

Original article

Social and Behavioral Determinants of Early Childhood Caries Among Displaced Children in Eastern Libya: A Cross-Sectional Study in the Tawergha IDP Camps of Benghazi

Mohamed Bazama^{1*} , Nasar Abdelgader² ¹Department of Dental Public Health and Preventive Dentistry, Faculty of Dentistry, University of Ajdabiya, Libya²Orthodontic Department, Faculty of Dentistry, University of Ajdabiya, LibyaEmail: Mohamedbazama86mb@gmail.com**Abstract**

Early childhood caries (ECC) is the most common chronic disease among preschool children globally, and preschool children displaced by conflicts have an excessive burden of ECC. Children from the town of Tawergha that have been displaced to IDP camps in Benghazi, Eastern Libya, since the 2011 conflict have not had their ECC assessed yet. The present study aimed to estimate the prevalence and severity of ECC and to explore the associated socio-behavioral factors in these children. Methods: A camp-based cross-sectional study was performed on 100 children aged 24 – 71 months. ECC experience was scored at the tooth level under natural light based on WHO diagnostic criteria to calculate the dmft index, and social, economic, dietary, and oral hygiene behavior of parents were collected through a questionnaire. Associations were analyzed using the chi-square test, and independent variables for ECC were determined using multiple logistic regression (SPSS 26.0; $p < 0.05$). Results: The overall prevalence of ECC in the study sample was 72.0%, while the mean dmft was 4.68 ± 3.71 , mostly due to the decayed component (mean $d = 4.14$). S-ECC prevalence was 22.0%. Age-wise prevalence showed a marked increase with age, being 55.0% between 24–35 months and reaching 90.0% at 60–71 months. In the adjusted analysis, frequent intake of sugar-containing snacks ($aOR = 4.06$), nocturnal feeding from the bottle ($aOR = 3.82$), consumption of sweetened milk at night ($aOR = 3.15$), insufficient teeth brushing ($aOR = 2.74$), low maternal education level ($aOR = 2.61$), and no ever visitation of the dentist ($aOR = 1.95$) were independently associated with ECC. Conclusion: Preschool children in displaced camps of Tawergha suffer from an extremely high, predominantly untreated burden of ECC due to modifiable feeding, diet, and hygiene habits and socioeconomic vulnerability. These results justify the need for preventive programs in the camps targeted at caregivers.

Keywords. Early Childhood Caries, Dmft, Internally Displaced Persons, Tawergha, Benghazi, Libya.

Received: 22/06/26

Accepted: 19/08/26

Published: 26/08/26

Copyright © Khalij-Libya Journal (KJDMR) 2026. Open Access. Some rights reserved. This work is available under the CC BY-NC-SA 3.0 IGO license.

Introduction

According to the American Academy of Pediatric Dentistry, Early Childhood Caries (ECC) is a condition wherein a child less than six years old has at least one tooth with at least one decayed (non-cavitated or cavitated), missing (because of caries), or filled tooth surface in any primary tooth. This disease is still the most common chronic disease of early childhood and, according to the World Health Organization, it affects more than half a billion children worldwide who have primary dentition [1, 2].

The etiology of ECC is multifactorial, involving a combination of factors like the presence of a carious biofilm, frequent dietary sugars, and the presence of a susceptible tooth surface, which all interact in a broader milieu comprising social, behavioral, and environmental determinants. Behavioral risk factors that are already known include long and night-time bottle feeding, use of sugar with milk, frequent intake of snacks and beverages containing sugar, infrequent brushing of teeth, and lack of fluoridation, while some socioeconomic factors such as low maternal education, unemployment, and poverty exist at the upstream end [3, 4, 5].

These populations are particularly susceptible due to displacement. It interferes with the food environment, disrupts preventive and restorative dental care, and brings families together in crowded conditions, which have limited access to fluoride-containing products and safe water supply. The results of a scoping review on the link between displacement and ECC revealed that there is an increased number of untreated caries among migrants, refugees, and IDPs compared to the host community, but also pointed out the surprising lack of empirical studies from the African region [6, 7]. Data collected from protracted emergencies and studies of Syrian refugees also indicate a worsening of the situation about their oral health over time [8].

Instability has persisted in Libya since 2011. People from Tawergha, a city situated in the north-western part of the country, were forced to leave their homes in the same year, with many of them living in IDP camps within Benghazi, an area located in eastern Libya. Population-based studies conducted in Benghazi revealed that children exposed to conflict and those living in IDP camps suffer from severe untreated decay, with the education level of parents influencing the relationship between conflict exposure and untreated decay [9, 10]. General literature from Libya indicates high levels of

caries prevalence among school children, along with inadequate toothbrushing practices and poor oral health care service provision [11, 12]. Nevertheless, there has been no research conducted yet on ECC among preschool children in Tawergha IDP camps.

