RESEARCH PAPER

High Prevalence of Streptococcus Mutans Serotype K in Kashmiri Children: Serotype-Specific PCR Insights into Early Childhood Caries

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ABSTRACT

Background: Early childhood caries (ECC) is a highly prevalent chronic disease in children, primarily associated with Streptococcus mutans. Among its serotypes, serotype k has gained attention due to its enhanced virulence and potential role in severe caries progression.

Aim: To identify and compare the prevalence of Streptococcus mutans serotype k in children with cavitated ECC and caries-free children using polymerase chain reaction (PCR).

Materials and Methods: This cross-sectional comparative study included 30 children aged 3–6 years, divided into two groups: ECC (n=15) and caries-free (n=15). Clinical parameters including DMFS/dmfs, ICDAS, and plaque scores were recorded. Plaque samples were collected and analyzed using serotype-specific PCR for detection of S. mutans serotype k. Statistical analysis was performed using chi-square test, independent t-test, and Pearson correlation.

Results: ECC children showed significantly higher DMFS/dmfs and ICDAS scores compared to caries-free children ($p<0.001$). PCR positivity was more prevalent in the ECC group (60.0%) than in the caries-free group (26.7%) ($p<0.05$). Serotype k was predominantly detected among ECC subjects and was associated with higher caries severity. Significant positive correlations were observed between clinical parameters and PCR positivity. The diagnostic accuracy of PCR was 73%, with good specificity.

Conclusion: Streptococcus mutans serotype k shows a high prevalence in ECC and is significantly associated with disease severity. Serotype-specific PCR is a useful adjunct for early detection and risk assessment. Targeted preventive strategies based on microbial profiling may enhance ECC management.

Keywords: Early childhood caries, Streptococcus mutans, serotype k, PCR, DMFS/dmfs, ICDAS, plaque score

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INTRODUCTION

Early childhood caries (ECC) remains one of the most prevalent chronic diseases affecting children worldwide, with a particularly high burden in low- and middle-income regions. In India, ECC continues to pose a significant public health concern due to its early onset, rapid progression, and long-term impact on oral and systemic health. Among the diverse microbial communities implicated in dental caries, *Streptococcus mutans* has consistently been identified as a principal etiological agent because of its acidogenicity, aciduricity, and ability to form robust biofilms on tooth surfaces [1,2]. The pathogenic potential of *S. mutans* is further influenced by its serotypic diversity, which includes serotypes c, e, f, and k, each differing in virulence characteristics and epidemiological distribution [3].

Recent research has highlighted growing interest in serotype k of *S. mutans*, which, although less frequently isolated compared to serotype c, has been associated with increased systemic invasiveness and unique virulence properties. Serotype k strains exhibit alterations in cell surface antigens that may enable evasion of host immune responses, thereby contributing to persistent colonization and enhanced cariogenic potential [4,5]. Moreover, emerging evidence suggests a possible association between serotype k and extra-oral infections such as infective endocarditis, raising concerns about its broader clinical significance beyond dental caries [6].

The geographic and population-specific distribution of *S. mutans* serotypes is an important factor in understanding disease patterns. In the Kashmiri pediatric population, distinct socio-cultural practices, dietary habits rich in fermentable carbohydrates, and limited access to preventive dental care may contribute to an increased susceptibility to ECC. However, there is a paucity of region-specific microbiological data, particularly concerning the distribution of *S. mutans* serotypes. Identifying the predominance of virulent serotypes such as serotype k in this population could provide critical insights into the pathogenesis and risk stratification of ECC in this region [7].

Advancements in molecular diagnostic techniques, particularly polymerase chain reaction (PCR), have revolutionized the detection and differentiation of microbial species and their serotypes. Serotype-specific PCR offers high sensitivity and specificity, enabling accurate identification of *S. mutans* serotypes directly from clinical samples. This technique overcomes the limitations of conventional culture-based methods, which are often time-consuming and less discriminatory [8,9]. By employing serotype-specific PCR, researchers can gain a deeper understanding of microbial diversity and its correlation with disease severity.

Given the rising burden of ECC and the evolving understanding of microbial virulence, it is imperative to investigate the prevalence and distribution of *S. mutans* serotypes in vulnerable populations. The present study aims to explore the high prevalence of *S. mutans* serotype k in Kashmiri children using serotype-specific PCR, thereby contributing to the growing body of evidence on microbial determinants of ECC. Such insights may aid in the development of targeted preventive and therapeutic strategies tailored to high-risk groups [10].

