

Oral Hygiene Practices and Prevalence of Early Childhood Caries in Low-Income Communities of Karachi, Lahore, and Peshawar.

Original Research

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ABSTRACT

Background: Early childhood caries (ECC) is one of the most common chronic diseases affecting young children, disproportionately impacting those from socioeconomically disadvantaged communities. In Pakistan, limited data exist comparing oral hygiene practices and ECC prevalence across major urban centers, despite evidence of widespread oral health disparities.

Objective: To assess the association between oral hygiene practices, feeding behaviors, and the prevalence of ECC among children aged 2–6 years in low-income communities of Karachi, Lahore, and Peshawar.

Methods: A cross-sectional study was conducted among 425 children and their caregivers using a multistage random sampling approach. Clinical dental examinations were performed according to World Health Organization (WHO) criteria, and ECC was measured using the decayed, missing, and filled teeth (dmft) index. Oral hygiene status was evaluated using the Simplified Oral Hygiene Index (OHI-S). A validated caregiver questionnaire captured data on demographics, hygiene routines, and dietary practices. Data were analyzed using IBM SPSS version 26.0, employing t-tests, chi-square tests, and multivariate regression. Ethical approval was obtained from the Institutional Review Board of Dow University of Health Sciences (Ref: IRB-2025/DUHS/0349).

Results: The overall prevalence of ECC was 51.8%, with the highest rates in Karachi (56.4%). Mean dmft score was 2.46 ± 1.78 . Infrequent tooth brushing (<1/day) and absence of fluoride toothpaste use were associated with significantly higher dmft scores ($p < 0.001$). Frequent sugary snacking and night-time feeding also increased ECC risk (OR = 2.17; 95% CI: 1.48–3.12). Maternal education and household income were inversely related to ECC prevalence.

Conclusion: ECC remains highly prevalent among children in Pakistan's low-income urban populations. Modifiable behaviors—such as oral hygiene frequency, fluoride exposure, and feeding practices—play a critical role. Community-based preventive programs focusing on caregiver education and early oral health promotion are essential to mitigate this burden.

Keywords: Caregivers, Child, Dental Caries, Feeding Behavior, Oral Health, Oral Hygiene, Pakistan

INTRODUCTION:

Early childhood caries (ECC) remains one of the most prevalent chronic diseases among children worldwide, affecting nearly 60–90% of those aged 2–11 years, particularly in low-income communities where access to oral healthcare and preventive education is limited (1). The condition is characterized by the presence of one or more decayed, missing, or filled tooth surfaces in any primary tooth of children under six years of age. ECC has profound impacts on child health, contributing to pain, infection, nutritional deficiencies, and impaired growth and development. Despite being largely preventable, ECC continues to disproportionately affect children from socioeconomically disadvantaged families due to behavioral, educational, and systemic inequalities (2). In Pakistan, ECC poses a growing public health concern, with several studies identifying alarmingly high prevalence rates in urban slums and low-income neighborhoods. A cross-sectional study conducted in a low-income urban community of Karachi found that over half (52.5%) of children aged 2–6 years suffered from ECC, with most cases remaining untreated (3). The same study highlighted the significant association between poor oral hygiene, anemia, and socioeconomic deprivation. This situation mirrors global trends where the burden of ECC is closely linked to poverty, low parental education, and limited access to preventive dental care. Such findings emphasize that ECC is not merely a dental problem but a broader indicator of health inequity and social marginalization.