Understanding the burden and causes of ECC in this vulnerable group is thus a fundamental step for intervention planning. The current study aimed at achieving the following aims: (1) to assess the prevalence and severity of ECC in terms of dmft in the preschool children who live in the Tawergha IDP camps in Benghazi; (2) to assess the demographic, socio-economic, nutritional, feeding, and oral hygiene habits of this community; (3) to examine the social and behavioural factors independently linked to ECC using multivariate analysis; and (4) to translate our results into guidelines for integrated ECC prevention. We expected ECC to be considerably higher than regional averages and to be largely caused by feeding and nutritional factors on a background of socio-economic disadvantage.

Methods

Study Design and Setting

This is a descriptive analytical cross-sectional study performed in IDP camps in Tawergha, which are located in Benghazi, Eastern Libya. The IDP camps provide shelter for families who have been internally displaced from the town of Tawergha due to conflict that occurred in 2011. The camps have a resident population that receives medical attention in a small primary health care center. Data were collected over a set time period during which eligible children within the specified age range were selected for the study.

Study Population, Sample Size and Sampling

The target population consisted of all children aged between 24 and 71 months residing in the camps together with their consenting primary caregivers. Those who were wearing fixed orthodontic devices, had any systemic or developmental diseases that affect their dentition, such as amelogenesis imperfecta, as well as non-cooperative participants unable to undergo a basic examination of the mouth were excluded from the study. Based on the expected prevalence of ECC of about 70% in light of Libyan studies [9, 11] using a 95% confidence level and 9% absolute precision, the calculated minimum number of participants was 100, which was reached.

Ethical Considerations

The ethical approval for this study was obtained from the Research Ethics Committee of the Dentistry Faculty, University of Benghazi, and the administrative approval was received from the camp authorities. The study respected the guidelines outlined in the Declaration of Helsinki. Written informed consent was obtained from the parents/guardians of each child after a complete explanation, both verbally and in writing, in Arabic. If any child needed treatment, he/she was referred to the dentist along with oral health advice.

Data Collection Instrument

Data collection involved a two-part, pilot-tested, interview-administered questionnaire conducted with the primary caregiver and a clinical examination of the child. The questionnaire was based on validated questionnaires used in previous studies of ECC and displaced populations [4, 6, 13] and was translated into Arabic and back-translated for accuracy. The questions addressed: (i) demographic factors (age, sex of the child); (ii) socio-economic factors (educational level of mother and father, occupation of mother, family monthly income rating by mother, number of children at home); (iii) feeding habits (breast feeding, bottle use, night time bottle use, sweetening of milk); (iv) dietary habits (frequency of daily consumption of sweetened food/drink); and (v) oral hygiene habits (frequency of toothbrushing, fluoride toothpaste use, help with toothbrushing) and use of dental services (any previous dental visit).

Clinical Examination and Caries Assessment

Each child was clinically evaluated by one trained dentist examiner in a seated knee-to-knee position with natural sunlight assisted by a portable LED headlight, utilizing a plane mouth mirror and WHO ball-ended (CPI) probe after gauze drying of the teeth. Radiographs were not done. Dental caries status was measured at the tooth level in accordance with World Health Organization (2013) diagnostic criteria, and the decayed, missing, and filled primary teeth (dmft) were calculated for each child. Early Childhood Caries (ECC) was defined as per American Academy of Pediatric Dentistry guidelines as the presence of any one decayed, missing (because of caries), or filled tooth or surface ($dmft \geq 1$) in a child below six years of age. Severe early childhood caries (S-ECC) was defined using the age-specific criteria (any smooth-surface caries in children < 3 years old, or $dmft \geq 4$ at 3 years, ≥ 5 at 4 years and ≥ 6 at 5 years). Before data collection, the examiner was calibrated by an experienced paediatric dentist using 15 children. Intra-examiner reliability, reassessed on 10% of study participants, was high (Cohen's Kappa= 0.88).

Statistical Analysis

Statistical analysis was performed using IBM SPSS Statistics Version 26.0. Age, dmft, and its components were described as mean and standard deviation for continuous variables, while frequency and percentage were described for categorical variables. ECC presence was defined as either dmft greater than or equal to 1 (ECC) or no dmft (caries-free). Bivariate association between ECC and each predictor variable was determined using the Pearson chi-square test (Fisher's exact test for variables having low expected cell counts). All variables associated with ECC at $p < 0.20$ in the bivariate analysis were entered into a multiple binary logistic regression model to identify independent predictors. Adjusted odds ratios (aOR) with 95% confidence intervals (CI) are reported, and statistical significance in the multivariable model was set at $p < 0.05$.