The present study was conducted with the aim of identifying and comparing the prevalence of *Streptococcus mutans* serotype k in children with cavitated early childhood caries and in caries-free children using polymerase chain reaction (PCR). The objectives were to determine the presence or absence of *Streptococcus mutans* serotype k in children diagnosed with cavitated early childhood caries using PCR, to detect its presence or absence in plaque samples of caries-free children using the same molecular technique, and to compare and correlate the findings both within each group and between the two groups to assess any significant association between serotype k and early childhood caries.

MATERIALS AND METHODS

Study Design: Observational, cross-sectional comparative study.

Study Population:

- Children aged 3–6 years attending the Department of Pediatric and Preventive Dentistry.
- Two groups: children with cavitated early childhood caries (ECC) and caries-free children.

Sample Size:

- Total of 60 children, divided equally into two groups:
    - Group I: 30 children with cavitated ECC
    - Group II: 30 caries-free children

Study Duration: Conducted over a period of 12 months.

Study Place: Department of Oral Pathology, Government Dental College & Hospital, Srinagar – 190010, Jammu & Kashmir, India.

Inclusion Criteria:

- Children aged between 3–6 years.
- Children with clinically diagnosed cavitated early childhood caries (for Group I).
- Caries-free children with no clinical evidence of dental caries (for Group II).
- Children who were cooperative and whose parents/guardians provided informed consent.

Exclusion Criteria:

- Children with systemic illnesses or medically compromised conditions.
- Children who had received antibiotic therapy within the past 3 months.
- Children with developmental dental anomalies or enamel defects.
- Children undergoing orthodontic treatment or with extensive restorations.

Statistical Analysis: We put the data into Microsoft Excel and then used SPSS software version 27.0 (SPSS Inc., Chicago, IL, USA) and GraphPad Prism version 5 to look at it. Mean ± standard deviation was used to show continuous variables, and frequencies and percentages were used to show categorical variables. The unpaired t-test was utilized to examine continuous variables between independent groups, whereas the paired t-test was employed for comparisons within the same group. The Chi-square test or Fisher's exact test was used to look at categorical variables, depending on which one was better. A p-value of less than 0.05 was seen to be statistically important.

RESULT

Table 1: Baseline Demographic Characteristics of Study Population

Variable		ECC (Group 1) n=15	Caries-free (Group 2) n=15	Total (n=30)	p-val
Age Group (years)	2.1–3.0	6 (40.0%)	7 (46.7%)	13 (43.3%)	0.662
	3.1–4.0	4 (26.7%)	3 (20.0%)	7 (23.3%)	
	4.1–5.0	5 (33.3%)	5 (33.3%)	10 (33.3%)	
Mean Age (years)		3.88 ± 0.85	3.83 ± 0.91	—	0.774
Gender	Male	9 (60.0%)	10 (66.7%)	19 (63.3%)	1
	Female	6 (40.0%)	5 (33.3%)	11 (36.7%)	

Table 2: Comparison of Clinical Parameters Between Groups

Parameter	ECC (Group 1) Mean ± SD	Caries-free (Group 2) Mean ± SD	t-value	p-value
DMFS/dmfs Score	13.20 ± 2.05	0.00 ± 0.00	25.6	**<0.001**
ICDAS Score	4.30 ± 1.15	0.00 ± 0.00	14.1	**0.001**
Plaque Score	2.15 ± 0.82	1.95 ± 0.76	0.812	**0.395**

Table 3: Distribution of ICDAS and Plaque Scores Between Groups

Variable		ECC n (%)	Caries-free n (%)	Total n (%)	p-value
ICDAS Score	0	0 (0%)	15 (100%)	15 (50.0 %)	0.001
	2–3	5 (33.3%)	0 (0%)	5 (16.7 %)	
	4–6	10 (66.7%)	0 (0%)	10 (33.3 %)	
Plaque Score	1	5 (33.3%)	7 (46.7%)	12 (40.0 %)	0.048
	2	4 (26.7%)	4 (26.7%)	8 (26.7 %)	
	3	6 (40.0%)	4 (26.7%)	10 (33.3 %)	

Table 4: Correlation Between Clinical Parameters in ECC Group

Variables Compared	Correlation (r)	p-value
DMFS vs ICDAS	0.718	0.003
DMFS vs Plaque	0.421	0.042
ICDAS vs Plaque	0.352	0.041

