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Original Article

Comparison of Gingival Health Among Children of Different Age Groups in Slum Areas

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ABSTRACT

Background: Gingival inflammation is a preventable oral health problem among children, particularly in underserved urban slum communities where access to dental care, oral hygiene resources, and caregiver awareness may be limited. **Objective:** To compare gingival health status among children of different age groups living in urban slum areas of Lahore, Pakistan, and to assess its association with selected oral hygiene practices. **Methods:** This cross-sectional observational study included 196 children aged 5–15 years who were examined during community dental outreach activities. Participants were categorized into three age groups: 5–7 years, 8–11 years, and 12–15 years. Gingival health was assessed clinically using the Gingival Index, and oral hygiene practices, including brushing frequency, parental supervision, and fluoridated toothpaste use, were recorded through a structured questionnaire. Data were analyzed using descriptive statistics, one-way ANOVA, and chi-square tests, with statistical significance set at $p < 0.05$. **Results:** Mean Gingival Index scores increased progressively with age, from 0.62 ± 0.23 in children aged 5–7 years to 0.89 ± 0.26 in those aged 8–11 years and 1.23 ± 0.29 in those aged 12–15 years ($p < 0.001$). Moderate-to-severe gingivitis was highest among children aged 12–15 years (46.9%). Twice-daily brushing, supervised brushing, and fluoridated toothpaste use were associated with lower Gingival Index scores. **Conclusion:** Gingival health was poorer among older children, particularly early adolescents, and was associated with oral hygiene practices. Age-targeted oral health education, supervised brushing, and community-based preventive programs are needed in underserved slum populations. **Keywords:** Gingival Health; Children; Slum Areas; Oral Hygiene; Gingivitis; Lahore; Parental Supervision; Fluoridated Toothpaste.

INTRODUCTION

Oral health is an essential component of general health and wellbeing, particularly during childhood, when health-related behaviors, dietary patterns, and hygiene practices begin to shape long-term disease risk. The World Health Organization defines health as a state of complete physical, mental, and social wellbeing rather than merely the absence of disease, and this broader understanding supports the inclusion of oral and gingival health within child health priorities (1). Gingival inflammation is one of the earliest and most common manifestations of poor periodontal health in children and adolescents. Although it is largely preventable, untreated gingivitis may progress over time and contribute to periodontal complications, discomfort, impaired oral function, and reduced quality of life (2). Because childhood oral health often predicts oral health status in later life, early identification of gingival inflammation and its associated behavioral determinants is important for reducing preventable oral disease burden in vulnerable populations (3).

Children living in low-income urban slum communities are particularly vulnerable to poor oral health because of intersecting social, environmental, and behavioral disadvantages. Limited access to dental services, inadequate availability of oral hygiene supplies, low parental oral health literacy, crowded living conditions, and competing household priorities may all contribute to poor plaque control and delayed recognition of gingival disease (4). Evidence from low- and middle-income countries shows that oral diseases, including gingivitis and periodontal conditions, are more prevalent among socioeconomically disadvantaged populations, with slum residents often experiencing a higher burden than non-slum urban residents (5). In such settings, preventive care is frequently underutilized, and dental visits are often symptom-driven rather than routine, allowing early gingival inflammation to remain undetected until more advanced signs such as bleeding, calculus accumulation, or persistent inflammation appear (6).

The development of gingival inflammation in children is closely related to oral hygiene behaviors, particularly plaque removal through regular toothbrushing. Inadequate brushing frequency, lack of parental supervision, and inconsistent use of appropriate toothpaste have been associated with poorer oral hygiene and greater gingival inflammation among school-aged children (7). Younger children often depend on parents or caregivers for effective brushing, whereas older children and adolescents gradually assume responsibility for their own oral hygiene. This transition may be accompanied by declining supervision, inconsistent brushing technique, and reduced adherence to preventive routines. At the same time, adolescence is a biologically sensitive period in which hormonal changes may increase gingival tissue response to plaque, making early adolescents more susceptible to gingival inflammation even when plaque levels are similar (8). These behavioral and biological factors suggest that gingival health may differ meaningfully across childhood age groups.

