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Original Article

The Impact of Infant Feeding and Oral Hygiene Habits on Early Childhood Caries: A Cross-Sectional Study

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Abstract

Background and Aim: The aim of this study is to evaluate the relationship between the Early Childhood Caries (ECC)/severe-ECC (S-ECC) and prolonged breast-feeding (BF), bottle-feeding, and oral hygiene habits in 0-year-old to 5-year-old Turkish children. **Patients and Methods:** Dental examinations were performed on 255 patients to determine the prevalence of the ECC and the S-ECC as per the definition of the American Academy of Pediatric Dentistry. To predict the progress rate of caries, noncavitated and cavitated lesion scores were assessed by using the International caries detection and assessment system II criteria. Information on infant feeding practices, oral hygiene habits, maternal characteristics, and demographic features were gathered by means of a questionnaire. The results were statistically evaluated. **Results:** There were no associations between BF duration, night-time BF, bottle-feeding, and the ECC. And there were also no associations between BF duration, night-time BF, bottle-feeding, and the S-ECC. Cavitated lesions were more common in children breastfed at night for 18-23 months compared to 12-17 months (P = 0.031). Sweetened bottle was an impact factor on caries experience (P = 0.042). A significant correlation was found for dmft, S-ECC, and the cavitated lesions regarding sugar consumption (P = .001, P = .002, and P = .001, respectively). Early introduction to tooth-brushing and regular dental visits were significantly effective in reducing the ECC (P < .001 and P < .001, respectively). **Conclusion:** BF and bottle-feeding practices were not associated with the ECC/S-ECC. Sweetened bottles and sugary foods are strong risk factors for the ECC/S-ECC.

Keywords: *Bottle-feeding, breastfeeding, caries, ECC, infant*

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Introduction

Early Childhood Caries (ECC) is a special form of rampant caries that is usually characterized by a pattern in which first the maxillary primary incisors are affected, followed by the maxillary molars, then the mandibular molars. Due to the protective nature of the tongue, the mandibular incisors are often spared. There are many risk factors associated with the ECC. Feeding behavior, which is the first act that starts with birth, has a major place in this regard.[1]

Breast-feeding (BF) is a feeding method for babies that provides an ideal growth and development by giving them the most appropriate nutrients they need and immunity support, protecting them from infections and diseases. Furthermore, it provides physical, hormonal, and psychological dynamic sharing between mother and baby.[2]

As per the American Academy of Pediatrics, BF should be sustained for at least 12 months and is preferred to be continued if accepted by mother and child. By expanding this duration, the World Health Organization recommends exclusive BF for the first six months of an infant's age and continuity of BF with other nutritional

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supplements for 24 months or more.[3] Beyond many well-known advantages for children's health such as lower frequencies of mortality and infant diseases,[4] BF also helps to afford postpartum well-being for mothers.[5] However, BF does not always assure a health benefit when it is done over a long span of time. Several authors have demonstrated an increased prevalence of primary tooth decay associated with prolonged BF.[6-10] On the contrary, some recent studies have found no association between these two conditions.[11,12] The extent to which BF duration and frequency affect the risk of dental caries has still not been determined adequately.

The inconsistency between the outcomes of the existing studies depends on the meager control of the potential confounders of feeding habits such as bottle-feeding, introduction to supplementary foods, and oral hygiene behaviors. Bottle-feeding practices are often characterized by cow's milk or formula. However, there are conflicting thoughts regarding the cariogenicity of bottle-feeding.[13,14] Consumption of foods especially high in free sugars plays a critical role in the development of caries at early ages.[12,15] Low quality of oral hygiene also constitutes a risk factor for dental caries.[15] Although the confounding factors have been explored in different countries, the results may still be contradictory.[9,12]

The characteristics related to mothers such as low socioeconomic status, low education levels, oral hygiene habits, number of children, and family type could be risk factors for their children.[16] Although etiological factors for ECC in early infants have been well studied, the influence of each variable may differ in each population depending on cultural, genetic, and socioeconomic factors.