Results

Sample Characteristics

A total of 100 children (48 boys and 52 girls), aged between 24 and 71 months, participated in the study with an average age of 47.6 ± 13.2 months. The age groups of the sample were divided into four categories, and the prevalence of ECC increased sharply with age (Figure 1). Social and economic disadvantage was also prevalent among the participants: 46% of mothers received only primary education, 71% were unemployed, and 58% of caregivers felt that their family's economic status was poor.

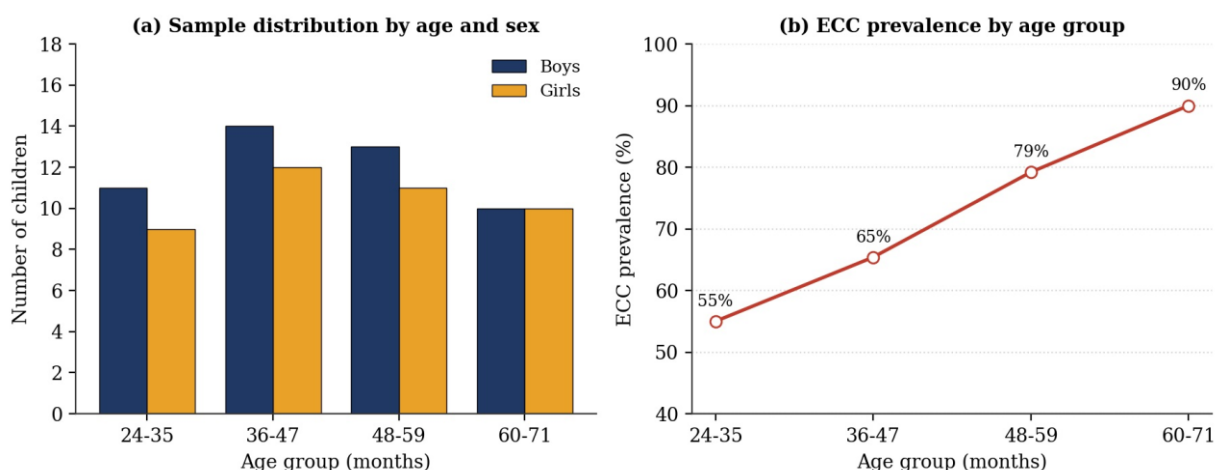


Figure 1. (a) Distribution of the study sample by age group and sex, and (b) prevalence of early childhood caries (ECC) by age group among displaced preschool children in the Tawergha IDP camps (n = 100).

Table 1. Demographic and socioeconomic characteristics of the study sample (n = 100).

Characteristic	Category	n	%
Child sex	Boys	48	48.0
	Girls	52	52.0
Age group (months)	24–35	20	20.0
	36–47	26	26.0
	48–59	24	24.0
	60–71	30	30.0
Maternal education	≤ Primary	46	46.0
	Secondary	38	38.0
	Tertiary	16	16.0
Maternal employment	Not employed	71	71.0
	Employed	29	29.0
Household income (self-rated)	Low	58	58.0
	Middle/high	42	42.0

Prevalence and Severity of ECC

The prevalence of ECC was 72.0%, while the prevalence of ECC-free children was 28.0%. The mean dmft of the whole group was 4.68 ± 3.71 , while the values varied between 0 and 15. The distribution of dmft was characterized by a positive skew, which implies that there was a large proportion of children with a very high dmft score (see Figure 2). S-ECC was diagnosed among 22.0% of the children. The dmft was mainly represented by the untreated decayed component (mean $d = 4.14$), while the missing component was small (mean $m = 0.42$), and the filled component was minimal (mean $f = 0.12$).

