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Pattern and surface prevalence of dental caries in posterior teeth among children at a Bihar teaching hospital in India

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Abstract:
Dental caries remains a major public-health problem in children and its distribution by tooth type and surface can guide targeted preventive care. Therefore, it is of interest to assess the pattern and surface prevalence of dental caries in posterior teeth among 506 children aged 5–12 years at a Bihar teaching hospital. Caries was present in 74.1% of children in the primary dentition and 25.1% in the permanent dentition. Primary-dentition caries was significantly higher among children aged 5–8 years (89.0%), whereas permanent-dentition caries was significantly higher among those aged 9–12 years (48.9%; both $p < 0.001$). No statistically significant gender difference was observed in either dentition. Mandibular primary molars were most affected, with the distal (72.7%) and occlusal (66.1%) surfaces showing the highest caries involvement. In posterior permanent teeth, the occlusal surface was most frequently affected (94.6%), followed by distal (15.0%) and mesial (14.4%) surfaces. Thus, data support age- and surface-specific prevention, including pit-and-fissure sealants, fluoride-based care and bitewing radiography for proximal caries detection.

Keywords: Dental caries, posterior teeth, surface prevalence, primary molars, permanent molars, DMFT

Background:
Dental caries is a chronic, progressive and multifactorial disease, characterized by the demineralization of the hard tissues of the teeth caused by acids through bacterial fermentation of dietary carbohydrates. The high incidence of dental caries, the negative impact on the quality of life and the costs associated with treatment make it a major global health burden according to the World Health Organization (WHO) **[1].** A hospital-based study in Ethiopia reported dental caries in 64.6% of dental-clinic attendees and found associations with infrequent toothbrushing, sugary-food consumption, lower income and poor oral hygiene **[2]**. Due to their less mineralized enamel, children are more likely to develop dental caries, particularly during the eruption period. Additionally, children are not particularly interested in practicing good oral hygiene **[3].** Dental caries is a localized disease process of teeth caused by the interaction of an azidogenic, microbial dysbiotic biofilm and certain food components, in particular low-molecular carbohydrates **[4, 5].** The frequency and progression of carious lesions were more affected by infrequent brushing in deciduous dentition than in permanent dentition **[6].** Preventive approaches to oral health diseases, mainly dental caries, require individual and collective policies. Major preventive measures are pit and fissure sealants, fluoride varnish application; school based oral health programs and behavior modification strategies **[7-9].** Contemporary caries management emphasizes risk-based prevention, early detection and minimally invasive treatment to preserve healthy tooth structure **[10].** Therefore, it is of interest to evaluate the knowledge of local disease patterns but also for the improvement of preventive pediatric dental services, academic training and the formulation of oral health policy in a given region.

Methods:
Objective of this cross-sectional study was conducted in a hospital setting with the aim to determine the distribution pattern and surface involvement of dental caries in posterior teeth of children. The study was conducted in the Department of Pediatric and Preventive Dentistry, Mithila Minority Dental College and Hospital, Darbhanga, Bihar, a tertiary level educational institute catering to urban and rural pediatric patients. Inclusion criteria included children attending for the first time during the study period and aged five to twelve years. This age group is referred to as the mixed dentition period and is characterized by increased susceptibility to caries of posterior teeth.

Sample size:
A total sample of 506 children was estimated based on previous prevalence estimates and feasibility considerations. Participants meeting the eligibility criteria were successively enrolled until the desired sample size was reached.

Sampling method:
All eligible children who presented throughout the study period were included one after the other using a successive sampling technique.

Inclusion criteria:
[1] Children aged 5–12 years
[2] Presence of primary or permanent posterior teeth
[3] Informed consent obtained from parent/guardian

Exclusion criteria:
[1] Teeth absent due to physiological exfoliation
[2] Systemic conditions affecting tooth structure or eruption
[3] Special healthcare needs limiting examination
[4] Uncooperative behavior preventing reliable assessment

Institutional ethical clearance:

The Institutional Ethics Committee of Mithila Minority Dental College and Hospital in Darbhanga, Bihar, India, granted ethical approval (EC/NEW/INST/2023/4152). Parents and guardians provided written informed consent.

