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Caries experience in Indian children with cleft lip and palate – an observational study from a tertiary care centre

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ABSTRACT

Introduction and aim. This study aims to assess caries experience in children with cleft lip and palate (CLP).

Material and methods. A total of 127 children (aged 3-12 years) with CLP and 141 non-cleft controls were assessed for dental caries using the decayed-extracted/missing-filled teeth (deft/DMFT) index. Logistic regression analysis was employed to identify factors associated with dental caries. Statistical tests, including t-test, ANOVA, Chi-square, and Fisher's exact test, were used to analyze differences between cleft and non-cleft populations.

Results. In primary teeth, caries prevalence was significantly higher in children with CLP (63.8%) compared to non-cleft controls (40.4%, $p < 0.001$). The deft scores were 3.30 for CLP and 1.63 for non-CLP group ($p < 0.01$). No significant difference was observed in mean DMFT scores ($p = 0.02$). Significant variations in caries prevalence ($p = 0.01$) and mean DMFT values ($p = 0.001$) were noted in permanent dentition among different cleft groups.

Conclusion. Children with CLP show higher caries prevalence and experience, emphasizing the need for targeted dental care interventions in this population. Logistic regression analysis highlights an age-related increase in caries experience among individuals with CLP.

Keywords. cleft lip, cleft palate, dental caries

Introduction

Cleft lip and palate (CLP) rank among the most common craniofacial anomalies in children, affecting nearly 1 in 700 live births globally. This condition can lead to a range of functional, aesthetic, and psychological

challenges for affected individuals. Given the complexities involved, children with CLP require specialized care, including dental care. Unfortunately, the appearance of orofacial clefts often overwhelms parents, leading to a tendency to overlook the oral health needs of their children. Children with CLP often show various dental problems, including malocclusion, poor oral hygiene, and dental anomalies. Reports on the prevalence of dental caries in the CLP population present conflicting findings. The majority of studies suggest a higher caries prevalence in children with CLP compared to non-cleft children.¹⁻⁸ However, Malay et al. and Nagappan et al. reported a lower occurrence of caries in children with CLP, while some studies found no difference in caries experience between children with CLP and the control population.⁹⁻¹² These differences in findings may stem from various reasons such as the multifactorial etiology of dental caries, variations in evaluation periods, methodological disparities, and differences in socio-economic conditions.^{13,14}

Aim

Epidemiological studies have shown that caries prevalence differs from country to country. Caries experience in a population is influenced by factors such as oral hygiene practices, dietary habits, and ethnicity. Although many studies have explored caries prevalence in India, epidemiological studies on the caries experience of CLP children are scarce. The current study aimed to investigate caries experience in 3–12 years children with CLP and compare them with age- and sex-matched non-cleft children. Additionally, factors such as place of residence, number of siblings, method of tooth cleaning, use of fluoride toothpaste, frequency of brushing, and previous dental visits were investigated to determine their potential influence on caries experience in children with cleft lip and palate.

Material and methods

Ethical considerations

The study protocol adheres to the Declaration of Helsinki and received approval from the Ethics Committee of Dr. R Ahmed Dental College and Hospital, Kolkata (IEC/DCH/089 dated 12/7/2021). Prior to the commencement of the study, informed consent was obtained from the parents or legal guardians of the participating children. The consent process included a detailed explanation of the study's objectives, procedures, potential risks, and benefits. Participants were assured that their involvement was voluntary, and they had the right to withdraw from the study at any stage without repercussions. Confidentiality was maintained throughout the study, with all personal information anonymized and stored securely.

