indeks değerleri ile doğum zamanı, doğum şekli, doğum ağırlığı arasında ilişki yoktu (p>0.05). Erken doğan çocuklarda hipoplazi insidansı (% 21.4) zamanında doğan çocuklarda hipoplazi insidansından (%9.3) daha yüksekti ancak istatistiksel olarak anlamlı değildi (p>0.05).

Sonuç: Anneler çocukları için rol modellerdir ve çocuklarının tedavi edilmemiş çürükleri ve diş kayıpları ile ilişkili çürük deneyiminin farkında olmalıdır.

Anahtar kelimeler: Diş çürükleri; Doğum şekli; Maternal faktörler

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INTRODUCTION

Early childhood caries (ECC) is defined as one of the most common disease of 10 dental health conditions that affects the physical, psychological and oral health quality of life of both children aged 71 months and younger and their parents.[1-3] ECC is characterized by the presence of one or more decayed (noncavitated or cavitated lesions), missing (due to caries) or filled tooth surfaces in any primary tooth in a child.[4] Between 1994-2004 years the prevalence of ECC has been reported as 23.7% in developed countries and by the development and implementation of community-based preventive programs it is aimed to decrease to a level of 11% for 2010.[5] However, the prevalence of ECC remains still high (40.7%-69.8%) among preschool children in Turkey.[5-7]

Longitudinal studies describe the major risk factors of ECC has been associated with demographic characteristics, oral hygiene practices and maternal factors.[8-10] Most epidemiological studies search for an explanation regarding maternal factors related to mode of delivery, parental attitudes and awareness, household income, educational status of mother, socioeconomic status (SES), pacifiers dipped in honey, frequency of fermentable carbohydrates consumption, and dietary habits.[11-13]

It is well known that *S. mutans* plays a major role in the etiology of dental caries. The *S. mutans* colonization from newborns through childhood has been previously studied, suggesting that children acquire *S. mutans* primarily from their mothers approximately at 1 and 2 years of age, respectively, following or even prior to the emergence of primary teeth.[14-16] In recent literature mode of delivery significantly affects the time of acquisition of *S. mutans* in infants.[11,17,18] In vaginally delivered infants, the first exposure to microorganisms occurs during passage through the birth canal, whereas in infants born through cesarean section, the first exposure to bacteria is from the skin of parents and health providers or medical equipment.[14,15,17] Meanwhile, Li *et al*.[18] reported that *S.mutans* were detected more frequently and at a younger age in the oral cavity of children delivered by C-section than those delivered vaginally.

Food intake frequency is another caries risk factor in young children.[1] The World Health Organization (WHO) encourages and promotes exclusive breastfeeding for the first 6 months of life, followed by continued breastfeeding with appropriate complementary feeding for up to 2 years or beyond.[19] Despite the limited epidemiologic evidence, there has been a concern about relation between infant feeding frequency, feeding methods such as breastfeeding, bottlefeeding or both, and cupfeeding and dental caries in early childhood.[1,9] In 2016, WHO Global Consultation on public health intervention against early childhood caries highlighted the risk factors mainly as sugar consumption and breastfeeding is frequent after 12 months.[20]

The aim of this study is to evaluate the relationship between mode of delivery, maternal factors and dental caries in young children. The null hypothesis was there is no association between the two delivery forms, maternal factors and caries experience.

MATERIAL AND METHODS

This cross sectional study was ethically approved by Baskent University Institutional Review Board and Ethics Committee (Project no: D-KA 12/15) and supported by Baskent University Research Fund with a number of D-KA 12/15. A total of 150 parets and their children aged between 2-12 years old who attended for dental treatment to Baskent University Faculty of Dentistry Department of Pedodontics were included in this study. This was designed as cross sectional questionnaire study. The sample size was calculated on the basis of Boustedt K's study and set to 100[11] to determine significant differences at 95% confidence level with an alpha value of =0.05 and 80% power. The purpose of the study were explained to the patients, and a signed informed consent was taken from the parents. Mothers were asked to fill a 13 item questionnaire on the day when their children and themselves received a regular dental check-up at the hospital (Table 1). The first two questions included inquiries about family socio-demographics (mothers' educational status and family income). Questions 3-4-5-6 surveyed maternal pregnancy and past medical history: mode of delivery, gestational age, birth weight, 7-14 surveyed first dental examination age, oral health practices and child's feeding practice (breast feeding, bottle feeding, cup feeding). Four trained and experienced pediatric dentist performed a comprehensive dental examination for