Clinical examination:
Children were examined under adequate illumination using a mouth mirror and CPI probe. All posterior teeth (molars and premolars) were assessed systematically for caries on all surfaces of teeth. The WHO diagnostic criteria were used to detect caries. Caries-related tooth restorations were noted as filled. Teeth pulled because of caries were noted as missing as long as the patient's medical history supported the diagnosis.

Radiographic assessment:
Bitewing radiographs were obtained where indicated to identify proximal lesions not clinically evident. Standardized exposure settings and protective measures were followed.

Data recording:
Data were entered into a structured proforma documenting:
[1] Age
[2] Gender
[3] Tooth type
[4] Surface-wise involvement

Statistical analysis:
Microsoft Excel was used to enter the data and SPSS software (version 26) was used for analysis. The following descriptive statistics were employed: mean standard deviation, frequency, percentage, Chi-square, Fisher's exact and Mann-Whitney U tests

Results:
The study comprised 506 children between the ages of 5 and 12. Mean age of the study population was 8.35 years (S.D. = 2.28). According to age-wise analysis, 233 children (46%) were in the 9–12 age group and 273 children (54%) were in the 5–8 age group. Of the 506 children, 311 (61.5%) were males and 195 (38.5%) were females. In both age categories, the proportion of men to women was comparable. Dental caries in the primary teeth was present in 74.1% of the children. The 5–8 age groups had a higher prevalence (89.0%) than the 9–12 age groups (56.7%). The difference between the age groups was tested using the chi-square test and the results showed that it was highly statistically significant (p-value < 0.001). The prevalence of dental caries in permanent teeth was significantly higher among children aged 9–12 years (48.9%) compared to those aged 5–8 years (4.8%). The association between age and caries occurrence was found to be highly statistically significant (p < 0.001). Amongst those with dental caries, prevalence was higher among boys (66.4%) compared to girls (33.6%). However, this gender difference was not statistically significant (p= 0.176). The prevalence of dental caries in permanent teeth was higher among males (27.7%) compared to females (21.0%). However, the difference was not statistically significant (p = 0.094) **(Table 1).** The study population (n=506) had a mean DMFT of 2.1 ± 1.98 in the primary dentition. There were an average of 1.8 ± 1.76 decaying teeth, 0.1 ± 0.38 missing teeth and 0.1 ± 0.49 filled teeth. The 5–8 age group had a larger mean number of decaying teeth (2.5 ± 1.8) than the 9–12 age group (mean d = 1.09 ± 1.2). This difference was statistically significant (p-value <0.001). In a similar vein, a higher mean was found for 5–8 years old compared to 9–12 years old for the mean number of missing teeth, filled teeth and mean DMFT. Additionally, there was a statistically significant difference between the age groups in the mean number of missing teeth and mean DMFT (p-values = 0.015 and <0.001, respectively). Nevertheless, there was no statistically significant difference in the number of filled teeth (p-value = 0.268). The study population (n=506) had a mean DMFT of 2.1 ± 1.98 in the primary dentition. On average, there were 0.1 ± 0.38 missing teeth, 0.1 ± 0.49 filled teeth and 1.8 ± 1.76 rotting teeth. The 5–8 age group had a larger mean number of decaying teeth (2.5 ± 1.8) than the 9–12 age group (mean d = 1.09 ± 1.2). This difference was statistically significant (p-value <0.001). In the same way, a higher mean was found for 5–8 years old compared to 9–12 years old for the mean number of missing teeth, filled teeth and mean DMFT. Additionally, there was a statistically significant difference between the age groups in the mean number of missing teeth and mean DMFT (p-values = 0.015 and <0.001, respectively). Nevertheless, there was no statistically significant difference in the number of filled teeth (p-value = 0.268). The majority of the DMFT (74.1%) was made up of the decayed component, which was followed by the filled component (5.9%) and missing component (7.3%). While there was no statistically significant difference in the filled component (p = 0.347), the decaying and missing components of DMFT were considerably greater among children aged 5–8 years compared to 9–12 years (p < 0.001 and p = 0.017, respectively). The younger age group had a considerably greater total DMFT (p < 0.001). The most significant percentage of the DMFT (25.1%) was made up of the decayed component, which was followed by the filled (1.4%) and missing (1.6%) components. Compared to children aged 5–8 years, children aged 9–12 years had a significantly greater prevalence of decaying, missing and filled permanent teeth (p < 0.05). Additionally, the older age group's overall DMFT score was considerably higher (p < 0.001), suggesting that permanent dental caries experience increases with age **(Table 2 and Figure 1)**. The posterior primary teeth assessed for surface caries were tooth numbers 54, 55, 64, 65, 74, 75, 84 and 85. 728 posterior primary teeth were found carious. The teeth most affected were the lower primary molars on both sides, lower right first primary molars having highest number of carious teeth (135), followed by lower right second primary molars (134), lower left first primary molars (117) and lower left second primary molars (109). In contrast, the upper right and left primary molars showed comparatively lower caries counts. Among all surfaces, the distal surface (n = 529, 72.67%) showed the highest prevalence of caries, followed by the occlusal surface (n = 481, 66.07%). The mesial surface (n = 193, 26.51%) demonstrated comparatively lower involvement, while the buccal (n = 110, 15.11%) and lingual surfaces (n = 112, 15.38%)

