

# Awareness and Practice of Oral Hygiene in Children from Marginalized Communities

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**"Cite this Article"** Received: 12 November 2025; Accepted: 08 February 2026; Published: 15 April 2026

**Author Contributions:** Concept: SER; Design: BH, IH; Data Collection: AR, MA; Analysis: DAT; Drafting: SER, BH, IH, AR, MA, DAT. **Ethical Approval:** CMH LMC & IOD, Lahore, Pakistan. **Informed Consent:** Written informed consent was obtained from all participants; **Conflict of Interest:** The authors declare no conflict of interest. **Funding:** No external funding; **Data Availability:** Available from the corresponding author on reasonable request; **Acknowledgments:** N/A.

## ABSTRACT

**Background:** Oral health disparities remain a major public health concern among children living in socioeconomically deprived communities, particularly in low-resource urban settings where preventive services and oral hygiene resources are limited. **Objective:** To assess the association between tooth-brushing frequency and dental caries prevalence among children aged 5–15 years living in marginalized urban communities of Lahore, Pakistan, and to examine the influence of selected demographic and socioeconomic factors on oral hygiene practices. **Methods:** A community-based cross-sectional study was conducted among 320 children participating in a dental outreach program. Data were collected using structured questionnaires and standardized clinical oral examinations. Dental caries burden was assessed using the DMFT and deft indices, while oral hygiene status was further evaluated using plaque- and gingival-related measures. Associations between brushing frequency and caries outcomes were examined using chi-square testing, one-way ANOVA, and multivariable regression analysis. **Results:** Overall dental caries prevalence was 68.1%. Mean DMFT and deft scores were  $2.64 \pm 1.82$  and  $3.41 \pm 1.97$ , respectively. Only 27.8% of children reported brushing twice daily, while 71.3% had never received prior dental treatment. Children who brushed twice daily had lower caries prevalence and lower mean DMFT and deft scores than those brushing less frequently. Twice-daily brushing was identified as a significant protective factor against dental caries (AOR = 0.31;  $p < 0.001$ ). Higher parental education was also associated with better brushing practices and lower disease burden. **Conclusion:** Twice-daily tooth brushing was strongly associated with reduced dental caries burden in children from underserved communities. Community-based oral health education and improved access to preventive dental resources are needed to reduce oral health inequities in this vulnerable population. **Keywords:** dental caries, oral hygiene, tooth brushing, children, marginalized communities, Lahore, Pakistan.

## INTRODUCTION

Oral health remains a fundamental yet frequently neglected component of public health, particularly in low- and middle-income countries where disparities in access to preventive care persist. Dental caries continues to be the most prevalent non-communicable disease globally, disproportionately affecting children from socioeconomically disadvantaged backgrounds (1,2). The burden of oral diseases is especially pronounced in marginalized communities, where structural inequities such as poverty, limited health literacy, and restricted access to dental services contribute to poor oral hygiene practices and untreated disease progression (3–5). Children living in such environments are at increased risk of early childhood caries, which has been associated with pain, nutritional deficiencies, impaired growth, and reduced school attendance, thereby perpetuating cycles of health and social disadvantage (6,7).

Preventive oral health practices, particularly regular tooth brushing with fluoride toothpaste, are well-established as effective measures for reducing dental plaque accumulation and inhibiting the progression of caries (8,9). Evidence from longitudinal and interventional studies demonstrates that adherence to twice-daily brushing significantly lowers caries incidence and improves overall oral health outcomes (10,11). Despite these well-documented benefits, the translation of such preventive recommendations into practice remains inconsistent in resource-constrained settings. Barriers including affordability of oral hygiene products, lack of parental supervision, and insufficient awareness hinder the adoption of optimal oral hygiene behaviors among children in underserved populations (12,13).