Age-stratified assessment is therefore important for understanding which pediatric groups require the greatest preventive attention. International oral health surveillance frameworks recommend standardized assessment of children across defined age categories using calibrated clinical examination methods so that disease patterns can be compared across populations and over time (9). However, in Pakistan, community-based evidence on gingival health among children living in marginalized urban slum settings remains limited. Existing local studies have more commonly addressed general oral health status, dental caries, or oral hygiene practices, while fewer have focused specifically on gingival health patterns across developmental age groups in underserved children (10). This evidence gap restricts the development of targeted oral health promotion strategies for children who may have the greatest need for early preventive intervention.

Lahore, as a large urban center with multiple low-income settlements, provides an important setting for examining pediatric gingival health in socially disadvantaged communities. Children in these communities may experience cumulative risk from poor access to preventive dental care, limited caregiver awareness, irregular brushing practices, and low exposure to structured oral health education. Understanding how gingival health varies between younger children, middle childhood, and early adolescence can help identify critical periods for intervention. In particular, comparing children aged 5–7 years, 8–11 years, and 12–15 years may provide useful insight into whether gingival inflammation increases as children become older and more independent in their hygiene practices.

Therefore, this study aimed to compare gingival health status among children aged 5–15 years living in urban slum areas of Lahore, Pakistan, using standardized clinical assessment, and to examine the association of gingival health with age group and selected oral hygiene practices. The study was guided by the hypothesis that older children, particularly those in early adolescence, would demonstrate poorer gingival health than younger children, and that favorable oral hygiene behaviors, including more frequent brushing, supervised brushing, and use of fluoridated toothpaste, would be associated with lower Gingival Index scores.

MATERIALS AND METHODS

This cross-sectional observational study was conducted as a community-based oral health assessment among children living in urban slum areas of Lahore, Pakistan. The study was designed to compare gingival health across defined pediatric age groups and to examine the association between gingival status and selected oral hygiene practices. Data were collected during community dental outreach activities organized in collaboration with Door of Awareness School, Lahore. The cross-sectional design was appropriate because clinical and questionnaire-based information was obtained at a single point in time, allowing estimation of gingival health status and its relationship with age group and oral hygiene behaviors within the target population.

The study population comprised children aged 5–15 years who were present during the outreach activity and were eligible for oral examination. Participants were categorized into three age groups: 5–7 years, 8–11 years, and 12–15 years, representing early childhood, middle childhood, and early adolescence. Children were included if they belonged to the specified age range, were available on the day of assessment, had parental consent and child assent, and completed the clinical gingival examination. Children undergoing orthodontic treatment, those with systemic conditions known to influence gingival health, those with incomplete clinical or questionnaire data, and those unable to cooperate during examination were excluded. A convenience sampling technique was used, whereby all eligible children attending the outreach activity during the data collection period were invited to participate.

Written informed consent was obtained from parents or guardians before participation, and verbal assent was obtained from children in an age-appropriate manner. The examination process was non-invasive and included routine oral screening, structured recording of oral health indicators, and oral hygiene-related questioning. All collected data were anonymized before analysis, and no personal identifiers were retained in the analytical dataset. Ethical approval for secondary analysis of anonymized outreach data was obtained from the relevant ethics review committee. The analysis was conducted in accordance with accepted ethical principles for human participant research, including respect for autonomy, confidentiality, minimal risk, and responsible use of health-related data.

Clinical data were collected using standardized oral examination procedures under adequate illumination with sterile mouth mirrors and periodontal probes. Gingival health was assessed using the Loe and Silness Gingival Index, which evaluates gingival inflammation based on clinical features such as color change, edema, and bleeding tendency. Gingival status was classified according to index scores into clinically interpretable categories, including healthy gingiva, mild gingivitis, moderate gingivitis, and severe gingivitis. Oral hygiene status was assessed using the Simplified Oral Hygiene Index where applicable, while dental health indicators recorded during outreach screening included caries status using DMFT/DEFT criteria. The primary outcome variable for this study was Gingival Index score, and the main exposure variable was age group. Additional explanatory variables included brushing frequency, parental supervision during brushing, and use of fluoridated toothpaste.