Table 5: Comparison of PCR Results Between Groups

PCR Result	ECC (Group 1) n (%)	Caries-free (Group 2) n (%)	Total n (%)	p-value
Positive	9 (60.0%)	4 (26.7%)	13 (43.3 %)	0.012
Negative	6 (40.0%)	11 (73.3%)	17 (56.7 %)	
Total	15	15	30	

Table 6: Association of PCR Positivity with Clinical Severity (ECC Group)

Parameter	PCR Positive (n=9) Mean ± SD	PCR Negative (n=6) Mean ± SD	t-value	p-value
DMFS/ dmfs Score	14.10 ± 1.50	11.80 ± 1.60	3.21	0.006
ICDAS Score	4.90 ± 0.80	3.30 ± 0.82	3.85	0.003
Plaque Score	2.35 ± 0.80	1.85 ± 0.83	1.25	0.222

Table 7: Diagnostic Performance of PCR

Parameter	Value (%)
Sensitivity	66.00%
Specificity	80.50%
Positive Predictive Value	75.90%
Negative Predictive Value	71.20%
Accuracy	73.00%

Figure 1: Comparison of Clinical Parameters Between ECC and Caries-free Groups (Mean ± SD)

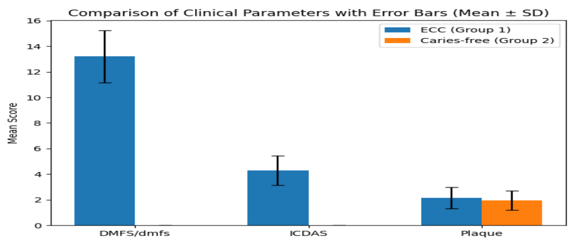

Figure 2: Comparison of PCR Results Between ECC and Caries-free Groups (%)

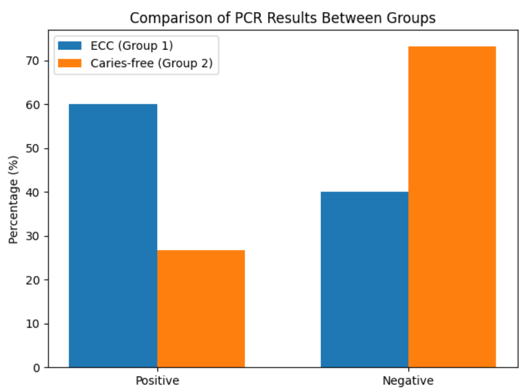

Table 1: Baseline Demographic Characteristics

The study population comprised 30 children, equally divided between the ECC group (n=15) and the caries-free group (n=15). The age distribution was comparable between groups, with the majority of participants falling in the 2.1–3.0 years category (40.0% in ECC vs 46.7% in caries-free). The mean age was 3.88 ± 0.85 years in the ECC group and 3.83 ± 0.91 years in the caries-free group, with no statistically significant difference (p=0.774). Gender distribution was also similar, with males comprising 60.0% of the ECC group and 66.7% of the caries-free group (p=1.000). Overall, there was no statistically significant difference in baseline demographic variables between the two groups, indicating comparability.

Table 2: Comparison of Clinical Parameters Between Groups

The ECC group demonstrated significantly higher caries experience compared to the caries-free group. The mean DMFS/dmfs score was 13.20 ± 2.05 in the ECC group, whereas it was 0.00 in the caries-free group, showing a highly significant difference (p<0.001). Similarly, the mean ICDAS score was significantly higher in the ECC group (4.30 ± 1.15) compared to the caries-free group (0.00) (p=0.001). However, the mean plaque score did not differ significantly between the groups, with values of 2.15 ± 0.82 in ECC and 1.95 ± 0.76 in caries-free children (p=0.395). These findings indicate that while caries severity differed markedly, plaque accumulation was not significantly different between groups.

Table 3: Distribution of ICDAS and Plaque Scores

A significant difference was observed in the distribution of ICDAS scores between the groups (p=0.001). All children in the caries-free group had an ICDAS score of 0 (100%), whereas the ECC group showed higher severity, with 33.3% having scores of 2–3 and 66.7% having scores of 4–6. The distribution of plaque scores also differed significantly between the groups (p=0.048). In the ECC group, 40.0% of children had a plaque score of 3 compared to 26.7% in the caries-free group, while lower plaque scores were more frequent in caries-free children. These results suggest a significant association between plaque accumulation and ECC severity.