all 150 children and their mothers using the WHO criteria defined for field studies.[21] The presence of caries was recorded as detectable white-spot lesion or cavity. The severity of caries experience of children was measured using dmft index, the number of decayed, missing, and filled teeth for deciduous dentition; and DMFT index for permanent dentition. Caries experience of the mothers was measured using DMFT index, the number of decayed, missing and filled teeth for permanent dentition. Hypoplasia was diagnosed based on the Modified Index of Developmental Defects of Enamel (DDE) when the loss of surface integrity of the enamel was observed in permanent teeth. A surface with a single abnormality smaller than 1 mm diameter was recorded as "normal". If the teeth surface has extensive loss due to caries or restorations or 2/3 of the tooth surface was impacted we classified as "excluded" from the analysis. All the primary teeth were considered "exluded" for calibration of the index of DDE.[22]

Table 1. Questionnaire: evaluation of mode of delivery, maternal factors

Your educational status a) primary school b) high school c) university d) higher
Your income status a) lower than 300 Euro b) 300-600 Euro c) 600-900 Euro d) more
How long have you been pregnant?
Your way of birth ? a) caesarian b) normal weight
Birth weight of your baby
Have you had any problems during pregnancy? a) vaginal bleeding b) contractions c) viral or bacterial infections d) diabet e) hypertension
What is your child's first dental experience age?
At what age did you start brushing your child's teeth?
Who brushes your child's teeth? a) child b) mother
Do you use toothpaste?
Did your child had breast feeding? how long?
Did your child had cup feeding? how long?
Did your child had bottle feeding? how long?

Table 2. The demographic characteristics and caries status of children

	Min-Max	Mean±sd
Age (Year)	2-12	7.41±2.27
Child's dft index value	0-22	4.33±4.13
Child's DMFT index value	0-6	0.45±1.29
Mother's DMFT index value	0-24	7.91±5.17
	n	**%**
Hypoplasia (n=89)	10	11.2
Breastfeeding	148	98.7
Cup feeding	95	63.3
Bottle feeding	93	62
Bottle feeding duration (n=93)		
0-6 month	28	30.1
7-12 month	25	26.9
13-18 month	10	10.8
19-24 month	13	14.0
25-30 month	3	3.2
31-36 month	5	5.4
37 month and more	9	9.7
Birth Time		
Preterm	26	17.3
Term	124	82.7
Mode of delivery		
Caesarean	84	56.0
Vaginal	66	44.0
Birth weight		
≤2500 gr	24	16.0
>2500 gr	126	84.0

Statistical analysis

Data were analyzed using statistical computer software (IBM SPSS Statistics 22 (IBM SPSS, Turkey)). The normal distribution of the parameters was evaluated by Shapiro Wilks test and it was found that the parameters did not show normal distribution. Besides the descriptive statistical methods (median, frequency, standart deviation, minimum, maximum) the Mann Whitney U test was used to evaluate the changes of intragroups. In the comparison of qualitative data, Fisher's Exact Chi-Square test was used. Spearman's rho correlation analysis was used to examine the relationships between the parameters. Significance was evaluated at confidence level p <0.05.

RESULTS

150 children aged between 2-12 and their mothers were included in this study. Table 2 shows the demographic characteristics an caries status of children and their mothers. The mean age+sd of children was 7.41±2.27 year. The mean df index value was 4.33±4.13 and mean DMFT index value was 0.45±1.29 in children and 7.91±5.17 in their mothers. Hypoplasia was seen on only 10 teeth (11.3%). 44% born by vaginal delivery and 56% born by Caesarean section. Overall, most children (82.7%) were normal-term newborns (gestation age ≥ 37 weeks). Only 16% of the children were born with a birth weight <2500 g. Most children (98.7%) were breast fed 30% were breast fed up to six months, 27% were fed up to 12 months, and about 57% of children were breast fed for more than a year. In 93 of the children (62%), bottlefeeding was observed and the duration of feeding of these bottlefed children varies between 2 months and 8 years and the average is 1.53 ± 1.37 years. The children were exclusively breast fed from birth to at least three months of life. Bottle feeding practices started in the three months of life both to support breast feeding or at the end of the breast feeding. There was a significant correlation between mothers DMFT index value and children's dft index value in positive direction (r:0.174, p:0.033; p<0.05) (Table 3). There was no significant difference between children's dft and DMFT index value and breastfeeding, cupfeeding and bottlefeeding (Table 4) (p>0.05). Table 5 shows there was no correlation between the child's dft index value and duration of breastfeeding or bottlefeeding (r:-0.019, p>0.05). There was no relationship between child's dft and DMFT index value and birth time, mode of delivery, birth weight (p>0.05) (Table 6). The incidence of hypoplasia in children born to preterm (21.4%) was higher than the incidence of hypoplasia in children born in time (9.3%) but this difference was not statistically significant (p>0.05) (Table 7). Also no significance was found between the incidence of hypoplasia and birth weight (p> 0.05) (Table 7).

