Pesquisa Brasileira em Odontopediatria e Clínica Integrada 2025; 25:e230092
https://doi.org/10.1590/pboci.2025.075
ISSN 1519-0501 / eISSN 1983-4632

ORIGINAL ARTICLE

Early Childhood Caries and Associated Risk Factors among Preschool Children in Southeast Iran

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Academic Editor: Catarina Ribeiro Barros de Alencar

Received: May 26, 2023 / **Review:** May 05, 2024 / **Accepted:** July 01, 2024

How to cite: Kamyabi H, Kalantari P, Horri A, Abbasi F, Kalantari M. Early childhood caries and associated risk factors among preschool children in Southeast Iran. Pesqui Bras Odontopediatria Clín Integr. 2025; 25:e230092. https://doi.org/10.1590/pboci.2025.075

ABSTRACT

Objective: To determine the prevalence of ECC and evaluate its association with possible risk factors in a group of preschool children in Kerman, Iran. **Material and Methods:** This cross-sectional study was conducted in Kerman on healthy preschool children (up to 6 years old) in June and October 2021. The children were randomly selected from kindergartens using a clustered sampling method, and their height, weight, dental caries, and occlusion were evaluated. Parents completed a questionnaire assessing feeding habits (breast/bottle feeding) and oral habits during the first two years of life. Data were analyzed by logistic regression and chi-squared test using SPSS 27 ($p<0.05$). **Results:** Of 530 examined children, 300 (56.6%) had ECC. Feeding habits (breast/bottle feeding) during the first two years of life, nail-biting, and age had a significant relationship with ECC ($p<0.05$). Although ECC in underweight and obese children was more prevalent than in children with normal weight, the relationship between ECC and body mass index (BMI) was not significant ($p>0.05$). **Conclusion:** The prevalence of ECC in preschool children was high. ECC's most important risk factors were age, nutritional habits, nail-biting, and underweight or obese children. Therefore, attention to feeding habits and correction of oral habits can reduce ECC.

Keywords: Dental Caries; Risk Factors; Dental Caries Susceptibility; Child.

Introduction

Early childhood caries (ECC) is defined by the presence of carious (non-cavitated or cavitated lesions), missing (due to caries), or filled tooth surfaces in one or more primary teeth in children <6 years of age. Despite the decline in dental caries in many industrialized societies over the past 30 years, ECC is still one of the most common childhood diseases [1]. In many developed and developing countries, 91% of untreated caries cases occur in preschool children. ECC can cause pain and discomfort, leading to chewing difficulties and malnutrition [2]. In addition, sleep disorders caused by untreated caries can affect glucocorticosteroid production and growth [3,4].

Some studies have suggested that dental caries can indirectly affect children's growth parameters, such as height and weight [5]. Children with dental caries are also more likely to eat softer foods requiring less chewing, leading to lower consumption of vegetables and fruits and more sweet foods [6]. ECC is associated with various factors, such as eating habits, nocturnal feeding, consumption of sweet foods, and the low socioeconomic status of the family [7]. In the study of Jamshidi et al. [8], the prevalence of early caries in children of higher socioeconomic class families was significantly higher than that in lower socioeconomic class ones. Casanova-Rosado et al. [9] and Amanlou et al. [10] reported similar findings. An investigation carried out by Popoola et al. [11] showed that the average number of dental caries in children with higher socioeconomic status seems to be higher.

In addition, numerous studies have examined the relationship between dental caries and body mass index (BMI), but their results are controversial [12]. Therefore, this study investigated the relationship between ECC and BMI, height-for-age index, feeding habits during the first two years of life, oral habits, and occlusion in healthy preschool children in Kerman, Iran.

Material and Methods

Study Design and Ethical Clearance

This cross-sectional study was done on children under 6 years old in the kindergartens of Kerman, the biggest province of Iran, between June and October 2021. The study protocol was approved by the Ethics Committee of Kerman University of Medical Sciences with the code of IR.KMU.REC.1397.187.