Parental knowledge and practices regarding oral hygiene play a critical role in shaping children's oral health behaviors. In Karachi, a study among mothers of children under five revealed that 91% had inadequate knowledge about oral hygiene and dental caries prevention, and nearly two-thirds engaged in improper oral care practices (4). Low literacy, limited awareness about fluoride use, and negative attitudes toward preventive care were major barriers. Similarly, research conducted in Lahore identified that children who were fed milk with added sugar or frequently consumed sweet snacks had significantly higher rates of ECC, underscoring the influence of dietary habits and inadequate oral hygiene routines (5). These findings underscore the necessity of integrating parental education into public health initiatives aimed at reducing ECC prevalence. Socioeconomic disparities further exacerbate oral health inequities across Pakistan. In Peshawar, a study assessing families' oral health knowledge and practices found poor awareness, irregular dental visits, and reliance on symptomatic treatment as common behaviors (6). Dental fear, cultural misconceptions, and limited affordability contribute to delayed care-seeking behaviors. Moreover, public dental health programs remain fragmented, and oral health promotion is often overshadowed by other pressing public health priorities. The lack of community-based preventive interventions targeting early childhood oral health perpetuates the intergenerational cycle of poor oral hygiene and disease.

The burden of ECC also extends beyond clinical outcomes, affecting children's overall well-being. Chronic pain and discomfort from untreated caries can lead to difficulties in eating, sleeping, and concentrating, ultimately impacting school performance and psychosocial development. In addition, untreated dental infections can have systemic consequences, contributing to malnutrition and growth retardation. Therefore, addressing ECC in low-income populations must involve a multidisciplinary approach that incorporates oral health education, community engagement, and access to affordable preventive services. International evidence further reinforces the importance of maternal involvement in shaping children's oral hygiene habits. Studies in both high- and low-income settings have demonstrated that maternal oral health knowledge and behavior strongly correlate with children's oral health outcomes. In Punjab, Pakistan, a study found a clear association between the mother's oral hygiene status and the child's caries experience, with children of mothers with poor oral hygiene having nearly twice the odds of developing ECC (7). Such findings highlight the need to target maternal oral health literacy as part of ECC prevention strategies.

Despite existing knowledge, the data on oral hygiene practices and ECC prevalence in Pakistan remain fragmented, with limited comparative studies across major urban centers. The cities of Karachi, Lahore, and Peshawar represent distinct socioeconomic and cultural contexts, each facing unique public health challenges. However, research comparing these cities in terms of early childhood oral health practices is scarce. This gap in evidence limits the development of targeted interventions and policy strategies that consider local determinants of health behavior. Given these circumstances, understanding the interplay between oral hygiene practices, caregiver behavior, and the prevalence of ECC in low-income communities across Pakistan's major cities is essential. This study seeks to address that gap by examining oral hygiene habits, caregiver knowledge, and ECC prevalence among children from disadvantaged areas in Karachi, Lahore, and Peshawar. The objective of this research is to assess the association between oral hygiene practices and the prevalence of early childhood caries among children in low-income communities across these three cities, while identifying modifiable behavioral and socioeconomic factors that contribute to disease prevention. By providing comparative insights, this study aims to inform future community-based oral health interventions and guide policymakers toward evidence-based strategies for reducing the burden of ECC in Pakistan.

METHODS:

This study adopted a descriptive, cross-sectional design to assess the relationship between oral hygiene practices and the prevalence of early childhood caries (ECC) among children residing in low-income communities of Karachi, Lahore, and Peshawar. The cross-

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sectional approach was chosen for its effectiveness in estimating disease prevalence and identifying associations between behavioral and sociodemographic factors and oral health outcomes at a specific point in time (7). The study period extended from January to June 2025, covering both urban and peri-urban neighborhoods known for socioeconomic disadvantage and limited access to dental health facilities. Participants included children aged 2–6 years and their primary caregivers. The inclusion criteria required that the children be permanent residents of the selected communities for at least six months, possess no craniofacial abnormalities or systemic conditions affecting dental development, and have at least one erupted tooth. Caregivers had to be the primary person responsible for the child's daily oral hygiene and feeding practices. Exclusion criteria included children with congenital oral malformations (such as cleft lip or palate), those undergoing orthodontic treatment, or those with chronic systemic diseases that could influence oral health, such as diabetes or immunodeficiency.