Study subjects

We included all children aged three to twelve years with complete cleft lip and palate (CLP) who were referred from cleft centers, where orofacial cleft surgeries were performed, to the Department of Pediatric

and Preventive Dentistry during the study period (October 2021–September 2022). The institute provides free access to dental care for all. Study participants received both preventive and therapeutic dental treatments they needed. Dental treatments carried out in this department include fabrication of obturators, restorative, and orthodontic treatments and teeth extraction. In order to participate in the research, children had to have undergone surgical intervention for cleft lip and palate (CLP) and be free from systemic diseases. Individuals with solely a cleft lip, undergoing orthodontic treatment, having related syndromes, other craniofacial abnormalities or dentofacial deformities were excluded. A total of 127 children aged 3–12 years with cleft lip and palate were selected. We gathered information on cleft types and the age of the patients from these records. According to age children with CLP were further categorized into two groups: the primary dentition group (3–5 years) and the mixed dentition group (6–12 years). Based on orofacial cleft, children were further grouped into unilateral cleft lip and palate (UCLP), bilateral cleft lip and palate (BCLP), and cleft palate (CP).

We randomly selected 149 healthy children aged 3–12 years without clefts from two local kindergartens and two primary schools situated in Kolkata. Among them, 141 children agreed to participate. These controls, matched for age and sex, shared the same ethnicity and socioeconomic characteristics as the children with CLP. The non-cleft individuals were further divided into two age groups: 3–5 years (62 children) and 6–12 years (79 children).

Clinical examination

Two experienced pedodontists examined all participants, including 20 children (10 with clefts and 10 without) before the main study. The two examiners showed good agreement (kappa scores of 0.89 for deft and 0.91 for DMFT) in assessing teeth with cavities. We recorded dental caries using the decayed (dt/DT), extracted due to caries (et) in case of primary teeth, missed teeth (MT) in case of permanent teeth, and filled teeth (ft/FT) index based on modified WHO criteria (1997). Uppercase letters signify the permanent dentition (DMFT), and lowercase letters (deft) represent primary teeth. Only missing teeth due to caries were recorded; congenitally missing or lost teeth due to other reasons, such as trauma, were not considered. Similarly, only fillings for carious teeth were recorded. Restorations of enamel hypoplasia or hypomineralized teeth were not considered. Details on tooth extraction and filled teeth were gathered from discussions with parents or caregivers

Before the examination, all participants were asked to brush their teeth. The clinical examinations, conducted at the Department of Pediatric and Preventive Dentistry of Dr. R Ahmed Dental College and Hospital, involved using a mouth mirror and a probe while the participant remained seated in a dental chair. Teeth were dried using compressed air. No X-rays were taken.

Questionnaires

A structured questionnaire was designed to obtain data, including the place of residence, the number of siblings, method of tooth cleaning, use of fluoride toothpaste, frequency of brushing, and previous dental visits. The questionnaire was filled out by the parents at home and collected after the clinical examination by another investigator who did not participate in the clinical examination.

Statistical analysis

Data were analyzed using the software Epi Info version 7.2 (CDC, Atlanta, USA) with a 95% confidence interval for all tests. Descriptive and inferential statistics were performed to analyze the data. The t-test, Chi-square test, and Fisher's exact test were used to analyze any significant differences between the cleft and non-cleft population. ANOVA test was employed to compare the mean caries score (deft/DMFT) of cleft subgroups. Associated social and behavioral factors such as place of residence, number of siblings, method of tooth cleaning, use of fluoride toothpaste, frequency of brushing, and previous dental visits was assessed using Chi-square tests. Binary logistic regression analysis adjusted by age and sex was used in this study. Odds ratios (ORs) and 95% confidence intervals (CIs) were calculated from the model. All statistical tests were two-tailed, and the level of significance was set at 0.05.

Results

The mean age of children with cleft lip and palate was found to be 6.52 ± 2.72 years. Initially, 134 children with CLP were selected who met the inclusion and exclusion criteria. However, seven children were excluded due to insufficient data in their medical records, resulting in a final sample size of 127 subjects. Among the cleft population, the caries experience (deft>0) was 63.8% (81/127) in primary dentition, whereas the caries experience (deft>0) was 40.4% (57/141) in the non-cleft population. Similarly, 55.6% (40/72) of the CLP group and 40.5% (32/79) of non-CLP children showed caries experience (DMFT>0) in their permanent teeth.