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exhibited the least caries prevalence. Occlusal and proximal (especially distal) surfaces were predominantly affected across almost all molars, suggesting greater susceptibility of pit and fissure areas and contact surfaces to carious involvement. Overall, the findings indicate that primary molars, particularly lower molars and their distal and occlusal surfaces are the most vulnerable sites for dental caries in the primary dentition. The posterior permanent teeth assessed for surface caries were tooth numbers 16, 17, 26, 27, 36, 37 46 and 47. A total of 167 posterior permanent teeth were found carious. In permanent dentition, the occlusal surface showed the highest caries involvement (158, 94.61%), indicating a strong predilection for pit and fissure caries. Proximal surfaces showed comparatively lower involvement (distal – 25, 14.97%, mesial – 24, 14.37%), while buccal and lingual surfaces exhibited minimal caries prevalence (4.79% each) **(Table 3 and Figure 2).**

Table 1: Demographic characteristics and prevalence of dental caries by age and gender

Variable	Total (n=506)	Caries in Primary Dentition n (%)	Caries in Permanent Dentition n (%)	p-value
Age 5–8 years	273 (54.0%)	243 (89.0%)	13 (4.8%)	<0.001
Age 9–12 years	233 (46.0%)	132 (56.7%)	114 (48.9%)	<0.001
Male	311 (61.5%)	224 (72.0%)	86 (27.7%)	0.176, 0.094
Female	195 (38.5%)	151 (77.4%)	41 (21.0%)	NS

Table 2: Mean caries experience (DMFT/DMFT) according to age

Variable	5–8 years	9–12 years	p-value
Mean d	2.50 ± 1.80	1.09 ± 1.20	<0.001
Mean m	0.13 ±0.46	0.05 ±0.23	0.015
Mean f	0.14 ±0.59	0.07 ±0.32	0.268
Mean DMFT	2.10 ±0.12	1.40 ±0.09	<0.001
Mean D	0.07 ±0.39	0.69 ±0.83	<0.001
Mean M	0.00	0.03 ±0.18	0.002
Mean F	0.00	0.03 ±0.17	0.004
Mean DMFT	0.05 ±0.25	0.76 ±0.90	<0.001