A multistage sampling technique was used to select participants. In the first stage, one low-income community from each city was purposively chosen based on socioeconomic indicators and accessibility. In the second stage, systematic random sampling was applied to select households within each community. Using a 95% confidence level, 5% margin of error, and assuming a 52.5% ECC prevalence from a previous Karachi-based study (3), the minimum required sample size was calculated to be 384 children using the formula for single population proportion ($n = Z^2P(1-P)/d^2$). To accommodate potential non-response and missing data, the sample was increased by 10%, resulting in a total of 425 children (approximately 140 from each city). Data collection was carried out by trained dental examiners and research assistants. Examiners underwent calibration sessions to ensure diagnostic consistency, achieving a kappa coefficient of ≥ 0.80 for intra- and inter-examiner reliability. Oral examinations were performed at community centers or local schools under natural light using sterile mouth mirrors and probes, following World Health Organization (WHO) criteria for caries assessment. Caries status was recorded using the decayed, missing, and filled teeth (dmft) index, which served as the primary outcome measure. Oral hygiene status was evaluated using the Simplified Oral Hygiene Index (OHI-S), while plaque accumulation was visually assessed using the Plaque Index by Silness and L  e. These indices have been validated for epidemiological use and are widely employed in similar population-based dental health studies (8).

A structured, pre-tested questionnaire was administered to caregivers to collect information on sociodemographic characteristics, oral hygiene behaviors, dietary habits, and dental care practices. The instrument was adapted from previously validated questionnaires used in Pakistani studies assessing oral health practices among caregivers and young children (9). It comprised four sections: (1) demographic information, (2) child's oral hygiene routine (toothbrushing frequency, fluoride toothpaste use, and parental supervision), (3) feeding practices (use of bottle-feeding, night-time feeding, and frequency of sugary snack intake), and (4) caregiver's oral health knowledge and attitudes. The questionnaire was first developed in English, then translated into Urdu and Pashto, and back-translated to ensure linguistic and conceptual equivalence. Face validity and reliability were established through a pilot study of 30 participants not included in the final sample. Ethical approval for the study was obtained from the Institutional Review Board of Dow University of Health Sciences, Karachi (Reference No. IRB-2025/DUHS/0349), and the study adhered to the ethical standards outlined in the Declaration of Helsinki. Written informed consent was obtained from all participating caregivers after providing verbal and written information about the purpose, procedures, benefits, and potential risks of the study. Children identified with untreated dental caries were referred to nearby public dental clinics for free or low-cost treatment as part of the ethical commitment to community benefit.

Data were coded and entered into IBM SPSS Statistics version 26.0 for analysis. Descriptive statistics were computed for demographic variables, oral hygiene practices, and dmft scores. The normality of continuous data (e.g., dmft and OHI-S scores) was assessed using the Shapiro–Wilk test, confirming a normal distribution. Mean and standard deviation were reported for continuous variables, while frequencies and percentages were used for categorical variables. To assess associations between oral hygiene practices and ECC prevalence, independent samples t-tests and one-way analysis of variance (ANOVA) were employed for continuous variables, while Chi-square tests were used for categorical comparisons. Multivariable linear regression analysis was performed to determine predictors of dmft scores, adjusting for confounding factors such as age, gender, socioeconomic status, and caregiver education level. Statistical significance was set at $p < 0.05$. The rigor of data collection and standardized diagnostic criteria ensured reproducibility and reliability, aligning with international epidemiological research standards in dental public health (10). All data were anonymized prior to analysis, and electronic files were stored on password-protected systems accessible only to the research team. This methodological framework provides a robust, ethically grounded, and scientifically replicable approach to investigating the relationship between oral hygiene practices and ECC prevalence in children from low-income urban communities in Pakistan. It integrates clinical assessment with behavioral data to yield a comprehensive understanding of disease determinants, thereby informing future preventive interventions and policy development aimed at improving child oral health equity.

