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Original Research Article

Dental Caries and Its Association with Recurrent Upper Respiratory Tract Infections in Children: An Observational Cross-Sectional Study

Pushkar Singh Parihar[1], Niharika Singh[2]

[1]MD (Paediatrics), Department of Paediatrics, Shyam Shah Medical College, Rewa, Madhya Pradesh Medical Science University (MPMSU), Jabalpur, Madhya Pradesh, India

[2]MDS (Conservative & Endodontics), Department of Dentistry, Shyam Shah Medical College, Rewa, Madhya Pradesh Medical Science University (MPMSU), Jabalpur, Madhya Pradesh, India

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Corresponding Author: Dr. Pushkar Singh Parihar

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Abstract:

Background: Dental caries is the most prevalent chronic infectious disease of childhood, affecting oral health and possibly contributing to systemic conditions including recurrent upper respiratory tract infections (URTI). Few studies from Central India have explored this association.

Objectives: To determine the prevalence of dental caries in children aged 3–12 years attending a tertiary care hospital in Rewa, Madhya Pradesh, and to investigate its association with the frequency of recurrent URTI.

Methods: A hospital-based observational cross-sectional study was conducted at Shyam Shah Medical College & SGM Hospital, Rewa, from July 2023 to June 2024. A total of 312 children (age 3–12 years) were enrolled. Dental caries was assessed using the WHO DMFT/dmft index. URTI episodes were recorded from medical records and parental history. Logistic regression was used to assess association.

Results: Dental caries prevalence was 63.5% (n=198). Mean dmft in primary dentition was 5.07 ± 2.61. Children with ≥6 URTI episodes/year had significantly higher caries prevalence (87.1%) compared to those with 0–2 episodes/year (42.9%; p<0.001). On multivariate logistic regression, frequent URTI (≥6/year) was independently associated with dental caries (aOR 6.72; 95% CI: 2.91–15.5; p<0.001), after adjusting for age, sex, socioeconomic status, and oral hygiene.

Conclusions: A strong and independent association exists between dental caries and recurrent URTI in children. Integrated pediatric-dental screening programs and oral health promotion should be prioritized in tertiary care settings in Central India.

Keywords: Dental caries; DMFT index; Upper respiratory tract infection; Children; Cross-sectional study; Central India; Oral health; Paediatrics.

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Introduction

Dental caries remains the single most prevalent chronic disease of childhood globally and disproportionately affects children in low- and middle-income countries (LMICs).[1] The World Health Organization (WHO) estimates that 60–90% of school-aged children worldwide experience dental caries, with the burden particularly high in South-East Asia.[2]

In India, reported prevalence of dental caries in children aged 5–12 years ranges from 52% to 78% depending on region, age group, and socioeconomic strata. [3,4] Madhya Pradesh, a state with significant rural population, limited oral health infrastructure, and high rates of child undernutrition, represents an under-studied region where dental caries prevalence and its systemic implications remain inadequately characterized.

Upper respiratory tract infections (URTI) — encompassing pharyngitis, tonsillitis, otitis media, sinusitis, and the common cold are the most frequent acute illnesses in pediatric practice, responsible for the majority of antibiotic prescriptions in children.[5] Children experience on average 6–8 URTI episodes per year in early childhood. Recurrent URTI, defined as ≥6 episodes per year, significantly impacts quality of life, school absenteeism, and healthcare utilization.[6]

A biological plausibility for an oral-respiratory axis exists: pathogenic bacteria harbored in dental biofilm chiefly Streptococcus mutans, Streptococcus sobrinus, and anaerobic Gram-negative organisms may ascend to the nasopharyngeal and adenotonsillar tissue via direct contiguity, lymphatic drainage, or aspiration of oral secretions.[7,8] Dental caries-associated chronic inflammation may also prime mucosal immunity toward a pro-inflammatory phenotype, potentially increasing susceptibility to respiratory pathogens.[9]

Despite these mechanistic links, epidemiological evidence from Central India is sparse. Existing studies are predominantly urban, single-center, or do not adjust for socioeconomic confounders.[10] The present study was, therefore, undertaken with the following objectives:

(i) To determine the prevalence of dental caries among children aged 3–12 years attending a tertiary care hospital in Rewa district; (ii) to describe the distribution of URTI frequency in the same population; and (iii) to examine the association between dental caries and recurrent URTI adjusting for relevant confounders.