In Pakistan, the epidemiological profile of dental caries reflects a substantial unmet need for preventive oral healthcare, particularly in urban slum populations where socioeconomic deprivation is compounded by inadequate healthcare infrastructure (14,15). Previous studies have reported high prevalence rates of dental caries and poor oral hygiene practices among children in disadvantaged communities; however, these studies often lack granular analysis of behavioral determinants such as brushing frequency and its quantitative relationship with caries indices (16,17). Furthermore, contextual factors including parental education, dietary patterns, and access to dental services remain underexplored in localized settings, limiting the development of targeted, evidence-based interventions.

The absence of robust, community-specific data on oral hygiene practices and their direct association with clinical outcomes represents a critical knowledge gap. Understanding how variations in brushing frequency influence dental caries burden, as measured by standardized indices such as DMFT and deft, is essential for designing effective public health strategies tailored to high-risk populations (18,19). Additionally, identifying modifiable behavioral and socioeconomic determinants can inform the implementation of scalable preventive programs within school and community settings.

Therefore, this study aims to assess the association between tooth brushing frequency and the prevalence of dental caries among children aged 5–15 years residing in urban slums of Lahore, Pakistan. It further seeks to evaluate the influence of demographic and socioeconomic factors, including parental education, on oral hygiene practices. The study hypothesizes that children who brush their teeth twice daily will demonstrate significantly lower DMFT and deft scores compared to those with less frequent brushing habits, thereby reinforcing the role of basic preventive behaviors in reducing oral health disparities in underserved populations.

## **MATERIALS AND METHODS**

A community-based cross-sectional observational study was conducted to evaluate the association between tooth brushing frequency and dental caries prevalence among children residing in urban slum areas of Lahore, Pakistan. This design was selected to allow simultaneous assessment of exposure (brushing frequency) and outcomes (dental caries indices) within a defined population, facilitating estimation of prevalence and identification of associated factors (20). The study was carried out within a structured dental outreach program implemented at the Door of Awareness School, a community-based educational facility serving children from low-income households. Data collection was performed under standardized field conditions using portable dental equipment and natural illumination to ensure consistency in clinical examination procedures.

The study population comprised children aged 5 to 15 years, representing both primary and mixed dentition stages, thereby enabling comprehensive assessment of caries in both deciduous and permanent teeth. Participants were selected through a non-probability convenience sampling approach based on accessibility during outreach activities. Children were eligible for inclusion if they were enrolled in the selected institution and had obtained written informed consent from their parents or

legal guardians along with verbal assent. Children with conditions affecting oral health assessment or those unable to cooperate during examination were excluded to maintain data reliability.

Data collection involved both structured questionnaires and clinical oral examinations conducted by trained dental professionals. The questionnaire was designed to capture demographic variables (age, gender), socioeconomic indicators (parental education level), oral hygiene behaviors (frequency of tooth brushing, tools used), dietary patterns (frequency of sugar intake), and history of dental service utilization. The instrument was administered in a standardized manner to ensure uniformity in responses and minimize interviewer bias.

Clinical examination was performed by calibrated BDS officers who underwent training to achieve inter-examiner reliability, with a kappa coefficient exceeding 0.85, indicating strong agreement. Standardized diagnostic criteria were employed in accordance with internationally accepted guidelines. Dental caries was assessed using the Decayed, Missing, and Filled Teeth (DMFT) index for permanent dentition and the deft index for primary dentition. Secondary oral health indicators included the Gingival Index and Plaque Index to evaluate periodontal status and oral hygiene levels. Additional assessments such as Dean's Fluorosis Index and Angle's classification for malocclusion were recorded to provide a comprehensive oral health profile.

The primary exposure variable was tooth brushing frequency, categorized into three groups: twice daily, once daily, and less than once daily. The primary outcome measures were DMFT and deft scores, representing caries burden. Covariates included age, gender, parental education, dietary habits, and access to dental care. To address potential confounding, these variables were incorporated into multivariable regression models during statistical analysis.