RESULTS:

A total of 425 children aged between 2 and 6 years, along with their primary caregivers, participated in the study from low-income communities in Karachi (n=140), Lahore (n=142), and Peshawar (n=143). The mean age of the children was 4.3 ± 1.2 years, with 52.9%

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males and 47.1% females. The mean household income was PKR 19,850 ± 5,400 per month, and 68.2% of caregivers had not completed primary education. The overall response rate was 94.4%. The prevalence of early childhood caries (ECC) across the combined sample was 51.8%, with significant variation across the three cities. Karachi reported the highest ECC prevalence (56.4%), followed by Lahore (50.0%) and Peshawar (48.9%). The mean decayed, missing, and filled teeth (dmft) index score was 2.46 ± 1.78, with the highest mean dmft in Karachi (2.73 ± 1.69) and the lowest in Peshawar (2.18 ± 1.81). Among affected children, 72.3% had untreated decay, 18.5% had missing teeth due to caries, and only 9.2% presented with restorations. These findings were consistent with prior epidemiological studies in similar socioeconomic settings (11).

Analysis of oral hygiene practices revealed that 61.9% of children brushed their teeth once daily, 22.4% brushed twice daily, and 15.7% brushed less than once daily. Only 38.8% of caregivers reported using fluoride toothpaste for their children, and 44.7% provided parental assistance during brushing. A significant difference was observed between cities, with Lahore showing the highest rate of fluoride toothpaste use (45.1%) compared to Karachi (36.4%) and Peshawar (35.6%). The mean Simplified Oral Hygiene Index (OHI-S) score for the study population was 1.78 ± 0.72, indicating a generally fair oral hygiene status. Poor oral hygiene was observed in 34.6% of children, while 48.2% demonstrated fair and 17.2% good hygiene. Dietary practices were found to play a crucial role in caries development. Approximately 58.1% of children consumed sugary snacks more than twice daily, and 49.6% were given sweetened milk or tea. Night-time bottle feeding was common, reported in 64.5% of children, with 37.9% of caregivers adding sugar to milk. These feeding behaviors significantly correlated with higher dmft scores ($p<0.01$), supporting prior observations that nocturnal feeding with sweetened liquids increases caries susceptibility in early childhood (12).

Multivariate regression analysis indicated that oral hygiene practices and feeding behaviors were the strongest predictors of ECC. After adjusting for confounders such as age, gender, and socioeconomic status, infrequent brushing ($<1/\text{day}$) was associated with a 1.84-fold increase in dmft score (95% CI: 1.32–2.56, $p<0.001$). Similarly, daily consumption of sugary snacks increased the odds of ECC by 2.17 (95% CI: 1.48–3.12, $p<0.001$). The use of fluoride toothpaste was found to be a significant protective factor, associated with a 41% reduction in caries odds (OR=0.59, 95% CI: 0.38–0.91, $p=0.018$). Maternal education and household income were also significantly correlated with children’s oral health outcomes. Children of mothers with no formal education had a mean dmft score of 2.96 ± 1.83 compared to 1.72 ± 1.48 among those whose mothers had secondary or higher education ($p<0.001$). Families earning below PKR 15,000 per month had an ECC prevalence of 63.7%, markedly higher than 42.4% among those earning more than PKR 25,000 ($p=0.004$). These socioeconomic disparities were consistent across the three study locations, echoing previously reported findings in similar low-income populations (13).

Oral health service utilization was notably low, with only 18.2% of caregivers reporting that their child had ever visited a dentist. Among those visits, 71.4% were prompted by dental pain, while preventive checkups were rare (7.3%). Logistic regression revealed that children who had never visited a dentist had significantly higher odds of untreated decay (OR=1.96, 95% CI: 1.24–3.10, $p=0.005$). This lack of preventive engagement aligns with global evidence linking limited access to dental services with higher ECC prevalence (14). Overall, the results demonstrated significant associations between ECC prevalence and oral hygiene frequency, fluoride use, night-time feeding, and socioeconomic status. The findings emphasized a clear urban variation and highlighted the need for tailored community-based interventions focusing on caregiver education and early preventive care in low-income areas of Pakistan.