Table 3: Distribution of caries according to tooth surface

Dentition	Carious teeth	Occlusal n (%)	Mesial n (%)	Distal n (%)	Buccal n (%)	Lingual n (%)
Primary	728	481 (66.1)	193 (26.5)	529 (72.7)	110 (15.1)	112 (15.4)
Permanent	167	158 (94.6)	24 (14.4)	25 (15.0)	8 (4.8)	8 (4.8

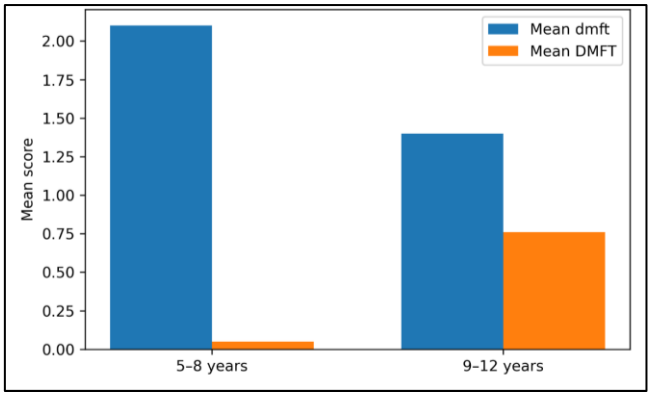


Figure 1: Mean DMFT and DMFT by age

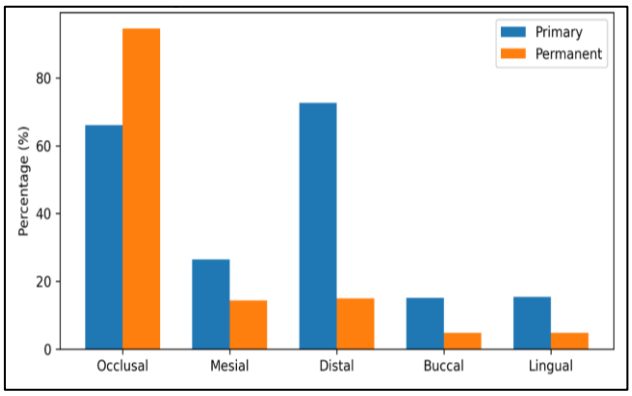


Figure 2: Surface-wise distribution of dental caries

Discussion:

The goal of the current hospital-based cross-sectional study was to evaluate the surface prevalence and pattern of dental caries in the posterior teeth of children attending a teaching hospital in Bihar between the ages of 5 and 12. The results of this investigation are examined. The average age of the 506 children participated in this study was 8.35 ± 2.28 years. 54% of the kids were in the 5–8 age range. This distribution is comparable to the hospital-based studies conducted by Popoola and Denloye (2009) **[11]** and Eigbobo and Etim (2015) **[12]** where the majority of children attending pediatric dental clinics were within the mixed dentition age group. The predominance of younger children in hospital settings may be attributed to increased parental awareness during early school years and symptomatic presentation of caries in primary molars. In the present study, dental caries in primary teeth was significantly higher in children aged 5–8 years (89%) compared to 9–12 years (56.7%) (P< 0.001). This finding is in agreement with Srivastava (2020) **[3]** who reported higher caries prevalence in preschool and early school children. Similarly, Manepalli and Nuvvula (2020) **[13]** observed greater susceptibility of primary molars in younger age groups. Thakur and Mohan (2021) **[14]** also reported a 56.6% prevalence of early childhood caries in 3–6-year-old children. The higher prevalence in younger children may be attributed to thin enamel, inadequate oral hygiene practices, frequent sugar exposure and poor parental supervision during early childhood.