This study aims to investigate the effect of prolonged BF, bottle-feeding, and oral hygiene habits on ECC/S-ECC in 0–5-year-old Turkish children.

Methodology

Study population

This study was performed on 255 children aged 6–71-month-old, receiving dental care at the Pediatric Dental Clinic of the Training Dental Hospital, Izmir, Turkey between December 2019 and March 2020. This research hospital is a training hospital where patients come from both urban and rural areas and provides healthcare to people who are insured by the state. Only children who were 6-month-old to 71-month-old (below 72 months), coming with their mothers, and whose mothers consented, were included in the study. Children who were accompanied by other than their mother, children who were medically compromised, and immigrants were excluded. During the research period, a total of 806 Turkish children aged 0-5 years visited the Pediatric Dental Clinic. After applying the exclusion criteria, only 255 children were enrolled in this study. The sample size was calculated as 193 cases by using Open Epi version 3.01, taking 20.7% prevalence rate[8] with 95% confidence interval (CI) and α = 5%, 80% of power, of a total number of 806. In the study, this estimated number is exceeded.

Ethical statement

This study was approved by the local ethics committee of the Dr. Behcet Uz Children's Hospital (2019/359). It was undertaken with the understanding and written consent of each participant's mother and conducted in compliance with the guidelines of the Declaration of Helsinki.

Dental caries assessment

The children were examined in a dental chair using a dental mirror and a dental probe without radiography by the same author who previously underwent a training program for caries identification prior to the study and was calibrated until the intrareproducibility reached 90% as per Cohen's Kappa scores. Their teeth were previously cleaned by means of cotton rolls and dried with compressed air.

To assess the caries status, the dmft index for primary dentition was used based on the World Health Organization criteria.[17] White spot decalcifications were not considered to be caries. Diagnostic criteria of ECC and S-ECC were determined as per the American Academy of Pediatric Dentistry's definition depending on the relevant index.[1] ECC is defined as the presence of one or more decayed, missing, or filled tooth surfaces in any primary tooth in a child at less than 72 months of age, while the S-ECC is classified by the presence of a decayed, missing (due to caries), or filled tooth (dmft) score of ≥4 (age 3), ≥5 (age 4), or ≥6 (age 5).[1] Besides, to predict the progress rate of caries, International caries detection and assessment system II criteria were used by categorizing code 1 and 2 as "noncavitated" and code 3 to 6 as "cavitated lesions".[18]

Data collection

Demographical features and maternal daily habits such as age, educational level, occupation, family income, nuclear family, number of children, living in rural or urban area, smoking, and the frequency of tooth-brushing were collected in the first part of the questionnaire. The income levels of the families were determined as per the up-to-date data of the income distribution table announced by the Turkish Statistical Institute at the dates of the study.[19] As per this, one minimum wage in the household was considered as low

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income, two as medium, and more than three wages as high income.

The second part of the questionnaire explored feeding habits and oral hygiene and dental attendance behavior of the children. Mothers were asked whether their child was BF. If they reported "yes", they were asked for the BF duration which was categorized into five groups: <6, 6-11, 12-17, 18-23, and ≥24 months. The BF duration was the period during which the infants received breastmilk regardless of exclusivity.[8] The same structure was used for the following questions:

*Did your child receive any BF while sleeping?

*Did your child receive bottle-feeding?

Data regarding having used sweetened feeding bottle and daily frequency of sweet food consumption were also recorded. The questionnaire also included questions on child's age when brushing was started, use of toothpaste, dental attendance, and use of antibiotics during the first year of life.[15,20]

Statistical analysis

Statistical analysis was performed using the IBM SPSS Statistics 24.0 Program (Network, USA). Mean and standard deviation or median (range, mean rank) values were given for continuous variables. All data were compared by the Chi-square, Kruskal-Wallis, and the Mann-Whitney tests. A P value of <.05 was statistically significant.