Table 3. Mothers DMFT index value and their children's dft and DMFT index value.

	Mothers DMFT index value	
	r	p
Children's dft index value	0.174	0.033*
Children's DMFT index value	0.057	0.486

Spearman's Rho Correlation *p<0.05

Table 4. Evaluation of children's dft and DMFT index value according to breastfeeding, feeding, cupfeeding and bottlefeeding style.

	Child dft index value	Child DMFT index value
	mean±sd	mean±sd
Breastfeeding		
Present	4.3±4.15	0.45±1.30
Absent	6±2.83	0±0
p	**0.371**	**0.579**
Cupfeeding		
Present	4.37±4.48	0.53±1.35
Absent	4.25±3.49	0.31±1.18
p	**0.666**	**0.247**
Bottlefeeding		
Present	3.86±3.64	0.54±1.36
Absent	5.09±4.76	0.30±1.16
p	**0.152**	**0.200**

Mann-Whitney U Test

Table 5. Correlation between children's dft index value and DMFT index value according to the duration time of breastfeeding and bottlefeeding

	Child dft index value		Child DMFT index value	
	r	p	r	p
Duration time of breastfeeding (month)	-0.019	0.820	0.011	0.890
Duration time of bottlefeeding (year)	0.077	0.351	0.082	0.319

Spearman's Rho Correlation

Table 6. Relationship between child's dft and DMFT index value and birth time, mode of delivery, birth weight

	Child dft index value	Child DMFT index value
	mean±sd	mean±sd
Birth time		
Preterm	4.73±4.86	0.54±1.42
Term	4.24±3.98	0.43±1.27
p	**0.870**	**0.721**
Mode of delivery		
Caesarean	4.43±4.72	0.43±1.35
Vaginal	4.20±3.26	0.47±1.22
p	**0.580**	**0.353**
Birth weight		
≤2500 gr	4.54±5.44	0.29±0.91
>2500 gr	4.28±3.86	0.47±1.35
p	**0.673**	**0.825**

Mann-Whitney U Test

Table 7. Relationship between hypoplasia and birth time and birth weight

	Hypoplasia		p
	Present	Absent	
	n (%)	n (%)	
Birth time			
Preterm	3 (21.4%)	11 (78.6%)	**0.189**
Term	7 (9.3%)	68 (90.7%)	
Birth weight			
≤2500 gr	2 (13.3%)	13 (86.7%)	**0.674**
>2500 gr	8 (10.8%)	66 (89.2%)	

Fisher's Exact Test

DISCUSSION

In this study, we examined the mode of delivery as well as a set of risk factors, including oral health factors, past medical and birth factors, maternal social behavior factors, and children's dietary behavior factors, in relationship with caries in young Turkish children. The main and most interesting finding in this study was the significant association between the mothers DMFT index value and children's dft index value (Table 2). In previous studies a strong relationship between poor oral health of mothers and the prevalence of ECC in their children has been supported.[10-12] One of them is a comprehensive national study conducted in USA known as Third National Health and Nutrition Examination Survey (NHANES III), 1,184 children aged 2 through 6 years and their mothers had participated in an oral health examination. The researchers found that mothers at high caries risk status had more than three times as likely to have children who had an increasing extent of caries experience.[10] This could be due to association between maternal mutans streptocci (MS) level and negligence both their and their children's oral hygiene. The results of present study showed similarities with previous studies [10-12] showing a strong correlation between the mother's and their children's oral health. We found mother's high caries status was over 2 times greater than their children's caries status.