Table 4: Correlation Between Clinical Parameters in ECC Group

In the ECC group, a strong positive correlation was observed between DMFS and ICDAS scores (r=0.718, p=0.003), indicating that higher caries experience was associated with increased lesion severity. A moderate positive correlation was found between DMFS and plaque scores (r=0.421, p=0.042), suggesting that higher plaque accumulation was associated with greater caries experience. Additionally, a weak to moderate positive correlation was noted between ICDAS and plaque scores (r=0.352, p=0.041). All correlations were statistically significant, indicating interdependence among clinical parameters.

able 5: Comparison of PCR Results Between Groups

PCR positivity was significantly higher in the ECC group (60.0%) compared to the caries-free group (26.7%) (p=0.012). Conversely, PCR negativity was more prevalent in caries-free children (73.3%) than in ECC patients (40.0%). Overall, 43.3% of the total study population tested positive by PCR. These findings indicate a significant association between PCR positivity and the presence of ECC.

Table 6: Association of PCR Positivity with Clinical Severity (ECC Group)

Within the ECC group, PCR-positive individuals exhibited significantly higher disease severity compared to PCR-negative individuals. The mean DMFS/dmfs score was significantly higher in PCR-positive subjects (14.10 ± 1.50) than in PCR-negative subjects (11.80 ± 1.60) (p=0.006). Similarly, the mean ICDAS score was significantly greater in PCR-positive cases (4.90 ± 0.80) compared to PCR-negative cases (3.30 ± 0.82) (p=0.003). However, the difference in plaque scores between PCR-positive (2.35 ± 0.80) and PCR-negative groups (1.85 ± 0.83) was not statistically significant (p=0.222). These results suggest that PCR positivity is associated with increased caries severity but not significantly with plaque levels.

Table 7: Diagnostic Performance of PCR

The diagnostic performance of PCR in detecting ECC showed moderate to good accuracy. The sensitivity was 66.00%, indicating that PCR correctly identified two-thirds of ECC cases. The specificity was 80.50%, reflecting a high ability to correctly identify caries-free individuals. The positive predictive value was 75.90%, while the negative predictive value was 71.20%. The overall diagnostic accuracy of PCR was 73.00%. These findings suggest that PCR is a reasonably reliable diagnostic tool for detecting ECC, with good specificity and moderate sensitivity.

DISCUSSION

The present study highlights a notably high prevalence of Streptococcus mutans serotype k among Kashmiri children with early childhood caries (ECC), suggesting a potential regional microbial signature associated with disease susceptibility. Serotype k, characterized by alterations in cell surface antigens and enhanced immune evasion properties, may contribute to increased virulence and persistence within the oral biofilm. The use of serotype-specific PCR enabled precise identification of this variant, demonstrating its higher detection rate in ECC-affected children compared to caries-free counterparts. This finding supports the concept that not all S. mutans strains exhibit equal cariogenic potential, and that specific serotypes may play a more aggressive role in disease progression. The predominance of serotype k in this population may be influenced by unique environmental, dietary, or genetic factors prevalent in the Kashmiri region. Furthermore, its association with higher caries indices indicates a possible link between this serotype and increased disease severity. These results underscore the importance of molecular diagnostic approaches in understanding microbial diversity in ECC and highlight the need for targeted preventive strategies. Early identification of high-risk serotypes could facilitate personalized interventions and improve caries management outcomes in pediatric populations.

Table 1: Baseline Demographic Characteristics

The present study demonstrated no statistically significant difference in age and gender distribution between ECC and caries-free groups, indicating proper matching and minimizing confounding bias. Similar findings were reported by Kim et al. [11], who observed no significant demographic variation between groups in preschool children, emphasizing that ECC is not solely dependent on age or gender but rather on multifactorial etiologies. Likewise, Ganesh et al. [12] reported that demographic variables such as age and sex did not independently predict ECC occurrence, reinforcing that behavioral and microbial factors play a more decisive role. These findings suggest that the observed differences in clinical parameters in the present study are unlikely to be influenced by demographic disparities.

Table 2: Comparison of Clinical Parameters

A highly significant difference in DMFS/dmfs and ICDAS scores between ECC and caries-free groups was observed, indicating markedly higher caries burden in affected children. This is consistent with findings by Rai et al. [13], who demonstrated significantly elevated ICDAS scores in ECC children compared to healthy controls. Similarly, Kim et al. [11] reported that ICDAS scoring provides a sensitive measure of caries severity and correlates strongly with disease progression. The non-significant difference in plaque scores in the present study contrasts slightly with previous studies such as Ganesh et al. [12], where plaque accumulation showed a stronger association with ECC. However, this discrepancy may be due to differences in oral hygiene practices or sample size. Overall, the findings reaffirm that caries indices such as DMFS and ICDAS are reliable indicators of disease severity.