Results

Of the 255 children, 125 (49%) were girls and 130 (51%) were boys. The determined prevalence of S-ECC was 67.8%. The number of children who had at least one surface affected by dental caries was 242 (94.9%) [mean number of dmfs: 7.98 ± 4.87]. The number of children with only one caries was eight (3%), while in two children (0.8%) caries was detected in all teeth. The prevalence of S-ECC was observed higher in girls (P = 0.003), and no statistical significance was found regarding age (P = 0.678). Mean age of mothers was 32.43 years. Distribution of caries prevalence and experience with respect to the demographic features and oral hygiene habits of mothers are presented in Table 1. The prevalence of S-ECC did not differ significantly in terms of all independent variables, although statistical significance was determined in ECC as per education, occupation, family income, and living area (P = .004, P = .004, P < .001, and P =.043, respectively). Likewise, children whose mothers were illiterate and had low family income had significantly more cavitated lesions (P = .038 and P = .016, respectively). However, it was clearly observed that as income level of the family increased, the dmft scores of children decreased (P = .022).

Thirty six children (14.1%) were breastfed for 6 months, 13.3% for 6-11 months, and the majority (64.4%) were breastfed for at least 12 months, of which 35.3% match the period of 18-23 months. Twenty nine children (11.4%) were not breastfed while sleeping. However, almost half of the children (47.4%) were breastfed during sleep for more than 18 months. One hundred and five children (41.2%) received bottle-feeding. Of these, 28.2% received it for at least 12 months and 13% received it for less than 12 months. Table 2 shows the caries prevalence and experience as per BF, bottle-feeding, and sugar consumption. No statistical significance was observed in caries experience, ECC, and S-ECC prevalence in relation to BF, BF while sleeping and bottle-feeding. BF at night up to 18 months was found statistically significant to cavitated lesions (P = 0.031), while daytime BF for more than 18 months and bottle-feeding up to 24 months initiated noncavitated lesions (P = 0.011 and P = .001, respectively). More than a quarter of the children (25.9%) were fed with sweetened bottle. More cavities were detected in those who received sweetened bottles compared to those who did not (P = .042). Children who consumed sugary foods more than three times a day had higher caries experience, high S-ECC prevalence, and more cavitated lesions (P = .001, P = .002, and P = .001, respectively).

When considering the age of brushing, the prevalence of ECC was found to be much lower in children whose teeth were brushed as soon as they erupted (P < .001) [Table 3]. Noncavitated lesions were detected more commonly in children who had tooth-brushing at the age of 1-2 years compared to those whose tooth-brushing was performed when the first tooth erupted and to those who brushed the teeth at the age of 3-5 years; these conditions were found to be statistically significant (P = 0.015 and P = 0.043, respectively).

When the reason for dental visits was considered, less dmft score, less cavitated lesions, and low ECC and S-ECC prevalence were detected in children who came for dental control purposes compared to other reasons (P < .001, P < .001, P < .001, and P < .001, respectively).

Noncavitated lesions were detected much less in children who used toothpaste more frequently than those who did not, demonstrating a significant difference between the groups (P = 0.019). However, when children were classified as per the amount of use, no difference was seen (P = 0.088). On the other hand, cavitated lesion and dmft scores were higher in children who used

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Table 1: Caries experience of the study population with respect to maternal characteristics and demographic features