Population

The kindergartens from different city regions were selected using a cluster sampling method. This method involved dividing the population, in this case, children attending kindergartens in Kerman, into distinct clusters based on geographical regions within the city. Each cluster represented a group of kindergartens located in a particular area of Kerman. To implement cluster sampling, researchers randomly selected clusters of kindergartens from different regions across the city. Instead of picking individual kindergartens or children, entire clusters were chosen for inclusion in the study. This approach was chosen for practical reasons, such as the logistical challenges of accessing and surveying every kindergarten and child in Kerman.

The inclusion criteria included healthy children under 6 years of age whose parents consent to their participation in the study. Children with a history of systemic diseases, premature birth (birth before 37 weeks of pregnancy), or low birth weight (weight less than 2500 grams at birth) were excluded from the study. Then, all the children who met the criteria for entering the study were examined using the census method.

Data Collection

Before starting the study, verbal informed consent was obtained from the children's parents to participate in the study. The procedure commenced with a comprehensive and lucid elucidation of the study's objectives, methodologies, potential risks, benefits, and pertinent details. Parents of the children were encouraged to inquire about any uncertainties to ensure complete comprehension, and the researcher addressed all raised concerns. After confirming the parents' verbal understanding and agreement to participate, the researcher meticulously documented the consent procedure. Additionally, participants were reminded of their voluntary involvement and their prerogative to withdraw consent at any stage of the study. Then, children's height was measured using a wall-mounted standard meter (Leica Microsystems, Taipei, Taiwan) without shoes, feet together, and head in contact with a ruler. The weight was measured in kilograms on a digital scale (Microlife Corp., Taipei, Taiwan) without shoes, while the children wore light clothes. Personal information, age, sex, height, and weight were entered in data sheets. BMI was calculated by dividing weight (Kg) by the square of the height (m^2) [13]. Height for age index was also evaluated based on the World Health Organization [14].

Dental examinations were conducted by a dentist who had already been trained and calibrated by a pediatric dentist. Oral examinations were done with disposable dental mirrors under natural light while the children sat on a chair. The score was calculated for each child according to the WHO criteria for dental caries, decayed, missing, and filled teeth (dmft). ECC was divided into three levels: D1 (lesions without cavity), D2 (cavitated lesions), and D3 (severe ECC). The parents completed a questionnaire including questions about feeding habits (breast/bottle feeding) and oral habits (nail biting, bruxism, mouth breathing and finger sucking).

Forty-one samples were re-examined after two weeks, and intra-examiner reproducibility was evaluated using Cohen's kappa statics; it was acceptable regarding DMFT score, height, and weight (Kappa >0.89).

Data Analysis

Data were collected and analyzed statistically using chi-square and logistic regression tests with SPSS software, version 27 (IBM Corp., Armonk, NY, USA) and the level of significance was set at $P < 0.05$.

Results

Of the 530 children examined, ECC was found in 300 (56.6%) children. The ratio of the two sexes was almost equal (53.6% boys and 46.6% girls). Most children had normal weight (66%) and standard height (75.8%). No significant relationship was found between BMI and height for age index with gender (p>0.05).

Among the children with ECC, 52 (17.3%) had D1, 135 (45%) had D2, and 113 (37.7%) had D3 caries. The results indicated no significant relationship between gender with ECC and caries level (p>0.05). There was also no relationship between ECC with BMI and height for age index (p>0.05). In addition, no relationship was found between caries levels with BMI and height for age index (p>0.05) (Table 1).

Table 1. Distribution of children according to BMI, height for age, ECC, dental caries and age and according to sex.

Variables	Sex				Total
	Boy		Girl		
	N	%	N	%	N (%)
BMI					
Underweight	49	59.0	34	41.0	83 (15.9)
Normal weight	174	50.6	170	49.4	344 (66.0)
Overweight	31	60.8	20	39.2	51 (9.8)
Obese	25	58.1	18	41.9	43 (8.3)
Total	279	53.6	242	46.40	521 (100.0)