Table 1. Demographic Characteristics of Participants (n = 425)

Variable	Mean ± SD / n (%)
Age (years)	4.3 ± 1.2
Gender (Male/Female)	225 (52.9%) / 200 (47.1%)
Mother's Education (None/Primary/Secondary+)	184 (43.3%) / 112 (26.4%) / 129 (30.3%)
Household Income (PKR)	19,850 ± 5,400
City (Karachi/Lahore/Peshawar)	140 / 142 / 143

Table 2. Oral Hygiene Practices Among Children Aged 2–6 Years

Variable	n (%) / Mean ± SD
Brushing Frequency (Once / Twice / <Once daily)	263 (61.9%) / 95 (22.4%) / 67 (15.7%)

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Fluoride Toothpaste Use (Yes/No)	165 (38.8%) / 260 (61.2%)
Parental Assistance (Yes/No)	190 (44.7%) / 235 (55.3%)
OHI-S Score (Mean ± SD)	1.78 ± 0.72

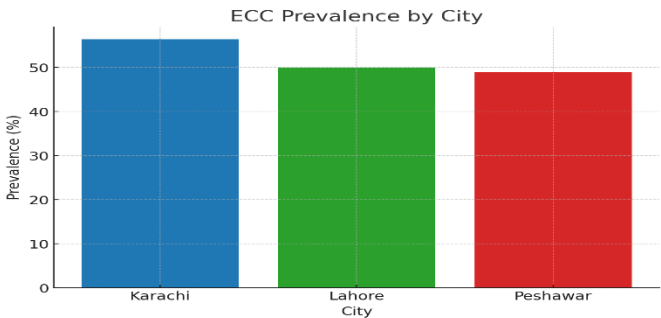
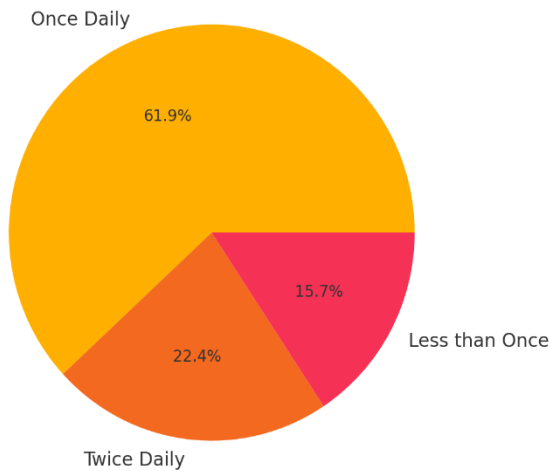
Table 3. Feeding Practices and Dietary Behaviors of Children

Variable	n (%)
Sugary Snack Intake (>2/day)	247 (58.1%)
Sweetened Milk/Tea Consumption	211 (49.6%)
Night-time Bottle Feeding (Yes/No)	274 (64.5%) / 151 (35.5%)
Sugar Added to Milk (%)	37.9%

Table 4. Prevalence of Early Childhood Caries (ECC) and Mean dmft Scores by City

City	ECC Prevalence (%)	Mean dmft ± SD	Untreated Decay (%)
Karachi	56.4	2.73 ± 1.69	74.1
Lahore	50.0	2.47 ± 1.74	70.8
Peshawar	48.9	2.18 ± 1.81	72.0

Distribution of Brushing Frequency among Children



DISCUSSION:

The findings of the present study demonstrated a high burden of early childhood caries (ECC) among children in low-income communities of Karachi, Lahore, and Peshawar, and revealed clear associations between oral hygiene behaviors, feeding practices, and socioeconomic factors. These results align with—and contribute to—the growing body of literature that identifies ECC as a major public health challenge in developing regions. A multicenter study among preschoolers in Riyadh similarly reported that children with nocturnal feeding habits and inadequate oral hygiene had significantly higher odds of developing ECC (15). Comparable observations were made in a large-scale cohort study in China, where poor diet quality and limited dietary diversity were significantly associated with elevated caries risk, underscoring the influence of nutritional practices on oral health outcomes (16). The overall ECC prevalence in this study (51.8%) is consistent with findings from national and regional surveys, indicating a persistent and substantial oral health disparity in

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South Asian populations. A systematic review reported a pooled prevalence of dental caries exceeding 56% among Pakistani children, reinforcing that oral disease begins early and remains inadequately addressed by preventive healthcare systems (17). The current study's observation of marked city-level variations suggests a complex interplay between cultural, socioeconomic, and environmental determinants. Such variation was similarly documented in India, where the prevalence of ECC ranged between 34% and 45% across urban and rural populations, depending on parental education and fluoride exposure (18).