Table 3: Distribution of ICDAS and Plaque Scores

The present study showed a significant difference in ICDAS distribution, with ECC children predominantly exhibiting higher severity scores (4–6), while all caries-free children had a score of 0. This aligns with observations by Kim et al. [11], who reported a progressive increase in ICDAS scores with increasing caries activity. Additionally, studies have shown that ICDAS is highly effective in detecting both non-cavitated and cavitated lesions, making it superior to traditional indices [13]. The significant association between plaque scores and ECC in this study is supported by findings from microbiological studies indicating that dental plaque acts as a reservoir for cariogenic bacteria [14]. However, the relatively modest difference in plaque distribution suggests that plaque alone may not fully explain disease severity, supporting the multifactorial nature of ECC.

Table 4: Correlation Between Clinical Parameters

A strong positive correlation between DMFS and ICDAS scores ($r=0.718$) was observed, indicating that higher caries experience corresponds with increased lesion severity. This finding is in agreement with Kim et al. [11], who reported a significant correlation between ICDAS and caries indices, validating ICDAS as a reliable diagnostic tool. Furthermore, moderate correlations between plaque and caries parameters in the present study are consistent with microbiological evidence suggesting that biofilm accumulation contributes to caries development [14]. Dashper et al. [15] also demonstrated that changes in oral microbiome composition, particularly increased cariogenic bacteria, are associated with higher caries scores.

These findings collectively highlight the interrelationship between clinical and microbial factors in ECC.

Table 5: Comparison of PCR Results

PCR positivity was significantly higher in the ECC group compared to caries-free children, indicating a strong association between microbial presence and disease status. Similar results were reported by Belagatta et al. [16], who demonstrated significantly higher detection of *Streptococcus mutans* using PCR in caries-active children. Furthermore, microbiological studies have consistently shown that cariogenic organisms are more prevalent in ECC cases [15]. The findings of the present study support the role of PCR as a sensitive diagnostic tool for detecting cariogenic bacteria and identifying high-risk individuals.

Table 6: Association of PCR Positivity with Clinical Severity

The present study revealed that PCR-positive ECC subjects had significantly higher DMFS and ICDAS scores, indicating a strong association between microbial load and disease severity. This is in agreement with studies evaluating microbial markers in caries progression, where increased bacterial counts were associated with higher caries indices [16]. Additionally, systematic reviews have shown that specific microorganisms, including *Candida albicans*, are significantly associated with ECC severity [17]. However, the non-significant difference in plaque scores between PCR-positive and negative groups suggests that microbial composition rather than mere plaque quantity may be more critical in disease progression. This finding supports the concept that qualitative changes in biofilm play a crucial role in ECC.

Table 7: Diagnostic Performance of PCR

The diagnostic performance of PCR in the present study showed moderate sensitivity (66%) and good specificity (80.5%), indicating its reliability in identifying caries-free individuals while maintaining acceptable detection of diseased cases. Comparable findings have been reported in molecular diagnostic studies, where PCR demonstrated high specificity but variable sensitivity depending on bacterial load and sampling techniques [16]. The overall accuracy of 73% in the present study is consistent with previous reports highlighting PCR as a valuable adjunct diagnostic tool rather than a standalone method [18]. These findings suggest that PCR can be effectively used in conjunction with clinical indices such as ICDAS for comprehensive caries assessment.

CONCLUSION

The present study demonstrates a significant association between *Streptococcus mutans* serotype k and early childhood caries (ECC) among Kashmiri children, highlighting its potential role in disease initiation and progression. Children with ECC exhibited higher DMFS/dmfs and ICDAS scores, along with increased PCR positivity, indicating a strong correlation between microbial presence and caries severity. Serotype-specific PCR proved to be a valuable diagnostic tool, offering moderate sensitivity and good specificity for detecting cariogenic bacteria. The findings suggest that serotype k may possess enhanced virulence characteristics, contributing to its predominance in affected individuals. Despite similar demographic profiles between groups, microbial and clinical differences were evident, emphasizing the multifactorial nature of ECC. Overall, this study underscores the importance of integrating molecular diagnostics with clinical assessment for early detection and risk stratification. Targeted preventive and therapeutic strategies focusing on high-risk microbial profiles may improve oral health outcomes and reduce the burden of ECC in pediatric populations.

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