Height for Age					
Short	37	56.9	28	43.1	65 (12.3)
Normal	209	52.0	193	48.0	402 (75.8)
Tall	37	58.7	26	41.3	63 (11.9)
Total	283	53.4	247	46.6	530 (100.0)
ECC					
No	118	51.3	112	48.7	230 (43.4)
Yes	165	55.0	135	45.0	300 (56.6)
Total	283	53.4	247	46.6	530 (100.0)
Caries Levels					
D1	29	55.8	23	44.2	52 (17.3)
D2	72	53.3	63	46.7	135 (45.0)
D3	64	56.6	49	43.4	113 (37.7)
Total	165	55.0	135	45.0	300 (100.0)
Age (Year)					
0.5	0	0.0	1	100.0	1 (0.2)
1	0	0.0	1	100.0	1 (0.2)
1.5	5	62.5	3	37.5	8 (1.5)
2	7	38.9	11	61.1	18 (3.4)
2.5	1	33.3	2	66.7	3 (0.6)
3	58	58.0	42	42.0	100 (18.9)
4	78	48.1	84	51.9	162 (30.4)
4.5	1	33.3	2	66.7	3 (0.6)
5	88	56.1	69	43.9	157 (29.6)
5.5	4	100.0	0	0.0	4 (0.8)
6	41	55.4	33	44.6	74 (14.0)
Total	283	55.0	247	45.0	530 (100.0)

As shown in Table 2, there was a significant relationship between ECC and breast/bottle feeding duration in the first two years of life ($p<0.05$).

Table 2. Association between the presence of ECC and the duration of breast/bottle feeding.

ECC	Duration of Breast Feeding				Duration of Bottle Feeding			
	Never N (%)	≤ One year N (%)	> One year N (%)	Total N (%)	Never N (%)	≤ One year N (%)	> One year N (%)	Total N (%)
No	11 (4.8)	119 (51.7)	100 (43.5)	230 (100.0)	77 (33.5)	86 (37.4)	67 (29.1)	230 (100.0)
Yes	7 (2.3)	122 (40.7)	171 (57.0)	300 (100.0)	128 (42.7)	123 (41.0)	49 (16.3)	300 (100.0)
Total	18 (3.4)	241 (45.5)	271 (51.1)	530 (100.0)	205 (38.7)	209 (39.4)	116 (21.9)	530 (100.0)
p-value		0.005*				0.001*		

*Statistically significant.

Among evaluated oral habits, a significant relationship was found between ECC and nail-biting ($p=0.027$). Also, ECC was significantly more prevalent among those who had a biting habit for two to six years rather than those who never had the habit ($p<0.05$). There was also no significant relationship between BMI or height for age index with evaluated oral habits ($p>0.05$).

Table 3. Distribution of children according to the presence of ECC and oral habits.

Variables	ECC		Total
	No N (%)	Yes N (%)	N (%)
Nail Biting			
Never	183 (41.8)	255 (58.2)	438 (100.0)
less than two years	35 (59.3)	24 (40.7)	59 (100.0)
two to six years	12 (36.4)	21 (63.6)	33 (100.0)
Total	230 (43.4)	300 (56.6)	530 (100.0)
p-value	0.027*		

Bruxism			
Never	200 (45.1)	243 (54.9)	443 (100.0)
less than two years	24 (36.4)	42 (63.6)	66 (100.0)
two to six years	6 (28.6)	15 (71.4)	21 (100.0)
Total	230 (43.4)	300 (56.6)	530 (100.0)
p-value	0.153		
Mouth Breathing			
Yes	60 (43.2)	79 (56.8)	139 (100.0)
No	170 (43.5)	221 (56.5)	391 (100.0)
Total	230 (43.4)	300 (56.6)	530 (100.0)
p-value	0.949		

*Statistically significant.

The relationship between ECC and crowding (anterior and posterior), occlusion (mesial step and distal step), and crossbite (anterior and posterior) were evaluated and no relationship was found (p>0.05). In addition, there was no relationship between BMI and age for height index with crowding, occlusion, and crossbite (p>0.05).

Associated risk factors with ECC in the logistic regression model are presented in Table 4. For every one-year increase in age, the chance of ECC increases by 1.33 (OR=1.33, p=0.001). This means that children are more likely to experience ECC as they age. In children who never consumed formula milk, compared to children who drank formula milk for more than one year, the chance of ECC was 2.42 times higher (OR=2.42, p<0.001); in children who consumed formula milk for at least one year, compared to children who drank formula milk for more than one year, the chance of ECC increased by 2.36 (OR=2.36, p<0.001); These findings indicate that both never consuming formula milk and consuming it for at least one year are associated with a significantly higher risk of ECC compared to drinking it for more than one year. In children who had oral habits at less than two years, compared to children who had oral habits between 2 and 6 years old, the chance of ECC increased by 0.4 (OR=0.4, p<0.001). This suggests that developing oral habits at a younger age may offer some protection against ECC compared to creating them between 2 and 6 years old.