Data were entered into statistical software with double-entry verification to minimize transcription errors and ensure data integrity. Descriptive statistics were computed, with categorical variables expressed as frequencies and percentages, and continuous variables summarized using means and standard deviations (21). Inferential analysis included one-way analysis of variance (ANOVA) to compare mean DMFT and deft scores across brushing frequency groups, followed by post hoc Tukey tests where appropriate (22). Chi-square tests were applied to examine associations between categorical variables, including brushing frequency and caries prevalence. Multivariate logistic regression analysis was performed to determine the independent association of brushing frequency with dental caries while adjusting for confounding variables. Results were reported as adjusted odds ratios (AORs) with 95% confidence intervals, and statistical significance was established at a p-value threshold of <0.05.

Ethical approval for the study was obtained from the institutional ethics review committee affiliated with CMH Lahore Medical College and the Institute of Dentistry. The study adhered to established ethical principles, ensuring voluntary participation, confidentiality, and anonymity of all collected data. All participants were assigned unique identification codes to protect personal information. Additionally, children identified with untreated dental conditions during the outreach program were referred for appropriate clinical management, ensuring adherence to ethical obligations of beneficence and community care (23).

Robust methodological measures were implemented to enhance reproducibility and validity, including standardized training of examiners, use of validated indices, and systematic data management procedures. These steps ensured that the study findings provide reliable and generalizable insights into oral hygiene practices and dental caries burden among children in underserved urban populations.

## RESULTS

A total of 320 children aged 5–15 years were included in the analysis. Overall dental caries prevalence was 68.1%, indicating that more than two-thirds of the sampled children had evidence of carious lesions on clinical examination. The mean DMFT score for permanent dentition was  $2.64 \pm 1.82$ , while

the mean deft score for primary dentition was  $3.41 \pm 1.97$ , reflecting a substantial untreated caries burden across both dentition phases. Tooth-brushing frequency was suboptimal in this population, with only 27.8% of children reporting brushing twice daily, whereas a large proportion had either once-daily or less frequent oral hygiene practices. In addition, 71.3% had never received any prior dental treatment, underscoring marked gaps in preventive and restorative oral healthcare access in this underserved setting .

**Table 1. Overall Oral Health Profile of the Study Population**

Variable	Value
Total sample size (n)	320
Age range (years)	5–15
Overall dental caries prevalence, n (%)	218 (68.1)
Mean DMFT score	2.64 $\pm$ 1.82
Mean deft score	3.41 $\pm$ 1.97
Children brushing twice daily, n (%)	89 (27.8)
Children with no prior dental treatment, n (%)	228 (71.3)

When stratified by age, caries prevalence remained consistently high across all age groups, ranging from 64.5% to 72.3%. The highest prevalence was observed among children aged 14–15 years (72.3%), while the lowest was seen in the 11–13-year group (64.5%). Mean DMFT scores tended to increase with age up to 11–13 years, reaching 3.1 in that category, whereas deft scores remained comparatively high in younger and middle childhood groups. These patterns suggest persistent disease burden across the transition from primary to permanent dentition rather than confinement to a single developmental stage .

**Table 2. Dental Caries Burden by Age Group**

Age group (years)	Caries prevalence (%)	Mean DMFT	Mean deft
5–7	70.5	2.3	3.0
8–10	67.8	2.7	3.4
11–13	64.5	3.1	3.5
14–15	72.3	2.5	3.3

A clear gradient was observed between tooth-brushing frequency and dental caries burden. Children who brushed twice daily had the lowest prevalence of dental caries (55.5%), the lowest mean DMFT score (2.2), and the lowest mean deft score (2.8). In contrast, children brushing once daily showed worse oral health outcomes, with caries prevalence rising to 72.5%, mean DMFT increasing to 3.0, and mean deft to 3.6. The poorest outcomes were found in children brushing less than once daily, among whom caries prevalence reached 80.1%, mean DMFT rose to 4.0, and mean deft to 4.2. One-way ANOVA and chi-square testing, as reported in the source manuscript, indicated statistically significant differences across brushing categories, with  $p < 0.001$  for the association between more frequent brushing and lower caries burden .