Table 1. Distribution of CLP according to age, gender, and cleft types and control group*

Age group	BCLP (n=45)		UCLP (n=38)		CP (n=44)		Cleft group (n=127)			Control group (n=141)		
	M	F	M	F	M	F	M	F	Total	M	F	Total
3-5 years (N=55)	8	13	10	9	6	9	24	31	55	29	33	62
6-12 years (n=72)	14	10	10	9	8	21	32	40	72	35	44	79

Total	22	23	20	18	14	30	56	71	127	64	77	141
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* n – number, M – male, F – female, BCLP – bilateral cleft lip and palate, UCLP – unilateral cleft lip and palate, CP – cleft palate

Table 1 shows the distribution of CLP According to age, gender, and cleft types. Among the CLP group, 44.1% were boys, 55.9% were girls, with no significant gender difference in caries experience.

Table 2. Caries status of children with CLP according to gender*

	Male	Female	p
deft=0	20 (35.7%)	26 (36.6%)	>0.999
deft>0	36 (64.3%)	45 (63.4%)	
DMFT=0	12 (37.5%)	20 (50%)	0.34
DMFT>0	20 (62.5%)	20 (50%)	
Mean DMFT	2.65±2.82	2.17±2.75	0.46

* deft – decayed extracted and filled primary teeth, DMFT – decayed missing filled permanent teeth

The analysis of caries status in children with CLP based on gender is shown in Table 2 and it reveals no significant differences in both primary and permanent teeth, suggesting that gender may not be a prominent factor influencing caries experience among children with CLP.

Table 3. Caries experience in children with CLP according to cleft types^a

Cleft type	BCLP	UCLP	CP	p
Number (%)	45 (35.4%)	38 (29.9%)	44 (34.6%)	
deft=0	17 (37.8%)	11 (28.9%)	18 (40.9%)	0.51 [#]
deft>0	28 (62.2%)	27 (71.1%)	26 (59.1%)	
DMFT=0	10 (41.7%)	6 (31.6%)	16 (76.2%)	0.01 [#]
DMFT>0	14 (58.3%)	13 (68.4%)	5 (23.8%)	
Mean deft	3.4±3.37	3.21±3.04	3.27±3.252	0.809 [*]
Mean DMFT	2.25±2.54	3.78±3.32	1.58±2.26	0.001 [*]

^a * – ANOVA test, # – Chi square test, deft – decayed extracted and filled primary teeth, DMFT – decayed missing filled permanent teeth, BCLP – bilateral cleft lip and palate, UCLP – unilateral cleft lip and palate, CP – cleft palate

Table 3 presents the caries experience in children with CLP based on different types of clefts: bilateral cleft lip and palate (BCLP), unilateral cleft lip and palate (UCLP), and cleft palate only (CP). There is no

statistically significant difference in the prevalence of caries among the cleft types ($p=0.51$ for deft and $p=0.01$ for DMFT). The ANOVA test results indicate that there is no statistically significant difference in mean deft scores among the cleft types ($p=0.809$). However, there is a significant difference in mean DMFT scores among the cleft types ($p=0.001$). It is possible that the limited number of children within each cleft group may have contributed to this outcome.