The strong associations observed between infrequent tooth-brushing, low fluoride toothpaste use, frequent sugary snacking, and night-time feeding behaviors with ECC reinforce the multifactorial nature of this condition. These behavioral determinants are widely recognized across diverse populations. A 2023 cross-sectional investigation found that delayed tooth-brushing initiation, prolonged bottle-feeding, and lack of preventive dental visits significantly increased caries prevalence (19). Moreover, a recent review emphasized that not only sugar frequency but also overall dietary patterns and nutrient quality strongly contribute to ECC, indicating the necessity of integrated nutritional and oral health education (20). Socioeconomic disparities played a pivotal role in shaping oral health outcomes in this study. Children from households with lower income and mothers lacking formal education exhibited nearly double the dmft scores compared to their counterparts from higher-income families. Similar trends were reported in a Brazilian epidemiologic study, where family income and maternal schooling were independently associated with ECC prevalence (21). Limited access to preventive care, financial constraints, and lack of awareness are common mediators in such contexts. Furthermore, a 2025 exposome-based analysis identified environmental determinants—such as housing quality and water fluoridation status—as crucial yet often overlooked risk modifiers for ECC, emphasizing that interventions must extend beyond individual behaviors to community-level determinants (22).

From a public health standpoint, the findings underscore the need for preventive interventions beginning at infancy, particularly targeting caregiver education and dietary modification. Integrating oral health awareness into maternal and child health programs could be transformative. Recent research from Karachi Montessori schools confirmed that maternal oral health literacy strongly predicts children's brushing frequency and dental visit patterns (23). Therefore, empowering caregivers through structured, culturally appropriate oral health education programs could substantially mitigate ECC risk in vulnerable populations. The strengths of this study lie in its robust multicentric design, the inclusion of three major metropolitan centers, and the use of standardized diagnostic indices (dmft, OHI-S) that allow comparability with international data. Trained and calibrated examiners minimized diagnostic bias, and the inclusion of sociodemographic and behavioral variables enabled multivariate analysis to identify independent predictors of ECC. Nonetheless, the study's cross-sectional design limited causal inference, and reliance on caregiver self-reports may have introduced recall bias. Additionally, microbiological and salivary parameters were not assessed, which could have enriched understanding of biological risk mechanisms. Future longitudinal studies incorporating these factors could clarify temporal and causal relationships more definitively. ECC remains a widespread and preventable health problem among children in low-income Pakistani communities. The results affirm that oral hygiene frequency, fluoride exposure, feeding patterns, and caregiver education are major determinants of disease occurrence. Addressing these through community-based preventive strategies, oral health integration into child wellness programs, and public policy emphasizing early dental care could markedly reduce ECC burden. Future research should expand to rural and peri-urban populations, evaluate interventional effectiveness, and explore genetic and environmental determinants to inform holistic, sustainable oral health initiatives.

CONCLUSION:

This study concluded that early childhood caries remains a prevalent and preventable public health issue among children in low-income communities of Karachi, Lahore, and Peshawar. Poor oral hygiene practices, inadequate fluoride use, and cariogenic feeding behaviors were the strongest predictors of disease. Socioeconomic disparities further exacerbated the burden. The findings highlight the urgent need for integrated, community-based preventive programs that educate caregivers, promote early oral hygiene, and improve access to affordable dental care to reduce ECC prevalence and advance child health equity in Pakistan.

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AUTHORS CONTRIBUTION

Author	Contribution
Muhammad Khalil Khan	Conceptualization, Methodology, Formal Analysis, Writing - Original Draft, Validation, Supervision