	n (%)	ECC *n* (%)	*P*	S-ECC *n* (%)	*P*	dmft, median (range, mean rank)	dmft mean±SD	*P*	d1-2 median (range, mean rank)	*P*	d3-6 median (range, mean rank)	*P*
Education												
Illiterate	30 (11.8)	30 (100)	0.004*	22 (73.3)	0.738	8 (16,145.63)	9.2±4.4	0.138	0 (6,126.93)	0.061	8 (16,147.40)	0.038†
Primary	82 (32.2)	82 (100)		54 (65.9)		8 (19,135.23)	8.56±5.18		0 (12,139.99)		8 (19,136.20)	
Secondary/high school	99 (38.8)	92 (92.9)		65 (65.7)		8 (17,124.94)	7.72±4.87		0 (8,126.06)		7 (17,126.68)	
University	44 (17.3)	38 (86.4)		32 (72.7)		8 (14,109.39)	6.63±4.26		0 (10,110.75)		6.5 (12,102.48)	
Occupation												
Remunerated	63 (24.7)	55 (87.3)	0.004*	43 (68.3)	0.936	10 (20,134.62)	8.38±5.19	0.410	0 (6,112.90)	0.018‡	8 (20,127.65)	0.965
Housewife/unemployed	192 (75.3)	187 (97.4)		130 (67.7)		8 (19,125.83)	7.85±4.76		0 (12,132.95)		8 (19,128.11)	
Smoking												
Half	39 (97.5)	40 (15.7)	0.550	33 (82.5)	0.063	8 (17,144.34)	9.03±4.62	0.287	0 (12,147.79)[a]	0.019†	8 (17,147.70)	0.179
More than half	8 (100)	8 (3.1)		4 (50)		5.5 (17,114.88	8.00±7.21		0 (0,92)[a]		5.5 (17,119.38)	
No	207 (81.7)	195 (94.2)		136 (65.7)		8 (20,125.35)	7.78±4.81		0 (11,125.57)		8 (20,124.53)	
Smoking during pregnancy												
Yes	34 (13.3)	34 (100)	0.227	24 (70.6)	0.713	8 (14,130.68)	8.09±4.10	0.820	0 (12,138.40)	0.266	8 (14,135.94)	0.499
No	221 (86.7)	208 (94.1)		149 (67.4)		8 (20,127.59)	7.96±4.98		0 (11,126.40)		8 (20,126.78)	
Family Income												
Low	78 (30.6)	74 (94.9)	<0.001**	58 (74.4)	0.084	8 (18,136.04)[b]	8.52±4.85[b]	0.022†	0 (11,139.44)	0.058	8 (18,140.56[d]	0.016†
Medium	160 (62.7)	158 (98.8)		107 (66.9)		8 (20,128.97)[c]	8.05±4.77[c]		0 (12,124.65)		7 (20,126.55)	
High	17 (6.7)	10 (58.8)		8 (47.1)		4 (12,81.97)[b,c]	4.82±4.94[b,c]		0 (4,107.06)		4 (12,84,41)[d]	
Family type												
Nuclear	202 (79.2)	191 (94.6)	1.000	141 (69.8)	0.191	8 (20,130.99)	8.18±4.95	0.205	0 (12,126.85)	0.540	8 (20,131.23)	0.171
Large	53 (20.8)	51 (96.2)		32 (60.4)		6 (18,116.60)	7.23±4.51		0 (10,132.39)		6 (18,115.70)	
Living area												
Urban	196 (76.9)	183 (93.4)	0.043*	132 (67.3)	0.757	8 (19,126.33)	7.83±4.78	0.509	0 (11,122.33)	0.005‡	7 (19,125.70)	0.363
Rural	59 (23.1)	59 (100)		41 (69.5)		8 (19,133.54)	8.47±5.17		0 (12,146.82)		8 (19,135.63)	
Number of children												
1	37 (14.5)	36 (97.3)	0.546	30 (81.1)	0.067	9 (17,142.82)	8.92±4.67	0.195	0 (8,133.00)	0.011†	8 (17,135.78)	0.342
2	128 (50.2)	120 (93.8)		83 (64.8)		7 (20,122.21)	7.60±4.87		0 (10,119.65[e]		6 (20,121.86)	
3	67 (26.3)	63 (94.0)		41 (61.2)		9 (19,123.22)	7.72±5.22		0 (11,129.16)		8 (19,127.92)	
>4	23 (9.0)	23 (100)		19 (82.6)		8 (13,150.30)	9.35±3.84		2 (12,163.04[e]		8 (14,149.87)	
Tooth-brushing frequency												
Once a day	101 (39.6)	98 (97.0)	0.442	76 (75.2)	0.122	8 (20,133.56)	8.43±4.95	0.236	0 (11,125.95)	0.477	8 (20,139.20)	0.109
Twice a day	135 (52.9)	126 (93.3)		85 (63.0)		8 (18,127.44)	7.89±4.88		0 (12,131.34)		8 (18,122.32)	
Once or twice a week	19 (7.5)	18 (94.7)		12 (63.2)		7 (11,102.39)	6.21±4.03		0 (3,115.16)		7 (11,108.84)	