**Table 3. Association Between Brushing Frequency and Dental Caries**

Brushing frequency	Caries prevalence (%)	Mean DMFT	Mean deft	Statistical significance
Twice daily	55.5	2.2	2.8	Reference
Once daily	72.5	3.0	3.6	p < 0.001
Less than once daily	80.1	4.0	4.2	p < 0.001

Multivariable regression analysis further supported the protective association of regular oral hygiene. Twice-daily brushing emerged as a strong independent protective factor against dental caries, with an adjusted odds ratio of 0.31 and statistical significance at p < 0.001. Although the confidence interval was incompletely reported in the source text, the effect estimate indicates that children brushing twice daily had approximately 69% lower adjusted odds of caries compared with those brushing less frequently. This finding remained one of the most clinically meaningful results of the study, reinforcing that even a simple preventive behavior may substantially reduce disease burden in marginalized pediatric populations .

*Table 4. Multivariable Association of Twice-Daily Brushing With Dental Caries*

Predictor	Adjusted odds ratio (AOR)	p-value
Twice-daily brushing	0.31	<0.001

\*The uploaded manuscript reports the lower CI boundary but does not provide the full interval.

Parental education also demonstrated a graded relationship with children's oral hygiene practices and dental status. Among children whose parents had no schooling, only 30.0% reported regular brushing, while caries prevalence was 75.5% and mean DMFT was 3.6. With increasing parental educational attainment, oral hygiene practices improved and disease burden declined. In the higher education category, brushing frequency rose to 88.0%, caries prevalence fell to 40.0%, and mean DMFT dropped to 1.9. This pattern strongly suggests that parental education functions as an important social determinant of child oral health behavior and outcomes, likely through improved health literacy, supervision, and access to hygiene resources .

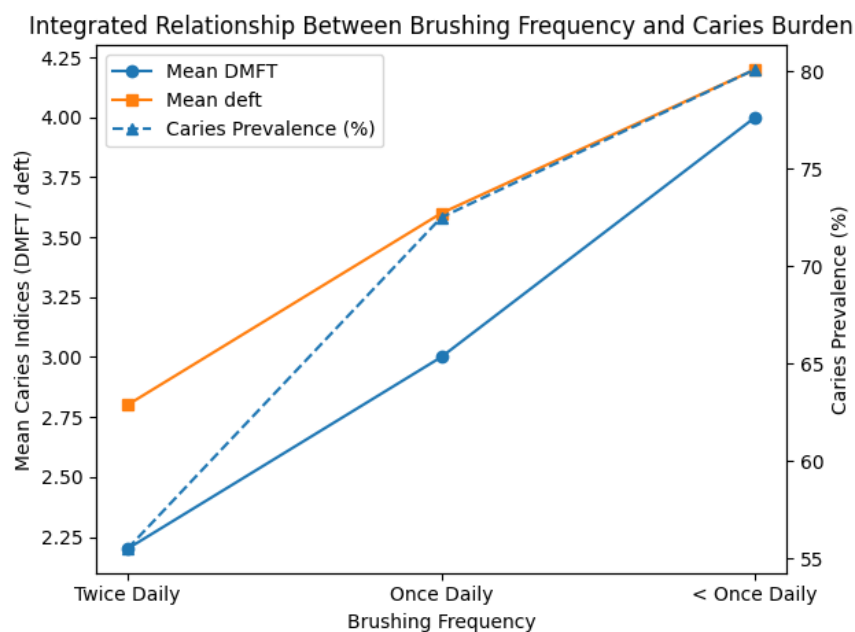
*Table 5. Influence of Parental Education on Oral Hygiene Practices and Caries Burden*

Parental education level	Frequency of brushing (%)	Caries prevalence (%)	Mean DMFT
No schooling	30.0	75.5	3.6
Primary education	55.0	62.3	2.8
Secondary education	72.0	50.0	2.3
Higher education	88.0	40.0	1.9