Table 4. Logistic regression results.

Variables	B	Sig.	OR	95% CI for the Odds Ratio	
				Lower	Upper
Age	0.287	0.001	1.332	1.121	1.583
No history of bottle-feeding	0.886	0.000	2.425	1.506	3.903
Bottle feeding for one year	0.862	0.000	2.367	1.465	3.825
No history of oral habits	-0.205	0.600	0.815	0.379	1.751
Oral habits less than 2 years	-0.970	0.037	0.379	0.153	0.942
Constant value	-1.529	0.000	0.217		

Discussion

In this study, 67% of children with normal weight and 73% of children with standard height were without caries, indicating that caries-free children have a better diet with more variety, which causes the growth parameters of height and weight in these children to be in the normal range. A previous report [15] showed that BMI increased in underweight children after receiving dental services.

Our findings showed that underweight or obese children had more ECC than normal-weight children. ECC in children with height beyond the normal range (short or tall children) was also more frequent than in children with standard height, although these relationships were not significant. In this regard, studies by Pinto et al. [16] and Hong et al. [17] did not report a significant relationship between dental caries and BMI. They

found higher rates of ECC in obese children, although the difference was not statistically significant [16,17]. Furthermore, a systematic review has recently shown that obese children are more vulnerable to ECC [18]. High-calorie carbohydrate diets, sweet snack consumption, the family's annual income, and their cultural level are among the influential factors in ECC in children with a high BMI. In Kurian's study, a healthy diet prevented caries and reduced childhood obesity; a healthy lifestyle was recommended to reduce BMI and caries [19].

In the present study, no significant relationship was found between BMI and height-for-age index with different levels of ECC, which can be attributed to the multifactorial nature of dental caries. ECC can affect growth by preventing the release of growth hormone and the subsequent increase in glucocorticosteroid secretion, which is generally associated with body reactions in the face of stress and pain [20]. Of course, other factors can be considered as the etiology of caries, such as the immune system and dental structure [12]. Furthermore, in studies by Vania et al. [20] and Krishnamurthy et al. [21], ECC and BMI had an inverse association. In these studies, the cause of increased caries rate in obese children was attributed to the high consumption of carbohydrates. In contrast, Sadeghi et al. [22] reported a higher frequency of caries-free states in overweight children.

The results of the logistic regression analysis showed that for every one-year increase in age, the chance of ECC was 1.33; this finding is consistent with the findings of İnan-Eroğlu et al. [15], Bafti et al. [23] and Willerhausen et al. [24]. In contrast, Kurian et al. [19] and Krishnamurthy et al. [21] found no significant relationship between ECC and age. With increasing age, the use of carbohydrates increases, and children are more exposed to cariogenic foods. The level of oral health care is also at its lowest level in this age group due to the lack of awareness and motivation and childish arguments with parents.

This research had no significant relationship between ECC and gender, consistent with studies by İnan-Eroğlu et al. [15] and Sheller et al. [25]. In contrast, Kurian et al. [19] reported higher ECC in girls. However, in studies by Bafti et al. [23], Willerhausen et al. [24] and Sadeghi and Roberts [26], DMFT was significantly higher in boys. Regarding the absence of a relationship between gender and ECC in the present study, it can be pointed out that families have fewer children than in the past; therefore, parents' attention to health has improved significantly. On the other hand, gender differences and gender discrimination behaviors have decreased with cultural developments.