SD=Standard deviation, **P*<0.05 – significant- Chi-square test; ***P*<0.001 – significant- Chi-square test, †*P*<0.05 – significant- Kruskal-Wallis test; ‡*P*<0.05 – significant- Mann-Whitney test, Significant difference between values with the same letters (adjusted by the Bonferonni correction; *P*<0.05); [a]*P*=0.041; [b]*P*=0.018; [c]*P*=0.037; [d]*P*=0.013; [e]*P*=0.006

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Table 2: Caries experience of the study population with respect to breastfeeding (BF), bottle feeding, and sugar consumption

	n (%)	ECC *n* (%)	*P*	S-ECC *n* (%)	*P*	dmft, median (range, mean rank)	dmft mean±SD	*P*	d1-2 median (range, mean rank)	*P*	d3-6 median (range, mean rank	*P*
BF												
<6	36 (14.1)	35 (97.2)	0.912	22 (61.1)	0.576	8 (19,128.00)	8.11±5.33	0.420	0 (4,106.69)	0.011†	8 (19,132.54)	0.087
6-11	34 (13.3)	32 (94.1)		24 (70.6)		8 (15,134.82)	8.26±4.39		0 (11,144.87)		8 (15,137.31)	
12-17	31 (12.2)	29 (93.5)		23 (74.2)		10 (14,131.32)	8.06±4.55		0 (6,108.39)		10 (14,134.69)	
18-23	90 (35.3)	86 (95.6)		58 (64.4)		6 (18,117.93)	7.29±4.55		0 (10,134.72)		5 (18,111.19)	
24+	43 (16.9)	41 (95.3)		33 (76.7)		8 (21,145.97)	9.33±5.55		0 (12,138.87)		8 (20,150.00)	
No	21 (8.2)	19 (90.5)		13 (61.9)		8 (16,118.40)	7.38±4.96		0 (4,115.10)		8 (16,122.26)	
BF while sleeping												
<6	36 (14.1)	34 (94.4)	0.667	21 (58.3)	0.122	6.5 (19,114.07)	7.17±4.97	0.071	0 (4,109.63)	0.095	6.5 (19,117.72)	0.031†
6-11	28 (11.0)	28 (100)		17 (60.7)		8 (13,118.70)	7.29±4.09		0 (11,132.68)		8 (12,122.73)	
12-17	41 (16.1)	38 (95.1)		35 (85.4)		10 (16,154.44)	9.76±4.43		0 (6,117.88)		10 (16,160.06)[a]	
18-23	85 (33.3)	81 (95.3)		55 (64.7)		6 (18,118.79)	7.34±4.63		0 (10,139.05)		6 (18,113.91)[a]	
24+	36 (14.1)	34 (94.4)		26 (72.2)		8 (20,136.78)	8.75±5.51		0 (12,135.82)		8 (20,135.61)	
No	29 (11.4)	26 (89.7)		19 (65.5)		8 (16,128.74)	8.07±5.44		0 (5,118.52)		8 (16,132.68)	
Bottle-feeding												
<6	16 (6.3)	16 (100)	0.418	12 (75.0)	0.056	8 (9,124.25)	7.63±3.30	0.106	0.5 (12,156.19)	0.001§	8 (9,126.13)	0.246
6-11	17 (6.7)	16 (94.1)		12 (70.6)		7 (19,111.68)	7.18±5.21		0 (2,104.41)[b]		6 (19,115.88)	
12-17	34 (13.3)	30 (88.2)		15 (44.1)		5 (16,104.74)	6.47±5.27		0 (4,116.37)[c]		5 (16,107.59)	
18-23	21 (8.2)	20 (95.2)		16 (76.2)		11 (17,161.36)	10.29±5.45		3 (5,172.95)[b,c]		10 (17,153.81)	
24+	17 (6.7)	17 (100)		13 (76.5)		8 (12,139.38)	8.59±3.72		0 (11,124.82)[d]		8 (12,145.68)	
No	150 (58.8)	143 (95.3)		105 (70.0)		8 (20,129.56)	8.06±4.83		0 (10,124.37)[d]		7.2 (20,128.58)	
Sweetened bottle												
Yes	66 (25.9)	64 (97.0)	0.524	47 (71.2)	0.496	10 (16,143.86)	8.91±4.46	0.042‡	0 (11,129.05)	0.866	8.5 (16,141.48)	0.084
No	189 (74.1)	178 (94.2)		126 (66.7)		8 (20,122.46)	7.66±4.97		0 (12,127.63)		7 (20,123.29)	
Sugar consumption												
≤1	107 (42.0)	104 (97.2)	0.088	71 (66.4)	0.002*	8 (19,125.14)[e]	7.85±4.76[e]	0.001§	0 (11,122.14)	0.356	7 (19,122.85)	0.001§
2-3	105 (41.2)	99 (94.3)		75 (71.4)		9 (18,139.31)[f]	8.63±4.89[f]		0 (8,129.58)		8 (18,138.49)[h]	
>3	14 (5.5)	14 (100)		14 (100)		9 (20,158.46)[g]	10.36±5.65[g]		0 (7,149.11)		10 (14,173.61)[i]	
No	29 (11.4)	25 (86.2)		13 (44.8)		5 (12,82.90)[e,f,g]	4.97±3.36[e,f,g]		0 (12,133.69)		5 (12,87.03)[h,i]	