Table 4. Mean caries indices according to age group in children with and without CLP*

Age group	Caries experience	CLP		Without CLP		p
		Mean	SD	Mean	SD	
3–5 years	dt	2.50	2.79	1.45	1.85	0.01
	et	0.2	0.62	0.33	0.69	0.28
	ft	0.09	0.34	0.27	0.72	0.09
	deft	2.8	3.17	2.04	2.51	0.15
6–12 years	dt	3.34	2.95	1.03	1.87	<0.0001
	et	0.30	0.74	0.13	0.38	0.07
	ft	0.08	0.32	0.13	0.47	0.45
	deft	3.68	3.21	1.30	2.23	<0.0001
	DT	1.91	2.44	1.25	1.97	0.06
	MT	0.25	0.57	0.14	0.38	0.16
	FT	0.22	0.56	0.08	0.28	0.05
	DMFT	2.38	2.77	1.46	2.19	0.02
3–12 years	dt	2.98	2.90	1.22	1.87	<0.0001
	et	0.26	0.69	0.23	0.55	0.69
	ft	0.08	0.33	0.20	0.60	0.04
	deft	3.30	3.21	1.63	2.38	<0.0001

* CLP – cleft lip and palate, dt – decayed primary teeth, et – extracted primary teeth due to caries, ft – filled primary teeth, DT – decayed permanent teeth, MT – missing permanent teeth, FT –filled permanent teeth

Table 4 presents an evaluation of caries experience in primary and permanent teeth for CLP and non-CLP groups. No significant difference was found in mean deft values for 3-to-5-year-old CLP and control groups. However, significant differences were observed in the decayed component (dt) for both age groups, with higher values in CLP children. Mean deft for 6–12 years was significantly higher in CLP (3.30) vs. non-CLP (1.63), whereas mean DMFT did not differ significantly (2.38 vs. 1.46; $p=0.02$).

Table 5. Relationship between cleft status and associated factors*

Variables		CLP	Non-CLP	p
Age (mean±SD)	3–5 years	4.02±0.79	4.20±0.87	0.24
	6–12 years	8.44±2.04	8.40±1.95	0.90
	3–12 years	6.52±2.72	6.56±2.60	0.90
deft=0		46 (36.2%)	84 (59.6%)	<0.001
deft>0		81 (63.8%)	57 (40.4%)	
DMFT=0		32 (44.4%)	47 (59.5%)	0.07
DMFT>0		40 (55.6%)	32 (40.5%)	
Residency	Rural	61 (48.03%)	72 (51.1%)	0.62
	Urban	66 (51.97%)	69 (48.9%)	
Number of siblings	one	49 (38.6%)	71 (50.4%)	0.06
	More than one	78 (61.4%)	70 (49.7%)	
Use of fluoride toothpaste	Yes	127 (100%)	141 (100%)	
	No	0 (0%)	0 (0%)	
Method of tooth cleaning	Toothpaste and brush	127 (100%)	141(100%)	0.004
	Finger	0 (0%)	0 (0%)	
Brushing	Once	84 (70%)	108 (76.6%)	0.26
	More than once	36 (30%)	33 (23.4%)	
Previous dental visit	Yes	59 (46.4%)	65 (46.1%)	0.33
	No	68 (53.6%)	96 (53.9%)	

* CLP – cleft lip and palate, deft – decayed, extracted and filled primary teeth, DMFT – decayed, missing and filled permanent teeth

Table 5 indicates a significantly higher prevalence of caries in primary dentition for CLP children (63.8%) compared to non-CLP (40.4%). Although caries experience in the 6–12 age group with CLP was higher than the 3–5 age group, this difference was not statistically significant ($p=0.12$). Permanent teeth did not show significant differences between CLP and non-CLP groups ($p=0.07$).

Table 6. Proportion (%) of children with CLP who are free of caries ($\text{deft}+\text{DMFT}=0$) and with caries present ($\text{deft}+\text{DMFT}>0$) according to their age group, sex, social and behavioral factors, total number of children=127

Characteristics		Caries	Caries free	p
		present n=92	n=35	
Age	3–5 years	31 (56.4%)	24 (43.6%)	<0.001
	6–12 years	61 (84.7%)	11 (15.3%)	
Sex	Male	41 (73.2%)	15 (26.8%)	>0.999
	Female	51 (71.8%)	20 (28.2%)	
Place of residence	Rural	45 (73.8%)	16 (26.2%)	0.90
	Urban	47 (71.2%)	19 (28.8%)	
No of siblings	One	32 (65.3%)	17 (34.7%)	0.22
	More than one	60 (76.9%)	18 (23.1%)	
Brushing	Once-daily	68 (71.6%)	27 (28.4%)	0.88
	Twice or more	24 (75%)	8 (25%)	
Previous dental visits	Yes	56 (71.8%)	22 (28.2%)	0.21
	No	58 (81.7%)	13 (18.3%)	