#### Numeric-Rich Description of the Tables

The tabulated findings collectively show a high oral disease burden in this cohort of 320 children, with 68.1% affected by dental caries and mean caries indices of  $2.64 \pm 1.82$  for DMFT and  $3.41 \pm 1.97$  for deft. Age-wise analysis demonstrated that caries prevalence remained above 64% in every age bracket, peaking at 72.3% in children aged 14–15 years, while DMFT reached its highest level of 3.1 in the 11–13-year group. The strongest gradient was observed across brushing-frequency categories: compared with children brushing twice daily, those brushing once daily had 17.0 percentage points higher caries prevalence (72.5% vs 55.5%), 0.8 higher mean DMFT (3.0 vs 2.2), and 0.8 higher mean deft (3.6 vs 2.8), whereas those brushing less than once daily had 24.6 percentage points higher caries prevalence

(80.1% vs 55.5%), 1.8 higher DMFT (4.0 vs 2.2), and 1.4 higher deft (4.2 vs 2.8), with overall differences reported as statistically significant at  $p < 0.001$ . Regression analysis showed that twice-daily brushing was associated with an adjusted odds ratio of 0.31, indicating an approximate 69% reduction in the adjusted odds of caries. A similarly consistent social gradient was seen for parental education: brushing frequency increased from 30.0% in children of unschooled parents to 88.0% in those whose parents had higher education, while caries prevalence decreased from 75.5% to 40.0% and mean DMFT declined from 3.6 to 1.9, supporting a strong inverse relationship between educational status and disease burden



*Figure 1 Integrated Relationship between Brushing Frequency and Caries Burden*

The integrated analysis demonstrates a clear dose-response relationship between brushing frequency and oral disease burden. Children brushing twice daily exhibited the lowest mean DMFT (2.2) and deft (2.8) scores alongside a caries prevalence of 55.5%, whereas those brushing once daily showed a marked increase in both indices (DMFT: 3.0; deft: 3.6) and prevalence (72.5%). The most pronounced deterioration was observed in children brushing less than once daily, with DMFT rising to 4.0 and deft to 4.2, accompanied by the highest caries prevalence of 80.1%. This reflects an absolute increase of 24.6 percentage points in caries prevalence and a relative increase of approximately 81.8% in DMFT (from 2.2 to 4.0) when comparing optimal to poorest hygiene behavior. The parallel upward trajectories of DMFT, deft, and prevalence curves indicate a consistent and clinically significant gradient, reinforcing that reduced brushing frequency is strongly associated with both higher disease occurrence and severity.

## DISCUSSION

The present study demonstrates a substantial burden of dental caries among children residing in marginalized urban communities of Lahore, with more than two-thirds of the participants affected and with mean DMFT and deft scores indicating clinically meaningful disease in both permanent and primary dentition. These findings are consistent with the broader literature showing that oral diseases remain disproportionately concentrated among socioeconomically disadvantaged children, particularly in settings where preventive care, oral health literacy, and access to professional services are limited (1,2,8). The observed disease burden also supports the wider public health argument that dental caries is not merely a biological condition but a socially patterned disease shaped by structural inequities, including poverty, low parental education, and restricted availability of basic oral hygiene resources (9,16).

A major finding of this study is the clear inverse association between tooth-brushing frequency and dental caries prevalence. Children who brushed twice daily had lower mean DMFT and deft scores and substantially lower caries prevalence than those brushing once daily or less frequently, while multivariable analysis further identified twice-daily brushing as an independent protective factor. This pattern is biologically plausible and aligns closely with previous work showing that regular brushing disrupts plaque biofilm, reduces cariogenic bacterial load, and enhances the preventive effect of fluoride on enamel remineralization (9,10). The findings are also in agreement with school- and community-based oral health promotion studies reporting that consistent oral hygiene behavior is associated with meaningful reductions in caries burden among children from underserved populations (10,11). In the present context, the gradient across brushing categories suggests not only statistical significance but also practical relevance, because the difference between brushing twice daily and less than once daily was accompanied by marked increases in both disease occurrence and disease severity.