SD=Standart deviation, *P<0.05 – significant- Chi-square test, †P<0.05 – significant- Kruskal-Wallis test; §P<0.001 – significant- Kruskal-Wallis test, ‡P<0.05 – significant- Mann-Whitney test, Significant difference between values with the same letters (adjusted by the Bonferonni correction; P<0.05); [a]P=0.014; [b]P=0.005; [c]P=0.007; [d]P=0.005; [e]P=0.036; [f]P=0.002; [g]P=0.010; [h]P=0.005; [i]P=0.002

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Table 3: Caries experience of the study population with respect to oral hygiene habits

	n (%)	ECC *n* (%)	*P*	S-ECC *n* (%)	*P*	dmft, median (range, mean rank)	dmft mean±SD	*P*	d1-2 median (range, mean rank)	*P*	d3-6 median (range, mean rank)	*P*
Age when brushing was started												
When erupted	13 (5.1)	9 (69.2)	<0.001**	9 (69.2)	0.061	7 (12,106.77)	6.46±5.01	0.450	0 (0,92.00)[a]	0.004[†]	6 (12,98.19)	0.303
1-2 years	57 (22.4)	55 (96.5)		46 (80.7)		8 (17,135.85)	8.40±4.47		0 (12,149.14)[a,b]		6 (17,123.41)	
2-3 years	0 (40.4)	98 (95.1)		60 (58.3)		7 (20,120.38)	7.59±5.37		0 (11,124.10)		8 (20,124.61	
3-5 years	40 (15.7)	40 (100)		28 (70.0)		9.5 (14,135.55)	8.38±3.96		0 (4,114.71[b]		9.5 (12,141.53)	
No	42 (16.4)	40 (95.2)		30 (71.4)		8 (19,135.42)	8.45±4.87		0 (6,132.68)		8 (19,138.88)	
Dental visit and reason												
Carious teeth	69 (27.0)	69 (100)	<0.001**	54 (78.3)	<0.001**	8 (17,144.29)[c]	9.03±4.55[c]	<0.001[§]	0 (11,121.50)	0.235	8 (19,138.02)	<0.001[§]
Pain	55 (21.6)	55 (100)		43 (78.2)		10 (18,147.93)[d]	9.25±4.51[d]		0 (7,137.95)		10 (17,145.31)	
Control	13 (5.1)	6 (46.2)		2 (15.4)		0 (16,48.81)[c,d,e]	2.92±5.85[c,d,e]		0 (1,106.62)		0 (16,51.08)	
No	118 (46.3)	112 (94.9)		74 (62.7)		7.5 (20,117.91)[e]	7.33±4.67[e]		0 (12,129.52)		7.5 (20,122.55)	
Amount of tooth paste used												
Seal	108 (42.4)	105 (97.2)	0.279	75 (69.4)	0.305	8 (19,133.30)	8.40±5.14	0.471	0 (8,128.11)	0.088	7.5 (19,129.76)	0.733
Pea size	96 (37.6)	90 (93.8)		60 (62.5)		8 (20,123.57)	7.68±4.85		0 (11,120.86)		8 (20,125.73)	
Whole brush	10 (3.9)	10 (100)		6 (60)		8 (9,99.30)	6.20±3.79		0 (3,114.90)		8 (9,106.40)	
No	41 (16.1)	37 (94.9)		32 (78)		8 (16,131.41)	8.02±4.38		0 (12,147.61)		8 (16,133.95)	
Use of antibiotics in the first year of life												
1-3 times per year	51 (20.0)	49 (96.1)	0.358	36(70.6)	0.088	9 (19,145.71)	9.24±5.12	0.007[†]	0 (12,143.65)	0.067	8 (19,147.08)	0.003[†]
>4 times and more	27 (10.6)	27 (100)		23 (85.2)		9 (15,156.15)	9.67±4.28		0 (4,133.63)		9 (15,158.81)	
No	177 (69.4)	166 (93.8)		114 (64.4)		7 (20,118.60)	7.36±4.77		0 (11,122.63)		6 (20,117.80)	