Data on oral hygiene practices were obtained through a structured questionnaire administered during the outreach assessment. The questionnaire recorded demographic characteristics, age, sex, oral hygiene habits, brushing frequency, supervision of brushing by parents or caregivers, and toothpaste use. Brushing frequency was categorized as once daily or twice daily. Brushing supervision was categorized according to whether the child's brushing was supervised by an adult. Toothpaste use was classified according to reported use of fluoridated or non-fluoridated toothpaste. These variables were selected because of their clinical relevance to plaque control and gingival inflammation in pediatric populations.

To improve consistency and reduce measurement bias, examiners were trained before data collection in the use of standardized diagnostic criteria and clinical recording procedures. Calibration was conducted to promote uniform assessment of gingival status and oral hygiene indicators. Examination procedures were performed under similar conditions for all participants, using the same clinical instruments and recording format. A structured screening form was used to ensure completeness and consistency of data capture. Data entries were checked for completeness and internal consistency before statistical analysis, and records with incomplete key outcome data were excluded from the final analysis.

The sample size was calculated using a conservative expected prevalence of 50%, a 95% confidence level, and a 7% margin of error, resulting in a required sample of 196 participants. This approach was used because local community-based estimates for the target population were limited, and a 50% prevalence assumption provides a conservative estimate for sample size calculation in cross-sectional studies. The final analytical sample included 196 children distributed across the three age groups.

Data were analyzed using IBM SPSS Statistics version 26. Descriptive statistics were used to summarize demographic characteristics, oral hygiene practices, and gingival health findings. Continuous variables such as Gingival Index scores were reported as means and standard deviations, while categorical variables such as gingival health categories, brushing frequency, brushing supervision, and toothpaste type were reported as frequencies and percentages. One-way analysis of variance was used to compare mean Gingival Index scores across the three age groups. Chi-square tests were used to assess associations between categorical variables, including age group and gingival health category. Comparisons involving oral hygiene practices and mean Gingival Index scores were analyzed using appropriate group comparison tests. Additional analyses examining relationships between oral hygiene behaviors and gingival health were considered exploratory and hypothesis-generating. Statistical significance was set at $p < 0.05$, and all analyses were interpreted as associations because of the observational cross-sectional design.

Bias was addressed through standardized examination procedures, examiner training, consistent data collection instruments, and predefined eligibility criteria. Selection bias was minimized by inviting all eligible children present during the outreach activity to participate, although the use of convenience sampling limited population representativeness. Information bias was reduced by using clinical examination for gingival assessment rather than relying only on self-reported oral health status. Response bias for oral hygiene practices was addressed by using simple, structured questions suitable for children and caregivers. Potential confounding by age-related behavioral differences was considered through age-group stratification, and oral hygiene variables were examined in relation to Gingival Index scores to support clinically meaningful interpretation.

All study data were handled using anonymized records. Data were entered into a structured database, checked for completeness, and reviewed for inconsistencies before analysis. The same operational definitions were applied throughout the analysis to ensure reproducibility. The primary analysis focused on comparison of Gingival Index scores and gingival health categories across age groups, while secondary exploratory analyses assessed associations between gingival health and brushing frequency, brushing supervision, and fluoridated toothpaste use.