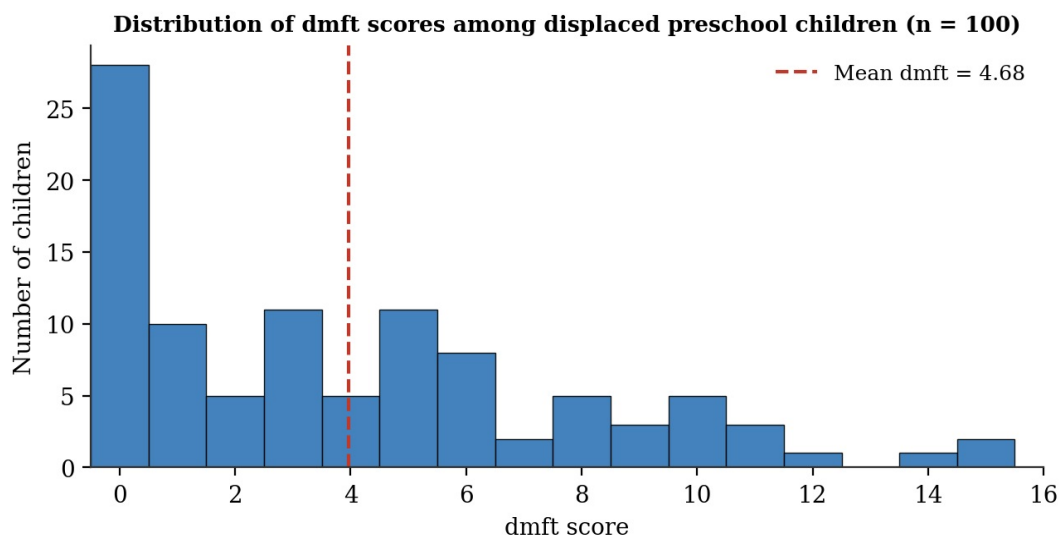


Figure 2. Distribution of dmft scores among displaced preschool children in the Tawergha IDP camps (n = 100). The dashed line marks the sample mean dmft of 4.68.

Age had an increasing effect on both the prevalence and the seriousness of the dental problem. The number of decayed teeth went up from 2.9 in the youngest age group to 6.2 in the oldest age group, and the number of missing teeth followed the same pattern (Figure 3).

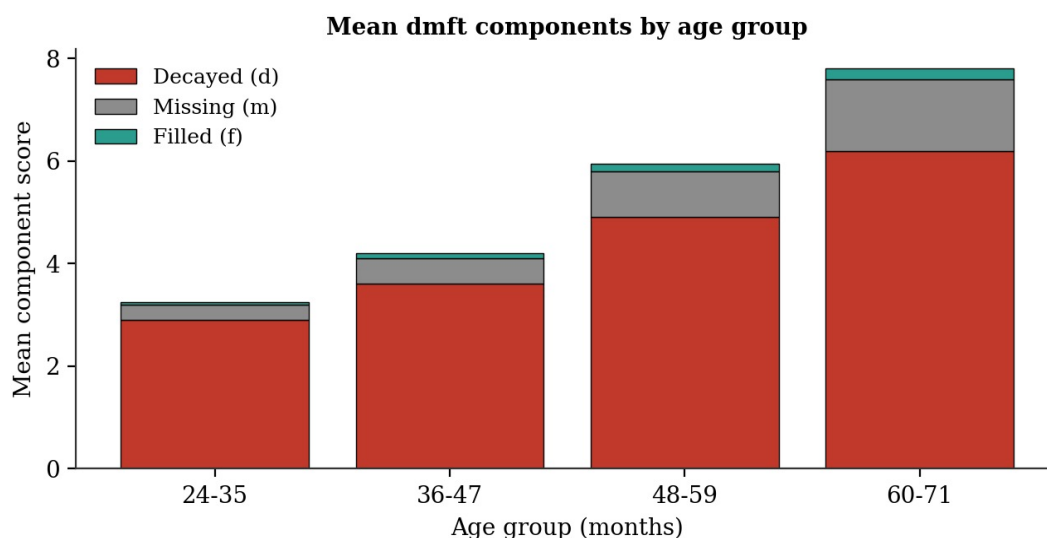


Figure 3. Mean decayed (d), missing (m), and filled (f) components of the dmft index by age group, showing progressive accumulation of untreated decay.

Behavioral and Dietary Exposures

Feeding behavior and diets that caused caries were common among the respondents. Nocturnal bottle feeding was observed in 61% of the children, whereas adding sugar to milk was practiced by 57%. Sugar-sweetened beverages were eaten by 64% of the children more than thrice each day. Oral hygiene habits were poor; 55% of the children brushed less than once daily, only 39% brushed using fluoride toothpaste, whereas 47% of the children had never visited a dentist. Prevalence of ECC in exposed children was significantly higher than in unexposed children for all exposures (Figure 4).