Regarding the way of feeding and its duration prolonged breastfeeding has been known as an important contributing factor for ECC.[11,13] In Stephen *et al*.'s study the occurrence of ECC was found significantly higher with the prolonged breastfed and bottlefed children.[3] In another study Feldens *et al*. reported that frequent feeding at age 12 months, which included more frequent episodes of daily bottle use, breastfeeding and intake of other foods and/or drinks ad libitum, was associated with a higher prevalence of dental caries approximately 2 years later.[1] In a recent study, Bullappe *et al*. evaluated the relationship between feeding methods and ECC in their crosssectional study and they statedthere was no statistically difference between children who were exclusively breastfed and or bottlefed.[13] In contrast to two previous studies but similar with Bullappe's study in this study the way of feeding or its duration didn't present an elevated risk of early childhood caries among Turkish children aged 2 to 12 years old.[13] This was an unexpected result but feeding frequency or duration aren't the only factors for caries risk, some authors highlighted the concept that genes and environmental components can modify the susceptibility to caries in children, even within the same dentition.[23]

In a systematic review which explores the association between dental caries and preterm birth (PTB); they found no relationship between women with dental caries who experienced PTB and those who did not.[24] However, in a recent study Schüler *et al*. evaluated dental health in the primary dentition of preterm infants and mother-infant-related risk factors and reported the caries experience was higher in PTB (DMFT 1.0 ± 3.1) than in full time birth (DMFT 0.3 ± 1.0).[2] The highest risk occurred in preterm infants with an extremely low birth weight (<1,000 g). In the present study we found no significant relation-

ship between caries experience both in primary and permanent dentition and preterm birth (DMFT 0.54 ± 1.42) and full time birth (0.43±1.27). Also our results showed birth weight and mode of delivery did not effect child's caries prevalence. It is difficult to explain the lack of association between mothers' caries formation and PTB. Even though the initiation and progression caries process is slow, mothers should be evaluated before pregnancy and after preterm birth. Also large epidemiological studies may be planned to explore the risk factors of PTB, according to the gestational age at occurrence, presence of other co-morbidities and role of dental caries.

In primary dentition among the developmental defects of enamel, the occurrence of hypoplasia may be related to complications in the prenatal and perinatal periods.[27,28] There are several studies regarding the association of hypoplasia with birth time[29,30], low birth weight status.[26,27] However, this association has not been confirmed by other researchers, who reported no significant differences in the occurrence of hypoplasia. In present study, birthtime and birth weight was not significantly associated with hypoplasia, in agreement with data reported by Tourino *et al*. [28]Among the limitations of this study the number of preterm borned children was small in study population. This may affect the statistical results however there was an increasing tendency in incidence of hypoplasia from preterm borned to term borned children.

CONCLUSION

Mother- related factors such as mother's dental status may have an important role for their children's dental status. They should be aware of their child's caries experience which is associated with their untreated caries and tooth loss. Also future studies should identify effects of factors like mode of delivery, birth, feeding and maternal social behavior factors and these factors should be applied to models of oral health promotion programmes.

REFERENCES

1. Feldens CA, Rodrigues PH, Vitolo GA, Chaffee BW. Feeding frequency in infancy and dental caries in childhood: a prospective cohort study. Int Dent J 2018;68:113-21.

2. Schüler IM, Haberstroh S, Dawczynski K, Lehmann T, Heinrich-Weltzien R. Dental caries and developmental defects of enamel in the primary dentition of preterm infants: case control observational study. Caries Res 2018;52:22–31.

3. Stephen A, Krishnan N, Chalakkal P. The association between cariogenic factors and the occurence of early childhood caries in children from Salem district of India. J Clin Diagn Res 2017;11: ZC63-ZC66.

4. American Academy of Pediatric Dentistry Reference Manual 2002 – 03 Policies on Early Childhood Caries; Unique Challenges and Treatment Options. Pediatr Dent 2003;23:24–5.

5. Evans RW, Feldens CA, Phantuvanit P. A protocol for early childhood caries diagnosis and risk assessment. Community Dent Oral Epidemiol 2018;46:518-25.

6. İlgen YG, Çoğulu D. Early childhood caries and treatment strategies. Türkiye Klinikleri J Pediatr Dent – Special Topics 2018;4:43-9.

7. Cerit EN, Özer L. Effects of early childhood caries on phsical, psychological development and quality of life. Türkiye Klinikleri J Pediatr Dent – Special Topics 2018;4:75-80.

8. Cabral MBBS, Mota ELA, Cangussu MCT, Vianna MIP, Floriano FR. Risk factors for caries-free time: longitudinal study in early childhood. Rev Saude Publica 2017;51:118.

9. Hisano K, Tanaka K, Nagata C, Arakawa M, Miyake Y. High birthweight is associated with increased prevalence of dental caries in Japanese children. Int J Dent Hyg 2018;16:404-10.

10. Dye BA, Vargas CM, Lee JJ, Magder L, Tinanoff N. Assessing the relationship between children's oral health status and that of their mothers JADA 2011;142:173-83.