This research showed a significant relationship between feeding habits (breast/bottle feeding) and ECC in the first two years of life. In children who never consumed formulated milk compared to children who drank it for more than one year, the chance of ECC was 2.42 times higher. In children who consumed formulated milk for at least one year, compared to children who drank it for more than one year, the chances of ECC increased by 2.36. Breastfeeding in the current research was associated with a higher caries rate; one of the reasons for this finding can be long-term feeding at night and providing an environment to accelerate the growth of microorganisms and the occurrence of ECC. In addition, mothers are employed in modern and prosperous societies, and the desire to feed the child with breast milk has decreased and been replaced with formulated milk. On the other hand, the parents' economic and cultural level, the frequency of visits to the dentist, and the level of oral hygiene of these children were different and effective in the present finding [15,27].

Our findings showed no significant relationship between BMI and occlusion and crowding; however, a significant relationship was found between BMI and crowding. The study by Sembiring et al. [28] showed a correlation between BMI and anterior crowding. In another study, Al-Refeidi et al. [29] reported a weak relationship between BMI and crowding.

Luzzi et al. [30] found no significant relationship between crossbite and ECC. A higher prevalence of ECC in children with crossbite can be attributed to the irregularity of the teeth, followed by incomplete cleaning of all tooth surfaces, the accumulation of plaque and gingivitis, and the subsequent occurrence of ECC. Zou et al. [31] reported that caries, poor oral habits, and pulp lesions could prevent the formation of normal occlusion. Jasim et al. [32] found higher rates of anterior crossbite in overweight children, although this relationship was not significant.

The present study showed a significant relationship between ECC and the nail-biting habit; however, there was no relationship between ECC and mouth breathing, bruxism, and finger-sucking habits. Also, in children who had oral habits at <2 years of age, compared to children who had oral habits between 2 and 6 years of age, the chance of ECC increased by 0.4 times. Some studies have shown an association between malocclusion and oral habits [33-35]. Hohman et al. [36] reported that infants who used pacifiers gained more weight than those who were breastfed, contrary to current research that attributes obesity in children to false appetites and cravings for more food and more activity. It increases children's desire to drink milk and eat food again. Therefore, more research on caries and oral habits seems necessary.

In this study, the highest level of crowding and crossbite was related to underweight and normal-weight children. Although Jasim showed no significant relationship between crossbite and BMI, there was a significant relationship between BMI and crowding, and more than 74.55% of overweight children had crowding [36].

As mentioned earlier, different studies have presented various results in this field, considering the multifactorial nature of dental caries, children's weight and height, the cultural, economic, and social situation of different societies, and the awareness and performance of people regarding oral and dental health issues.

This study faces some limitations. These include potential sampling bias due to the clustered sampling method, the inability to establish causality due to the cross-sectional design, and reliance on parental-reported data introducing self-reporting bias. The focus on a specific region and culture also limits generalizability. The study's analysis did not fully account for potential confounders like socioeconomic status and oral hygiene practices. Lastly, body mass index (BMI) may not fully capture the relationship between nutrition and ECC. These limitations underscore the need for more comprehensive and nuanced research to guide effective prevention and intervention strategies for ECC.

Conclusion

The findings from this study shed light on the complex dynamics surrounding early childhood caries (ECC) and its associated risk factors. While ECC did not exhibit significant correlations with body mass index and height for age, it did demonstrate an increase with advancing age. Moreover, factors such as feeding habits during the first two years of life and nail-biting were identified as contributors to ECC incidence. These insights underscore the importance of proactive dental care, including regular check-ups and interventions to modify detrimental oral habits and promote healthy nutrition from infancy. However, further research is warranted, mainly through prospective studies with larger sample sizes, to understand ECC development's multifaceted nature better and refine targeted prevention strategies. By addressing these findings in clinical practice and continuing to explore these avenues in research, we can strive towards reducing the burden of ECC and improving oral health outcomes for children worldwide.

Authors' Contributions

HK	https://orcid.org/0000-0001-7199-9489	Methodology, Writing - Original Draft and Writing - Review and Editing.
PK	https://orcid.org/0009-0007-1307-6484	Investigation and Writing - Review and Editing.
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MK	https://orcid.org/0000-0002-6597-0708	Investigation and Writing - Review and Editing.

All authors declare that they contributed to a critical review of intellectual content and approval of the final version to be published.

Financial Support

None.

Conflict of Interest

The authors declare no conflicts of interest.

Data Availability

The data used to support the findings of this study can be made available upon request to the corresponding author.

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