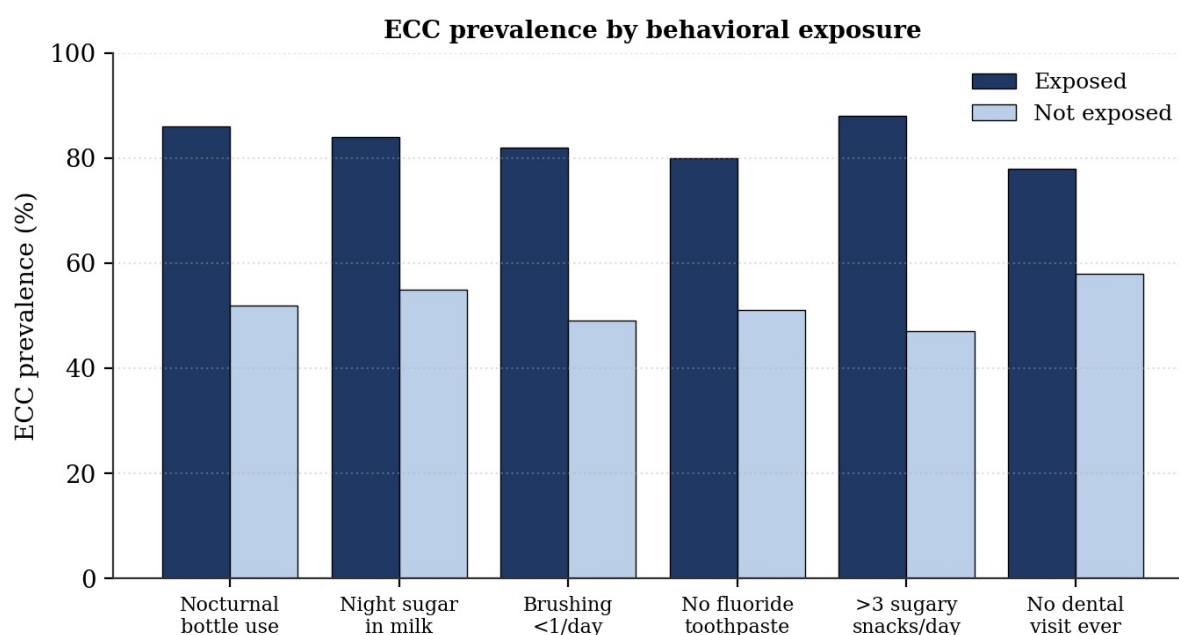


Figure 4. Prevalence of early childhood caries (%) according to key feeding, dietary and oral-hygiene exposures, comparing exposed and unexposed children.

Table 2. Feeding, dietary and oral-hygiene behaviours and their bivariate association with ECC (n = 100).

Variable	Category	n (%)	ECC % within group	p-value
Nocturnal bottle feeding	Yes	61 (61.0)	86.9	< 0.001
	No	39 (39.0)	51.3	
Sugar added to milk	Yes	57 (57.0)	84.2	0.002
	No	43 (43.0)	55.8	
Sugary snacks/drinks > 3/day	Yes	64 (64.0)	87.5	< 0.001
	No	36 (36.0)	44.4	
Tooth-brushing frequency	< once daily	55 (55.0)	83.6	0.003
	≥ once daily	45 (45.0)	57.8	
Fluoridated toothpaste use	No / irregular	61 (61.0)	80.3	0.020
	Regular	39 (39.0)	59.0	
Ever visited a dentist	No	47 (47.0)	80.9	0.041
	Yes	53 (53.0)	64.2	

Independent Determinants of ECC

All variables associated with ECC at $p < 0.20$ in the bivariate analysis were entered into the multiple binary logistic regression model. Six factors remained independently and significantly associated with ECC ($p < 0.05$) after mutual adjustment (Figure 5, Table 3): frequent intake of sugary snacks (more than three times per day) (aOR = 4.06, 95% CI 1.79–9.21; $p < 0.001$), nocturnal bottle feeding (aOR = 3.82, 95% CI 1.71–8.53; $p = 0.001$), night-time sugared milk (aOR = 3.15, 95% CI 1.44–6.90; $p = 0.004$), tooth-brushing less than once daily (aOR = 2.74, 95% CI 1.28–5.87; $p = 0.009$), maternal education of primary level or below (aOR = 2.61, 95% CI 1.19–5.72; $p = 0.017$), and never having visited a dentist (aOR = 1.95, 95% CI 1.01–3.78; $p = 0.048$). Two further variables retained in the model showed positive but statistically non-significant associations, with 95% confidence intervals that included the null value: no or irregular use of fluoride toothpaste (aOR = 2.38, 95% CI 0.93–6.12; $p = 0.072$) and low household income (aOR = 2.19, 95% CI 0.96–4.97; $p = 0.061$).