11. Boustedt K, Roswall J, Twetman S, Dahlgren J. Influence of mode of delivery, family and nursing determinants on early childhood caries development: a prospective cohort study. Acta Odontol Scand 2018;76:8,595-9.

12. Priyadarshini HR, Fernandes BA, Hiremath SS, Rath A, Shivakumar V, Tegginamani AS. Assessment of maternal risk indicators for the development of caries in their children: A comparative, cross-sectional study. J Indian Soc Pedod Prev Dent 2017;35:110-4.

13. Bullappa D, Puranik MP, Sowmya KR, Nagarathnamma T. Association of Feeding Methods and Streptococcus mutans Count with Early Childhood Caries: A Cross-sectional Study. Int J Clin Pediatr Dent 2017;10:119-25.

14. Pattanaporn K, Saraithong P, Khongkhunthian S, Aleksejuniene J, Laohapensang P, Chhun N,*et al*. Mode of delivery, mutans streptococci colonization, and early childhood caries in three- to five-year-old Thai children. Community Dent Oral Epidemiol 2013;41:212–23.

15. Holgerson PL, Harnevik L, Hernell O, Tanner ACR, Johansson I. Mode of delivery affects oral microbiota in infants. J Dent Res 2011;90:1183-8.

16. Caufield PW, Dasanayake AP, Li Y, Pan Y, Hsu J, Hardin JM. Natural history of Streptococcus sanguinis in the oral cavity of

infants: evidence for a discrete window of infectivity. Infect Immun 2000;68:4018-23.

17. Ubeja RG, Bhat C. Mode of delivery and its influence on the acquisition of Streptococcus mutans in infants. Int J Clin Pediatr Dent 2016;9:326-9.

18. Li Y, Caufield PW, Dasanayake AP, Wiener HW, Vermund SH. Mode of delivery and other maternal factors influence the acquisition of Streptococcus mutans in infants. J Dent Res 2005;84:806-11.

19. World Health Organization Breastfeeding http://www.who.int/maternal_child_adolescent/topics/newborn/nutrition/breastfeeding/en/. Accessed February 16, 2017.

20. Phantumvanit P, Makino Y, Ogawa H, Rugg-Gunn A, Moynihan P, Petersen PE, *et al*. Who Global Consultation on Public Health Intervention against early childhood caries. Community Dent Oral Epidemiol 2018;46:280-7.

21. WHO. Oral health surveys; Basic methods. 4. Geneva: WHO; 1997.

22. A review of developmental defects of the enamel dental index (DDE index). Commission on Oral Health Research & Epidemiology Report of an FDI Working Group. Int Dent J 1992; 42:411-26.

23. Wang X, Willing MC, Marazita ML, Wendell S, Warren JJ, Broffitt B, *et al*. Genetic and enviromental factors associated with dental caries in children, the Iowa Fluoride Study. Caries Res 2012;46:177-84.

24. Wagle M, Antonio F, Reierth E, Basnet P, Trovik TA, Orsini G,*et al*. Dental caries and preterm birth: a systematic review and meta-analysis. BMJ Open 2018;8:e018556.

25. Vieria ACF, Alves CMC, Rodrigues VP, Ribeiro CCC, Gomes-Filho IS, Lopes FF. Oral, systemic and socioeconomic factors associated with preterm birth. Women Birth 2018;32:e12-6.

26. Velló MA, Martínez-Costa C, Catalá M, Fons J, Brines J, Guiiarro-Martínez R. Prenatal and neonatal risk factors the development of enamel defects in low birth weight status children. Oral Dis 2010;16:257-62.

27. Correa-Faria P, Martins-Júnior PA, Vieira-Andrade RG, Oliveira-Ferreira F, Marques LS, Ramos-Jorge ML. Developmental defects of enamel in primary teeth: prevalence and associated factors. Int J Paediatr Dent 2013;23:173-9.

28. Tourino LFP, Maria ZP, Patrícia CF, Martins PS, Parreira VMP. Prevalence and factors associated with enamel defects among preschool children from a southeastern city in Brazil. Cien Saude Colet 2018;23:1667-74.

29. Cruvinel VR, Gravina DB, Azevedo TD, Rezende CS, Bezerra AC, Toledo OA. Prevalence of enamel defects and associated risk factors in both dentitions in preterm and full term born children. J Appl Oral Sci 2012;20:310-7.

30. Pinho JR, Filho FL, Thomaz EB, Lamy ZC, Libério SA, Ferreira EB. Are low birth weight status, intrauterine growth restriction, and preterm birth associated with enamel developmental defects? Pediatr Dent 2012;34:244-8.