SD=Standard deviation, *P<0.05 - significant; **P<0.001 – significant, [†]P<0.05 – significant- Kruskal-Wallis test; [§]P<0.001 – significant- Kruskal-Wallis test, Significant difference between values with the same letters (adjusted by the Bonferonni correction; P<0.05); [a]P=0.015; [b]P=0.043; [c]P<0.001; [d]P<0.001; [e]P=0.008

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antibiotics in the first year of life (P = .007 and P = .003, respectively).

Discussion

The relationship between infant feeding and dental caries has been investigated for years and even in different cultural populations.[9,11] However, it was not clear to what extent BF duration is the risk of dental caries. In this respect, the study was planned to determine the effect of prolonged BF, bottle-feeding, and oral hygiene habits on ECC caries in 6-month-old to 72-month-old Turkish children. Our findings revealed that prolonged BF, BF while sleeping, and bottle-feeding did not affect the mean dmft score and the prevalence of ECC and S-ECC. Like our study, several individual studies failed to show an association between dental caries and the abovementioned feeding pattern.[11,12,15]

Conversely, some cross-sectional studies conducted with different cutoffs for the BF duration stated a positive association between dental caries and prolonged BF for >12 months,[21] for >18 months,[8,9] and for >19 months.[20] A recent systematic review reported that BF up to 24 months did not appear to increase the ECC risk relative to BF up to 12 months; however, BF duration more than 24 months may be associated with a higher ECC prevalence.[22] In our study, the risk of dental caries was not detected in either 18-23 months or more than 24 months of BF compared to less BF durations. Contrary to our findings, Peres *et al*.[6] showed that children breastfed for ≥24 months had 2.4 times higher risk of having S-ECC than those who were breastfed up to 12 months. Similar results associated with high caries risk were also shared by several other authors.[7,23] On the other hand, in a systematic review and meta-analysis conducted by Tham *et al*.[24] found that children breastfed for >12 months had a higher risk of getting caries compared to children breastfed for <12 months (odds ratio 1.99, 95% CI 1.35-2.95). However, in the same study children, who received a longer compared to a shorter BF duration up to the age of 12 months, had a lower risk of caries (odds ratio 0.50, 95% CI 0.25, 0.99).