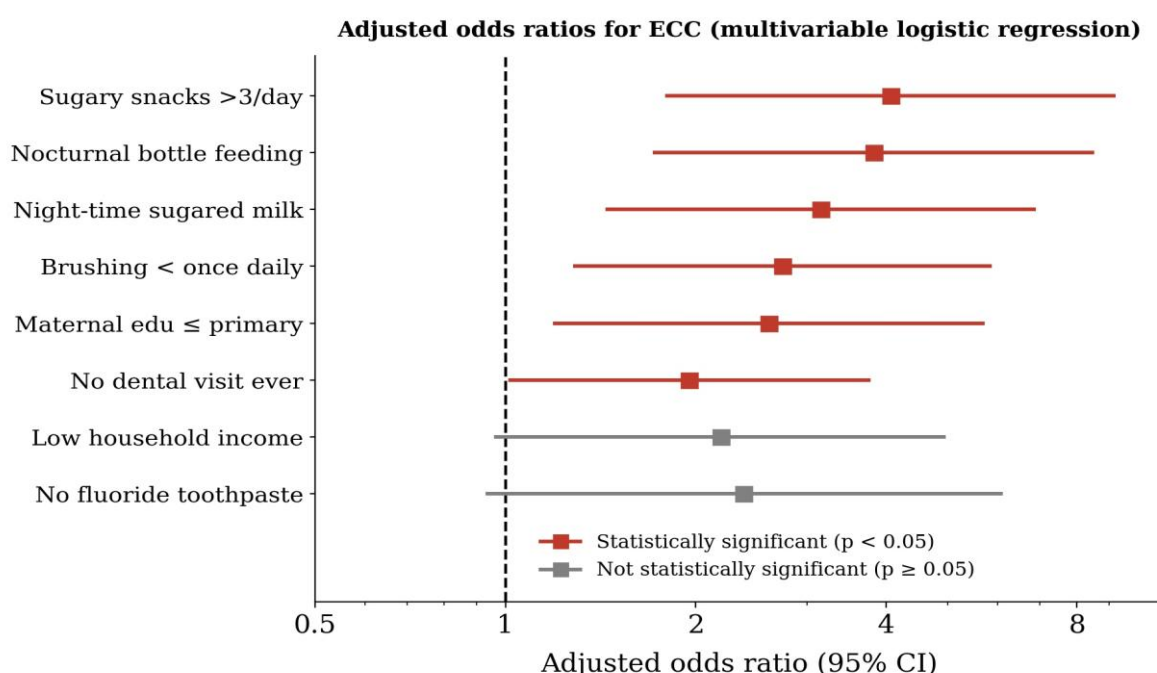


Figure 5. Adjusted odds ratios (95% CI) for early childhood caries from the multivariable logistic regression model, shown in the same order as Table 3. Squares mark point estimates and horizontal bars the 95% confidence intervals; the vertical dashed line indicates the null value (OR = 1). Estimates shown in red are statistically significant ($p < 0.05$); those shown in grey are not ($p \geq 0.05$).

Table 3. Multivariable logistic regression: independent determinants of ECC. All variables associated with ECC at $p < 0.20$ in the bivariate analysis were entered into the model. aOR = adjusted odds ratio; CI = confidence interval. Statistical significance was set at $p < 0.05$; the last two rows did not reach significance.

Determinant	aOR	95% CI	p-value
Sugary snacks/drinks > 3 per day	4.06	1.79–9.21	< 0.001
Nocturnal bottle feeding	3.82	1.71–8.53	0.001
Night-time sugared milk	3.15	1.44–6.90	0.004
Tooth-brushing < once daily	2.74	1.28–5.87	0.009
Maternal education ≤ primary	2.61	1.19–5.72	0.017
Never visited a dentist	1.95	1.01–3.78	0.048
Low household income	2.19	0.96–4.97	0.061
No / irregular fluoride toothpaste	2.38	0.93–6.12	0.072

ECC Severity Distribution

Grouping according to the degree of caries resulted in 28.0% caries-free, 26.0% mildly affected ECC (dmft 1-3), 24.0% moderately affected ECC (dmft 4-6), and 22.0% severely affected ECC (S-ECC, dmft ≥ 7) among the children. Almost half of the children thus belonged to the category of moderate or severe ECC (Figure 6).

Distribution of ECC severity categories (n = 100)

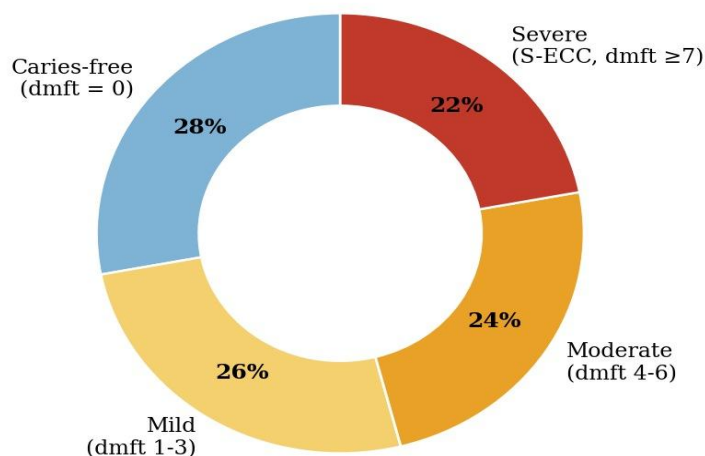


Figure 6. Distribution of early childhood caries severity categories among displaced preschool children (n = 100).