RESULTS

A total of 196 children aged 5–15 years were included in the analysis. The sample was distributed almost equally across the three predefined age groups, with 64 children aged 5–7 years, 68 aged 8–11 years, and 64 aged 12–15 years. The overall mean Gingival Index score was 0.91 ± 0.31, with values ranging from 0.20 to 1.80. Mean Gingival Index scores increased progressively across age groups, from 0.62 ± 0.23 in children aged 5–7 years to 0.89 ± 0.26 in those aged 8–11 years and 1.23 ± 0.29 in those aged 12–15 years. One-way ANOVA showed a statistically significant difference in mean Gingival Index scores across the three age groups ($F = 87.71$, $p < 0.001$), with a large effect size ($\eta^2 = 0.476$), indicating that age group accounted for approximately 47.6% of the observed variation in Gingival Index scores.

Table 1. Gingival Index Scores Across Age Groups

Age Group	n	Mean GI ± SD	Minimum	Maximum	Mean Difference vs Previous Age Group	95% CI	ANOVA p-value
5–7 years	64	0.62 ± 0.23	0.20	1.10	Reference	—	—
8–11 years	68	0.89 ± 0.26	0.30	1.40	+0.27	0.18 to 0.36	<0.001
12–15 years	64	1.23 ± 0.29	0.60	1.80	+0.34	0.25 to 0.43	<0.001
Total	196	0.91 ± 0.31	0.20	1.80	—	—	Overall ANOVA: $F = 87.71$, $p < 0.001$; $\eta^2 = 0.476$

The distribution of gingival health categories also differed significantly across age groups. Healthy gingiva was most frequent in the youngest group, affecting 29 of 64 children aged 5–7 years (45.3%), but declined to 19 of 68 children aged 8–11 years (27.9%) and 9 of 64 children aged 12–15 years (14.1%). In contrast, moderate gingivitis increased from 8 children (12.5%) in the 5–7-year group to 14 children (20.6%) in the 8–11-year group and 22 children (34.4%) in the 12–15-year group. Severe gingivitis was uncommon overall but showed the same upward pattern, rising from 3.1% in the youngest group to 12.5% in the oldest group. The association between age group and gingival health category was statistically significant ($\chi^2 = 22.40$, df = 6, $p = 0.001$), with a small-to-moderate association strength (Cramer's V = 0.239).

Table 2. Distribution of Gingival Health Status Across Age Groups

Gingival Condition	5–7 years n (%)	8–11 years n (%)	12–15 years n (%)	Total n (%)	Chi-Square Statistic	p-value	Effect Size
Healthy gingiva	29 (45.3%)	19 (27.9%)	9 (14.1%)	57 (29.1%)			
Mild gingivitis	25 (39.0%)	31 (45.6%)	25 (39.1%)	81 (41.3%)			
Moderate gingivitis	8 (12.5%)	14 (20.6%)	22 (34.4%)	44 (22.4%)			
Severe gingivitis	2 (3.1%)	4 (5.9%)	8 (12.5%)	14 (7.2%)	$\chi^2 = 22.40$, df = 6	0.001	Cramer's V = 0.239
Total	64 (100%)	68 (100%)	64 (100%)	196 (100%)			

When moderate and severe gingivitis were combined as clinically more concerning gingival inflammation, the proportion increased steadily with age. Moderate-to-severe gingivitis was present in 10 of 64 children aged 5–7 years (15.6%), 18 of 68 children aged 8–11 years (26.5%), and 30 of 64 children aged 12–15 years (46.9%). This represents an approximate three-fold increase from the youngest to the oldest age group. Conversely, the proportion of children with healthy gingiva decreased by more than two-thirds across the same age range, from 45.3% to 14.1%.

Table 3. Clinically Relevant Gingival Status Gradient by Age Group

Age Group	n	Healthy Gingiva n (%)	Mild Gingivitis n (%)	Moderate-to-Severe Gingivitis n (%)	Absolute Increase in Moderate-to-Severe Gingivitis vs 5–7 years	p-value
5–7 years	64	29 (45.3%)	25 (39.0%)	10 (15.6%)		0.001
8–11 years	68	19 (27.9%)	31 (45.6%)	18 (26.5%)	+10.9 percentage points	
12–15 years	64	9 (14.1%)	25 (39.1%)	30 (46.9%)	+31.3 percentage points	
Total	196	57 (29.1%)	81 (41.3%)	58 (29.6%)	—	