The prevalence of permanent tooth caries was significantly higher in 9–12 year old children (48.9%) compared to 5–8 year olds (4.8%) ($p < 0.001$). This pattern is consistent with Pitts (1994) **[15]**, who emphasized increased caries risk soon after eruption of permanent molars. Broadbent *et al.* (2008) **[16]** showed a marked increase in caries incidence during the mixed dentition period. Chankanka *et al.* (2011) **[17]** also reported increased caries prevalence in permanent molars among older children. The increased prevalence in older children may be explained by post-eruptive enamel maturation, pit and fissure morphology and increased independence in dietary habits. Although males showed slightly higher caries prevalence, the difference was not statistically significant. Eigbobo and Etim (2015) **[11]** reported similar findings with no significant gender difference. Bagramian *et al.* (2009) **[18]** also suggested that behavioral and environmental factors play a more significant role than gender in caries development. The mean DMFT was 2.1 ± 1.98, with the decayed component forming the major portion. This finding is comparable with Goenka *et al.* (2018) **[19]** from Bihar, who reported high untreated caries burden among children. Pandey *et al.* (2021) **[20]** similarly reported that the decayed component dominated the DMFT index. The predominance of untreated decay reflects delayed dental visits and inadequate restorative care. The mean DMFT (0.4 ± 0.73) was significantly higher in 9–12 year old children. This aligns with Khan *et al.* (2021) **[21]** who reported increasing DMFT scores with age in hospital-based pediatric populations. The present study revealed highest caries prevalence on distal surfaces (72.67%), followed by occlusal surfaces (66.07%). Popoola and Denloye (2009) **[11]** reported high occlusal caries prevalence in primary molars, while Eigbobo and Etim (2015) **[12]** reported significant proximal surface involvement. The higher distal surface involvement in the present study may be due to broad contact areas and difficulty in cleaning interproximal surfaces. These findings emphasize the importance of bitewing radiographs for early proximal caries detection. In permanent molars, occlusal surfaces showed the highest caries prevalence (94.61%). This strongly agrees with Carvalho (1983) **[22]**, who reported that occlusal pits and fissures account for the majority of caries in children. Ferro *et al.* (2009) **[23]** also found occlusal surfaces to be the most susceptible sites in mixed dentition children. The high susceptibility of occlusal surfaces may be attributed to deep fissure anatomy and plaque retention. The lower primary molars (especially 84 and 85) were most affected. Similarly, mandibular permanent molars (36 and 46) showed higher caries prevalence. This is consistent with Thakur and Mohan *et al.* **[14]**, Chankanka *et al.* (2011) **[17]**. Mandibular molars are more susceptible due to early eruption, deep fissure morphology and greater plaque retention. The present findings closely resemble Popoola and Denloye (2009) **[11]** (Nigerian teaching hospital study), Goenka *et al.* **[19]** (Bihar study). Both studies emphasized high posterior tooth involvement, predominance of occlusal and proximal surfaces and need for radiographic screening. Thus, the present study reinforces global and national patterns while providing region-specific data for Bihar, where limited surface-wise studies exist. The findings suggest that Posterior teeth, particularly molars, are highly susceptible. Distal surfaces in primary molars require special attention. Occlusal surfaces in permanent molars need early sealant therapy. Bitewing radiographs are essential for proximal caries detection. Preventive strategies must begin before eruption of permanent molars. The hospital-based, cross-sectional design limits the generalizability of the findings, does not permit assessment of disease progression and did not evaluate important factors such as socioeconomic status and dietary habits.

Conclusion:

Dental caries was highly prevalent among children aged 5–12 years, particularly in posterior teeth, with prevalence of 74.1% in primary dentition and 25.1% in permanent dentition, showing an age-related shift during the mixed dentition period. Mandibular molars and proximal surfaces were predominantly affected, while the high decayed component highlights the burden of untreated caries and the importance of bitewing radiography for early detection. Thus, data support focused preventive strategies, including pit-and-fissure sealants, routine assessment of proximal caries and strengthened pediatric oral health programs in Bihar.

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