Discussion

Burden of ECC in the Displaced Population

This is the first time a detailed description of early childhood caries in displaced preschoolers from Tawergha, now residing in Benghazi's IDP camps, has been done. It is clear from the results obtained that there is an exceptionally high prevalence of 72.0% and a mean dmft of 4.68. Both numbers can be considered high compared to international standards and are congruent with, but at the higher limit of, the high levels of caries experienced by Libyan children in general [9, 11]. This result is in harmony with the conclusion from the recent scoping review, which states that untreated caries is more prevalent among displaced and refugee children than their hosts, and also serves the purpose of filling the identified gap of evidence from Africa [6]. The lack of any restoration (mean f = 0.12) shows that all the caries seen is untreated, similar to the case of untreated caries observed in Libyan children after the conflict [9, 10].

Feeding and Dietary Determinants

These prominent independent predictors – regular consumption of sugary snacks, nocturnal bottle-feeding, and sweetening of milk – are those same exposures that have been implicated time and again by the broader literature on ECC. Nocturnal bottle-feeding, particularly of sugar-containing liquids, has been shown time and again to be one of the most important aetiological factors for ECC in that it increases the length of contact between the fermentable carbohydrates and the developing teeth at times when there is low salivary flow [4, 5]. The strength of association in the current study (with adjusted odds of approximately three- to four-fold) is in line with previous cross-sectional and retrospective studies conducted among preschool-age children elsewhere [4, 5]. In this particular case of displacement, these risk factors may be further facilitated by disruption in the food environment and access to affordable sugar-containing products, such that dietary counseling must be based on what is feasible within the camp environment.

Oral Hygiene, Fluoride and Service Access

Inadequate oral hygiene practice and lack of access to dental health services worsened the risk posed by poor nutrition. Over half of the study population brushed fewer than once per day; most of them were not consistent users of fluoride-containing toothpaste, and nearly half had never visited a dentist. Both infrequent tooth-brushing and lack of fluoride consumption are known to be risk factors for caries, and their high incidence in the population can be attributed not only to individual practices but also to the lack of structure of oral health care in Libya [11, 12]. In the adjusted model, however, only tooth-brushing frequency remained statistically significant, while no or irregular use of fluoride toothpaste did not reach significance (aOR = 2.38, 95% CI 0.93–6.12; p = 0.072); given the modest sample size, this should be read as inconclusive rather than as evidence of no effect. The independent association between never visiting a dentist and ECC (aOR = 1.95, 95% CI 1.01–3.78; p = 0.048) is most probably an indication of access barriers, rather than a protective factor, since in that context such visits were mainly pain-driven and restorative.

Socioeconomic Gradient

Maternal education was found to be an independent risk factor for ECC, whereas low household income showed a positive but statistically non-significant association after adjustment (aOR = 2.19, 95% CI 0.96–4.97; $p = 0.061$). This relationship is in line with many studies that have shown how poor socioeconomic conditions, poor levels of parental education, and maternal employment are upstream factors leading to tooth decay among children, as well as data from Libya where the parental level of education influences the impact of living in areas affected by conflict on the level of untreated decay [9, 14]. This suggests the role of maternal education through oral health knowledge and ability to access preventive products.

Implications for Practice and Policy

The findings as a whole suggest that the higher ECC prevalence among the displaced population is a result of modifiable risk factors against a backdrop of socioeconomic adversity and limited access to services. In light of the preventable nature of the above-mentioned risk factors, camp-based intervention programs seem feasible and likely to succeed. Some of the priorities will involve educating the caregivers on bottle weaning and sugar intake reduction, distribution and supervision of fluoride toothpaste application, and creation of a screening referral program for the camp health center. The displaced children, as well as those affected by conflict, need to be specifically considered for national oral health programs, just as has been recommended before in Libya [9, 10].