Oral hygiene practices showed statistically significant associations with mean Gingival Index scores. Children who brushed twice daily had a lower mean GI score (0.62 ± 0.21) than those who brushed once daily (0.95 ± 0.29), with a mean difference of −0.33 and a 95% confidence interval from −0.43 to −0.23. Supervised brushing was also associated with better gingival status: children with adult supervision had a mean GI score of 0.72 ± 0.25, compared with 1.05 ± 0.28 among those without supervision, giving a mean difference of 0.33. Use of fluoridated toothpaste was similarly associated with lower mean GI scores, with children using fluoridated toothpaste showing a mean GI of 0.84 ± 0.27, compared with 1.09 ± 0.31 among children using non-fluoridated toothpaste.

Overall, the results demonstrate a consistent age-related worsening in gingival health among children aged 5–15 years. The oldest group had both the highest mean Gingival Index score and the highest burden of moderate-to-severe gingivitis. Oral hygiene behaviors showed parallel associations: twice-daily brushing, adult-supervised brushing, and fluoridated toothpaste use were each linked with lower Gingival Index scores. These findings indicate that both age group and hygiene-related practices were meaningfully associated with gingival health status in this pediatric slum population.

Table 4. Association Between Oral Hygiene Practices and Gingival Index Scores

Variable	Category	n	Mean GI ± SD	Mean Difference	95% CI for Mean Difference	Test Statistic	p-value	Effect Size
Brushing frequency	Once/day	173	0.95 ± 0.29	Reference	—	—	—	—
	Twice/day	23	0.62 ± 0.21	−0.33	−0.43 to −0.23	t = −6.73	<0.001	Cohen's d = −1.17
Brushing supervision	Yes	85	0.72 ± 0.25	Reference	—	—	—	—
	No	111	1.05 ± 0.28	+0.33	0.26 to 0.40	t = 8.69	<0.001	Cohen's d = 1.23
Fluoridated toothpaste use	Yes	142	0.84 ± 0.27	Reference	—	—	—	—
	No	54	1.09 ± 0.31	+0.25	0.15 to 0.35	t = 5.22	<0.001	Cohen's d = 0.89