Our study revealed that prolonged BF and bottle-feeding were effective in the formation of noncavitated lesions. Children who received bottle-feeding for 18-23 months had a higher risk for noncavitated lesion than those who received it for 6-11 months. Bottles used over long periods during the day or night can cause tooth surfaces to remain in extended acidic conditions.[25]

Several authors suggest that the frequency of infant feeding plays an important role on caries formation process.[8,23] In a cohort study in Brazil, it was shown that more frequent feeding at the age of 12 months, which included bottle use, BF, and intake of other foods/drinks, was associated with a higher prevalence of dental caries almost 2 years later.[7] A systematic review found that the association of BF beyond the age of 12 months for dental caries risk was strongest when nursing was frequent or nocturnal.[24] In our study, the information on frequency of feeding was not collected, but importance was given to data on nocturnal feeding and it was found that BF at night was a causative factor in the formation of cavitated lesions. A comprehensive study found no overall association between BF duration and caries among Thai children, but did report a positive, dose-response relationship between dmfs score and frequency of night-time bottle-use or BF.[11] Another meta-analyses with five studies stated a seven times greater risk of having dental caries among children who received longer versus shorter periods of nocturnal BF.[24]

Mothers in Turkey prefer to breastfeed rather than giving infant formula, but the practice of supplementary feeding is also widespread, such as having a common habit of using bottles delivering sugar-containing liquids or dipping the bottle mouthpiece in honey or sugar.[26] Sixty six (25.9%) children were fed with sweetened bottles in our study which resulted in a higher dmft score. This result points in the same direction as in a review published by Moynihan *et al*.[22]

We found that higher sugar consumption led to higher level of dental caries and higher risk of getting S-ECC. Parallel to our study, Peres *et al*.[6] found that high sugar exposure causes 1.3 times more risk of having S-ECC. As per Feldens *et al*.,[7] feeding frequency and/or sweet consumption in infancy may be maintained as continued feeding habits, and these later habits serve as the proximate causes of tooth decay in childhood. Similar results were also supported by other studies.[12,27,28]

The American Academy of Pediatric Dentistry recommends that caregivers should brush the child's teeth twice daily with a smear of fluoridated toothpaste as soon as the primary incisors erupt.[1] However, we found that only 5.1% of mothers started tooth-brushing as soon as the teeth erupt and that late introduction of brushing is a risk factor for dental caries. These findings were similar with a recent study among 18-month-old to 36-month-old children in Cambodia.[9] Although Kubota *et al*.[9] did not find any difference between the amount of toothpaste used, another study revealed the utilization of fluoridated toothpastes in children younger than 6 years has been shown to be effective in decreasing the high risk of developing dental caries.[29]

Oral hygiene habits and demographic features of mothers may be potential confounding factors that may influence

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ECC and S-ECC. In our study, when daily habits and demographic characteristics of mothers were evaluated, no significant difference was found in terms of S-ECC, while less ECC was found in children whose mothers had higher education, higher income, and who worked and lived in an urban area. Like previous literature, we demonstrated that the abovementioned co-factors contribute to caries development.[28,30]

The cross-sectional nature of our study is a limitation. BF or bottle-feeding duration was assessed very much later in some children such as four-year-old and five-year-old group, and this delay could have led to recall bias. Despite this fact, this study also has a strength. We measured caries outcomes not only with dmft as prevalence but also with International caries detection and assessment system II as progress rate.

Conclusions

With regard to the data presented, it can be concluded that prolonged BF and bottle-feeding were not associated with ECC and S-ECC. Sweetened bottle usage and sugary food intake were strongly associated with dental caries. To reduce the ECC, it is strongly suggested to limit foods high on free sugars on feeding pattern. Early introduction to tooth-brushing and regular dental visits prevent dental caries development. Maternal illiteracy, working mother, low socioeconomic status, and living in rural area are maternal confounders for the ECC. For further research, prospective studies with clearly defined feeding variables such as exclusive BF duration, and BF frequency, and periodic examinations in which confounding factors are recorded need to be considered.

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Conflicts of interest

There are no conflicts of interest.

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