Strengths and Limitations

The strengths of this study are that it is based on a population that was not studied before; it uses standardised diagnostic criteria provided by WHO with an experienced and calibrated examiner and intra-examiner reliability; and multivariate analysis is used. The weaknesses of the study are several. First of all, the cross-sectional study design means that causality cannot be determined; secondly, the direction of certain relationships (especially dental visit history) cannot be determined either. In addition, there are weaknesses connected with sampling methods – convenience sampling within only one camp cluster and a small sample size of 100 children. There was a possibility of recall and social desirability bias in behavioral and socioeconomic data collection, and non-cavitated early lesions can be underreported under such conditions. The modest sample size also produced wide confidence intervals and limited statistical power, so the associations that did not reach significance in the adjusted model (household income and fluoride toothpaste use) should be interpreted as inconclusive rather than as evidence of no association. It is necessary to conduct larger and longitudinal studies.

Conclusion

Children under five years who have been displaced from Tawergha and are residing in camps for internally displaced people in Benghazi suffer from high rates of early childhood caries, which is largely untreated, with the prevalence being 72.0%, a mean dmft of 4.68, and severe ECC in over 20% of the children. This condition is caused by modifiable behaviors such as frequent consumption of sugary snacks, nocturnal bottle feeding, sugared milk, along with infrequent toothbrushing, low fluoride consumption, low maternal education, and low utilization of dental services. All these factors can be intervened upon, and the results obtained point to the urgent need for the development of camp-based caregiver-oriented interventions such as preventive programs, supervised use of fluoride, and screening services. The identification of conflict-affected and displaced children as a target group in Libya's oral health policy can contribute significantly to this end.

Conflict of interest. Nil

References

1. Uribe SE, Innes N, Maldupa I. The global prevalence of early childhood caries: A systematic review with meta-analysis using the WHO diagnostic criteria. *Int J Paediatr Dent*. 2021;31(6):817-830. doi:10.1111/ipd.12783
2. World Health Organization. *Global Oral Health Status Report: Towards Universal Health Coverage for Oral Health by 2030*. Geneva: World Health Organization; 2022.
3. Dhull R, et al. Decoding early childhood caries: A comprehensive review navigating the impact of evolving dietary trends in preschoolers. *Cureus*. 2024;16(4):e58227. doi:10.7759/cureus.58227
4. Nirmala M, Chandra S, Reddy S. Feeding practices and early childhood caries: A cross-sectional study of preschool children. *Int J Dent*. 2013;2013:275193. doi:10.1155/2013/275193
5. Sardella G, et al. Feeding and smoking habits as cumulative risk factors for early childhood caries in toddlers, after adjustment for several behavioral determinants: a retrospective study. *BMC Pediatr*. 2014;14:45. doi:10.1186/1471-2431-14-45
6. Folayan MO, et al. A scoping review linking early childhood caries to violence, neglect, internally displaced, migrant and refugee status. *BMC Oral Health*. 2023;23(1):728. doi:10.1186/s12903-023-03459-0

7. Folayan MO, et al. A scoping review on the association between early childhood caries and life on land: the Sustainable Development Goal 15. *PLoS One*. 2024;19(7):e0304523. doi:10.1371/journal.pone.0304523
8. Arheiam A, et al. Syria profile of the epidemiology and management of early childhood caries before and during the time of crisis. *Front Public Health*. 2019;7:271. doi:10.3389/fpubh.2019.00271
9. Arheiam A, Alhashani A, Kwidir T, Bosif Y, Ballo L, El Tantawi M. Untreated dental caries among Libyan children during and after the war and in internally displaced person camps. *Community Dent Oral Epidemiol*. 2023;51(4):636-643. doi:10.1111/cdoe.12886
10. Aoun E, Ballo L, Elhabony S, Arheiam A. Association between dental caries and obesity among Libyan schoolchildren during the armed conflict in Benghazi. *BMC Oral Health*. 2023;23(1):442. doi:10.1186/s12903-023-03156-y
11. Peeran SW, Altaher OB, Peeran SA, Alsaid FM, Mugrabi MH, Ahmed AM. Oral health in Libya: addressing the future challenges. *Libyan J Med*. 2014;9(1):23564. doi:10.3402/ljm.v9.23564
12. Arheiam A, et al. The oral health care system in Libya: a case study. *BMC Oral Health*. 2024;24(1):900. doi:10.1186/s12903-024-04684-x
13. Haque F, Folayan MO, Virtanen JI. Maternal factors associated with early childhood caries among 3–5-year-old children with low socio-economic status in Trishal, Bangladesh. *Front Oral Health*. 2023;4:1244359. doi:10.3389/froh.2023.1244359
14. Javadzadeh E, Razeghi S, Shamshiri A, Heidarian Miri H, Moghaddam F, Schroth RJ, Mohebbi SZ. Prevalence and socio-behavioral determinants of early childhood caries in children 1–5 years old in Iran. *PLoS One*. 2023;18(11):e0293428. doi:10.1371/journal.pone.0293428