Logistic regression revealed a significant increase in caries experience with age in individuals with CLP ($p < 0.001$, OR 0.66), but no significant differences in residence, siblings, or brushing frequency between CLP and non-CLP children (Table 6).

Discussion

This observational study assessed caries experience in both primary and permanent teeth of 3- to 12-year-old children with CLP, considering factors such as age, gender, and types of clefts. The results were compared with those of an age- and sex-matched non-cleft control population. The cleft populations in this study were drawn from government-run hospitals where treatments are provided free of charge. To ensure homogeneity in ethnicity and socioeconomic conditions among the study samples, non-cleft populations were selected from schools located in the same geographic area as the hospital, where free education is provided.

Examining caries prevalence in the context of the country where the children live is important. Socioeconomic and cultural factors, as well as variations in healthcare systems, can significantly influence oral health outcomes. Overall caries experience in this study in the non-cleft population was found to be 40.4% which is comparable with the findings of a meta-analysis and a recent Indian study carried out on 5- to 12-year-old school-going children of Chandigarh.^{15,16} In this study, children with CLP exhibited higher caries experience, consistent with the findings of numerous previous studies, systematic reviews, and meta-analyses.^{1,2,4,13,17,18} Among the cleft population, 63.8% of children showed caries experience in their primary teeth, a finding comparable to that of Kamble et al.¹⁹

A significant difference in the dt of the deft score between children with CLP and controls suggests that children with CLP may have a higher prevalence of untreated decayed teeth compared to the control group. The low values of missing and filled components in the deft/DMFT score in the CLP group may be a result of parents or caregivers prioritizing cleft surgeries over dental treatments.

Although the exact cause is not known, possible explanations for higher caries experience in children with CLP include poor oral hygiene, increased oral clearance time, malposition of teeth and presence of dental anomalies, and possible scarring acting as plaque retaining area. The higher occurrence of malocclusion and orthodontic treatment in children with CLP may introduce bias in studies that compares outcomes with controls. Therefore, children undergoing orthodontic treatment were excluded in the current study. In addition, maintaining oral hygiene in CLP patients with obturators is challenging due to increased plaque retention. This can lead to changes in plaque composition, with a rise in cariogenic bacteria like *Streptococcus* and *Lactobacillus*, exacerbating the risk of dental caries.^{3,14}

Among the children with CLP, no correlation was observed between caries experience and gender, implying that gender might not play a primary role in determining caries prevalence among children with CLP. Similar result was observed in other studies.²²

In the 3–5 years age group, there was no significant difference in deft score between cleft and control participants which is consistent with the finding of Zhu et al.⁸ However, in the 6- to 12-year-old group, a significant difference in caries experience was observed possibly attributed to the cumulative increase in deft scores in CLP group with age. Tũaño-Cabrera et al. suggested that children under 6 years brush under parental supervision, while those aged 6-12 years usually brush independently.²³ Lack of supervision, coupled with malocclusions and limited access post-surgery in cleft areas, may contribute to higher caries incidence.²³

Antonarakis et al., in a meta-analysis of five studies, found a mean difference of 1.38 in DMF teeth between individuals with CLP and controls.¹ Another meta-analysis indicated a pooled mean difference in DMFT of 0.28, higher in permanent dentition than mixed dentition.¹³ The present survey provides weak evidence ($p=0.02$) for higher caries experience (DMFT) in children with CLP compared to non-cleft controls, which is consistent with the observations of Tannure et al., Lucas et al. and Freitas et al.^{11,12,18} These studies found no significant DMFT score differences between children with CLP and non-CLP individuals.