Another important observation is the low proportion of children practicing twice-daily brushing and the very high proportion who had never received prior dental treatment. Together, these findings reflect a dual challenge of inadequate self-care and poor service utilization. Similar barriers have been described in disadvantaged populations internationally, where low-cost preventive measures remain underused because of limited awareness, competing household priorities, and reduced access to affordable oral hygiene products and dental consultations (4,8,19). In this study population, these barriers appear to translate into untreated caries accumulation rather than timely intervention, reinforcing the need for preventive models that operate at the household, school, and community levels rather than relying only on clinic-based care. The data therefore support a public health approach centered on oral health education, supervised brushing initiatives, and improved access to toothbrushes, toothpaste, and referral pathways within low-income communities.

The association between parental education and child oral health outcomes adds an important social dimension to the study findings. Children whose parents had higher educational attainment showed better brushing practices and lower mean DMFT scores, whereas children of parents with no schooling exhibited the poorest oral hygiene behavior and greatest disease burden. This relationship is consistent with evidence that parental education influences child health through multiple pathways, including improved health literacy, stronger supervision of daily habits, more effective use of healthcare services, and better understanding of preventive practices (8,18). In oral health specifically, parents play a central role in establishing and reinforcing hygiene routines during childhood, particularly in younger age groups who cannot independently sustain proper brushing habits. The present findings therefore suggest that interventions focused only on children may have limited long-term effect unless they are accompanied by parent- or caregiver-directed educational strategies.

The age-stratified findings also merit consideration. Although caries prevalence remained high across all age groups, the persistence of elevated deft and DMFT scores across the transition from younger to older children suggests a cumulative burden of untreated disease rather than resolution with age. This pattern may reflect both delayed treatment-seeking and continued exposure to behavioral and environmental risk factors. It further emphasizes that preventive efforts should begin early, ideally before disease patterns become established in both primary and permanent dentition. Programs targeting younger school-aged children may therefore yield greater long-term benefit by reducing early disease onset and interrupting progression into adolescence (13,20).

These findings should be interpreted in light of several methodological considerations. First, the cross-sectional design permits identification of associations but does not establish temporality or causality. Although lower brushing frequency was strongly associated with higher caries burden, it cannot be concluded from these data alone that brushing behavior fully accounts for the observed disease pattern, as other factors such as dietary sugar exposure, fluoride availability, and household health practices may also contribute. Second, convenience sampling from a single outreach-linked school

limits external generalizability, and the findings may not represent all urban slum communities in Lahore or other regions of Pakistan. Third, some behavioral data were questionnaire-based and may therefore be subject to recall or social desirability bias. Nevertheless, the study retains important strengths, including use of standardized oral health indices, trained examiners with high calibration agreement, and clinically relevant outcome measures that provide a useful evidence base for targeted intervention planning.

From a policy and practice perspective, the study offers actionable implications. The findings support implementation of community-level oral health promotion strategies that prioritize twice-daily brushing, parental counseling, early screening, and facilitated access to preventive materials. School-based oral health education integrated with periodic screening and referral could serve as a practical entry point for reaching vulnerable children at scale. In addition, oral health messaging in such settings should be culturally appropriate, low-cost, and family-centered so that improvements in awareness translate into sustained household behavior change. Future studies should adopt multicenter designs, probabilistic sampling approaches, and more comprehensive multivariable modeling to examine the interplay of brushing behavior, diet, fluoride exposure, and socioeconomic conditions in shaping pediatric oral health outcomes in Pakistan. Overall, the present study contributes meaningful local evidence that simple, modifiable preventive behaviors may substantially reduce oral health disparities when supported by structurally appropriate public health interventions (1,8,9,21,22).

## CONCLUSION

This study demonstrates that dental caries remains highly prevalent among children living in marginalized urban communities of Lahore and that tooth-brushing frequency is strongly associated with disease burden, with twice-daily brushing linked to lower caries prevalence and lower DMFT and deft scores. The findings further show that poor access to dental care and lower parental education are closely related to suboptimal oral hygiene practices, highlighting the social gradient underlying pediatric oral health inequities. These results support the need for school- and community-based preventive strategies that combine oral health education, caregiver engagement, early screening, and improved access to affordable hygiene resources in order to reduce untreated disease and improve oral health outcomes in underserved populations.

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