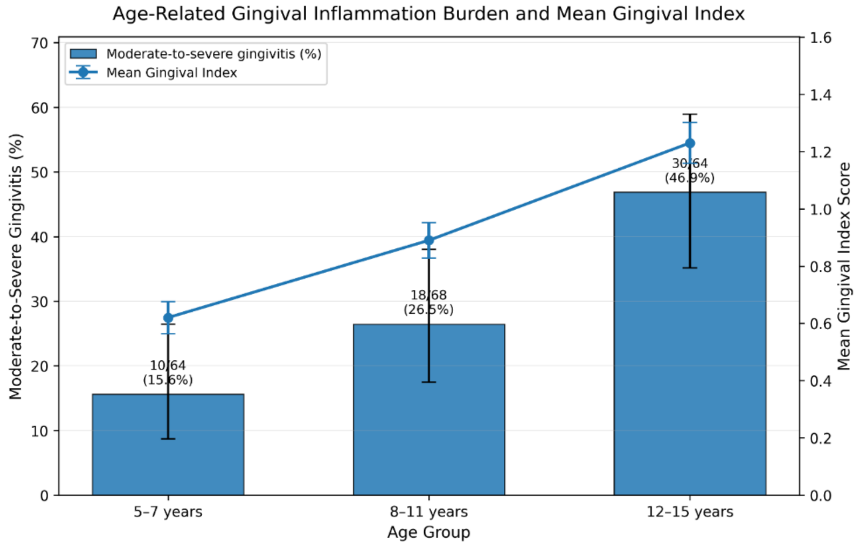

Figure 1. Age-Related Gingival Inflammation Burden and Mean Gingival Index

The figure demonstrates a parallel age-related increase in both clinically concerning gingival inflammation and mean Gingival Index scores among 196 children. Moderate-to-severe gingivitis increased from 15.6% in the 5–7-year group to 26.5% in the 8–11-year group and 46.9% in the 12–15-year group, while mean Gingival Index scores rose from 0.62 ± 0.23 to 0.89 ± 0.26 and 1.23 ± 0.29, respectively. This combined pattern shows that older children not only had higher average gingival inflammation scores but also a greater proportion reaching moderate-to-severe disease categories, indicating a clinically meaningful worsening of gingival health during early adolescence.

DISCUSSION

The present study found a clear age-related worsening of gingival health among children aged 5–15 years living in urban slum areas of Lahore. Mean Gingival Index scores increased progressively across the three age groups, from 0.62 ± 0.23 in children aged 5–7 years to 0.89 ± 0.26 in those aged 8–11 years and 1.23 ± 0.29 in those aged 12–15 years. A similar pattern was observed in categorical gingival status, where the proportion of children with healthy gingiva declined from 45.3% in the youngest group to 14.1% in the oldest group, while moderate-to-severe gingivitis increased from 15.6% to 46.9%. These findings indicate that early adolescence represents a particularly vulnerable period for gingival inflammation in this underserved pediatric population. The pattern is clinically important because gingivitis in childhood is preventable and reversible when plaque control, oral hygiene education, and caregiver involvement are strengthened at an early stage.

The observed deterioration in gingival health with increasing age may reflect a combination of behavioral, developmental, and biological factors. Younger children are more likely to receive direct assistance or supervision from parents and caregivers during toothbrushing, whereas older children gradually become responsible for their own oral hygiene practices. This transition may reduce brushing quality and consistency, especially in low-resource households where oral health awareness and access to preventive dental services are limited. Adolescence may also increase susceptibility to gingival inflammation because pubertal hormonal changes can heighten gingival tissue response to plaque biofilm, making plaque-related inflammation more pronounced during this period (11-13). The higher burden of moderate-to-severe gingivitis among children aged 12–15 years therefore suggests that preventive programs should begin before adolescence, when hygiene habits are still being shaped and caregiver involvement can still be reinforced.

The association between oral hygiene practices and gingival health further supports the behavioral relevance of the findings. Children who brushed twice daily had substantially lower mean Gingival Index scores than those who brushed once daily, and supervised brushing was associated with markedly better gingival status. The difference between supervised and unsupervised brushing was clinically meaningful, with mean GI scores of 0.72 ± 0.25 and 1.05 ± 0.28, respectively. This finding highlights that brushing frequency alone may not be sufficient; brushing quality, technique, and caregiver monitoring are also important. In socioeconomically disadvantaged communities, where formal dental visits may be infrequent and preventive counseling may be limited, parental supervision can serve as a practical and low-cost protective behavior. Similar findings have been reported in school-based and community-based studies showing that supervised toothbrushing and oral health education improve oral hygiene status among children (14,15).

Use of fluoridated toothpaste was also associated with lower mean Gingival Index scores, with children using fluoridated toothpaste showing better gingival health than those using non-fluoridated toothpaste. Although fluoride is primarily recognized for its role in caries prevention, regular use of fluoridated toothpaste may also reflect better overall oral hygiene behavior, greater caregiver awareness, and more consistent exposure to oral health guidance. Therefore, the association should be interpreted as part of a broader hygiene-related pattern rather than as an isolated causal effect. In low-income settings, toothpaste availability, affordability, caregiver knowledge, and product selection may influence children's daily oral care practices. Public health interventions should therefore address not only knowledge but also access to basic oral hygiene materials.