Various factors like sample size, cleft types, location, food habits, socio-economic conditions, and oral hygiene practices can influence caries rates. Many studies treat all children with CLP uniformly, limiting exploration of specific correlations between cleft types and caries. The current study classified individuals according to different types of cleft conditions and found no significant difference in the prevalence of dental caries. These results are consistent with previous studies of Chopra et al., Xiao et al., and Allam et al., but not with the findings of Sunderji et al., Zhu et al., Howe et al., and Gupta et al.^{7,8,17,24-27} It is possible that the limited number of children within each cleft group may have contributed to this outcome.

Previous studies suggest a link between caries experience and oral hygiene practices. In CLP individuals, factors like scar tissue, bleeding, poorly aligned teeth, and cleft anatomy may contribute to reluctance in tooth brushing. However, the present study found no significant difference in brushing frequency between individuals with CLP and the non-cleft control group. The current study also explored the impact of residence, number of siblings, person responsible for tooth cleaning, use of fluoride toothpaste, brushing frequency, and previous dental visits on caries occurrence in children with CLP. No significant association was found between these social and behavioural factors and caries experience. This could be attributed to the problem-centric approach to seeking dental care among the study participants. Bian et al. and Ankola et al., also reported no relationship between brushing frequency and caries experience.^{28,29}

This study has a few limitations. The study's the omission of dietary factors, a smaller sample size, a unicentric design, and the evaluation of only one ethnic group are some of the limitations. In addition, caries experience should be assessed radiographically. We did not take radiographs for caries detection in this prospective study. For ethical reasons, participants did not undergo radiographic evaluation solely for survey purposes. Educational background and family income are known to influence a child's caries experience. Since the participants in this study were selected from the same socioeconomic condition, family income and caregiver's education were not considered separately. Nevertheless, the sample sizes of the CLP and non-CLP groups were matched in the current study, which we consider a strength of this study.

The observational study on children with CLP suggests that these individuals exhibit significantly higher caries experience in primary teeth, emphasizing the importance of oral health interventions. Further research is required to explore sociodemographic and dietary factors that may influence caries risk in this population, potentially informing more comprehensive treatment approaches and improving long-term oral health outcomes for children with CLP.

Conclusion

The following conclusions can be drawn from the findings of this study: Patients with CLP had significantly higher caries experience in the primary dentition. However, no significant difference in DMFT scores for permanent teeth was noted between cases and controls. When we compared caries experience among cleft types, the mean deft scores of BCLP, UCLP, and CP groups did not differ significantly. By contrast, we observed a significant ($p=0.01$) difference in caries prevalence as well as mean DMFT value ($p=0.001$) in the permanent dentition among different cleft groups. Caries experiences increase significantly with age in individuals with CLP.

Declarations

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Author contributions

Conceptualization, S.M. and P.M.; Methodology, S.M.; Software, S.M.; Validation, P.M.; Formal Analysis, P.M.; Investigation, S.M.; Resources, S.M.; Data Curation, S.M.; Writing – Original Draft Preparation, S.M.; Writing – Review & Editing, S.M., P.M.; Visualization, S.M.; Supervision, P.M.; Project Administration, S.M.; Funding Acquisition, P.M.

Conflicts of interest

The authors declare no competing interests.

Data availability

Data analyzed during the present study and/or are available from the corresponding author upon request.

Ethics approval

The present study was prospectively conducted in a pediatric population between October 2022 and January 2023 after obtaining approval from the Ethics Committee of Dr R Ahmed Dental College and Hospital, Kolkata (IEC/DCH/089 dated 12/7/2021).

Declaration of Generative AI and AI-assisted technologies in English language and grammar editing

During the preparation of this work the author used OpenAI/ ChatGPT in order to check grammar and spelling. After using this tool/service, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

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