The findings are consistent with evidence from low- and middle-income countries showing that children and adolescents in disadvantaged settings experience a high burden of plaque-related oral conditions. Studies from urban slum and low-resource populations have reported that poor oral hygiene practices, low caregiver awareness, limited dental service use, and socioeconomic constraints are associated with poorer gingival and periodontal outcomes (16,17). Research from Pakistan has similarly indicated that children and adolescents living in slum communities experience substantial oral health needs, reflecting gaps in preventive care, oral hygiene education, and early disease detection (18). The current findings add age-stratified evidence from Lahore and suggest that older children in slum settings may require targeted preventive strategies in addition to general school-based oral health promotion.

The public health relevance of these findings is strengthened by the study setting. Urban slum communities often face overlapping barriers, including financial constraints, low health literacy, limited access to dental care, and competing household priorities. In such environments, gingival inflammation may not be recognized as a condition requiring attention until bleeding, pain, or visible oral disease occurs. Community outreach programs can help bridge this gap by providing screening, oral hygiene instruction, caregiver counseling, and referral pathways. The results suggest that interventions should not be limited to younger children but should specifically include pre-adolescents and adolescents, who demonstrated the highest Gingival Index scores and the greatest proportion of moderate-to-severe gingivitis.

This study has several strengths. It focused on a marginalized pediatric population that is underrepresented in community-based oral health research, used clinical examination rather than relying only on self-reported oral health status, and compared gingival outcomes across developmentally meaningful age groups. The use of standardized gingival assessment and structured oral hygiene data collection allowed clinically interpretable comparisons between age categories and hygiene behaviors. The inclusion of brushing frequency, supervision, and toothpaste type also provided practical behavioral targets for future oral health promotion programs.

Several limitations should be considered when interpreting the findings. The cross-sectional design does not allow causal inference, so the observed relationships between age, oral hygiene practices, and Gingival Index scores should be interpreted as associations. Convenience sampling may have introduced selection bias, and the findings may not represent all children living in slum areas of Lahore or other urban settings. Some oral hygiene variables were based on reported behavior, which may be affected by recall bias or social desirability bias. Potential confounders such as diet, parental education, household income, access to dental care, plaque levels, and prior oral health education may also influence gingival status. Although age-group comparisons showed a strong pattern, longitudinal studies are needed to determine whether gingival health worsens over time as children transition into adolescence.

Despite these limitations, the findings provide useful evidence for community oral health planning in low-resource pediatric populations. The marked rise in moderate-to-severe gingivitis among children aged 12–15 years suggests that preventive education should begin before adolescence and continue through school age. Programs should emphasize correct brushing technique, twice-daily brushing, caregiver supervision for younger children, continued parental monitoring during early adolescence, and access to appropriate toothpaste. School-based and community-based outreach models may be particularly effective when combined with caregiver education, periodic oral screening, and referral for children with moderate or severe gingival inflammation.

Overall, this study demonstrates that gingival health was poorer among older children in urban slum areas of Lahore and that unfavorable oral hygiene practices were associated with higher Gingival Index scores. The findings support the need for age-targeted, behavior-focused preventive strategies that address both child-level hygiene habits and caregiver involvement. By identifying early adolescence as a period of increased gingival inflammation, the study provides a practical basis for designing oral health interventions that are responsive to the needs of underserved children.

CONCLUSION

This cross-sectional study found that gingival health was poorer among older children living in urban slum areas of Lahore, with a progressive increase in mean Gingival Index scores from 0.62 ± 0.23 in children aged 5–7 years to 0.89 ± 0.26 in those aged 8–11 years and 1.23 ± 0.29 in those aged 12–15 years. Moderate-to-severe gingivitis also increased with age, affecting 15.6%, 26.5%, and 46.9% of children in the respective age groups. Twice-daily brushing, adult-supervised brushing, and use of fluoridated toothpaste were associated with lower Gingival Index scores, indicating the importance of consistent oral hygiene practices and caregiver involvement. Because of the cross-sectional design and convenience sampling, these findings should be interpreted as associations rather than causal relationships. The results highlight the need for age-targeted oral health education, reinforcement of supervised brushing, and community-based preventive programs before and during early adolescence to reduce gingival health disparities among underserved children.

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