Materials and Methods

Study Design and Setting: A hospital-based, observational cross-sectional study was conducted at the Outpatient Departments of Paediatrics and Conservative Dentistry & Endodontics, Shyam Shah Medical College and S.G.M. Hospital, Rewa, Madhya Pradesh, India, from July 2023 to June 2024 (12 months).

Study Population and Sampling: Children aged 3–12 years attending the outpatient clinics were recruited by systematic random sampling (every 3rd eligible child). Inclusion criteria: children of both sexes, aged 3–12 years, accompanied by a parent or legal guardian, attending for routine illness or scheduled review. Exclusion criteria: children with chronic systemic illness (asthma, immunodeficiency, congenital heart disease), those on long-term antibiotics or inhaled steroids, and those whose guardian declined consent.

Sample Size Calculation: Based on an expected prevalence of dental caries of 65% (from prior regional data [3]) with 95% confidence, 5% margin of error, and 10% non-response rate, the minimum required sample was 286. We enrolled 312 participants to increase precision.

Data Collection Instruments: A structured, pretested, interviewer-administered questionnaire captured: sociodemographic details (age, sex, residence, parental occupation, modified Kuppuswamy scale for socioeconomic status [11]), dietary habits (frequency of sugar intake, breastfeeding duration), oral hygiene practices (toothbrushing frequency, use of fluoride toothpaste), and URTI history (number of doctor-diagnosed episodes in the preceding 12 months from medical records corroborated by parental recall).

Clinical Dental Examination: All clinical examinations were performed by a single trained and calibrated examiner (Dr. Niharika Singh, MDS) to minimise inter-examiner variability. Examination was conducted under natural light supplemented by a dental torch, using sterile mouth mirrors and CPI probes. Dental caries was recorded using the WHO 1997 diagnostic criteria:[12]

1. dmft index (decayed, missing, filled teeth) for children in the primary dentition phase (3–8 years).
2. DMFT index for children with permanent dentition (9–12 years, mixed/fully permanent).
3. The Significant Caries Index (SiC) was calculated for the highest-caries tertile.[13]

Oral hygiene was assessed using the Simplified Oral Hygiene Index (OHI-S) and categorised as good (0–1.2), fair (1.3–3.0), or poor (3.1–6.0).[14]

URTI Classification: URTI frequency was classified as: Low (0–2 episodes/year), Moderate (3–5 episodes/year), and High (≥6 episodes/year), consistent with the WHO definition of recurrent URTI.[5]

Statistical Analysis: Data were entered in Microsoft Excel 2019 and analysed using IBM SPSS Statistics v26.0. Descriptive statistics are reported as mean ± SD for continuous variables and frequency/percentage for categorical variables. Associations between dental caries (binary outcome: present/absent) and categorical predictors were assessed by Chi-square test. Multivariable binary logistic regression was performed to calculate adjusted odds ratios (aOR) with 95% confidence intervals (CI), including age group, sex, SES, oral hygiene, rural/urban residence, and URTI frequency as covariates. Statistical significance was set at $p<0.05$.

Ethical Considerations: Ethical clearance was obtained from the Institutional Ethics Committee, Shyam Shah Medical College, Rewa (Ref: IEC/SSMC/2023/112). Written informed consent was obtained from parents/guardians; verbal assent was obtained from children ≥7 years. Confidentiality of participant data was maintained throughout.

Results

Demographic Profile: A total of 312 children were enrolled; 3 were excluded due to incomplete data, leaving 312 for final analysis. Mean age was 7.4 ± 2.7 years. Males constituted 51.9% (n=162). Rural residents comprised 60.6% (n=189). Table 1 summarises the demographic characteristics

Table 1: Demographic and Socioeconomic Characteristics of Study Participants (n=312)

Characteristic	Total (n=312)	Caries (n=198)	No Caries (n=114)
Age Group			
3–5 years	98 (31.4%)	71 (72.4%)	27 (27.6%)
6–8 years	114 (36.5%)	74 (64.9%)	40 (35.1%)
9–12 years	100 (32.1%)	53 (53.0%)	47 (47.0%)
Sex			
Male	162 (51.9%)	101 (62.3%)	61 (37.7%)
Female	150 (48.1%)	97 (64.7%)	53 (35.3%)
Socioeconomic Status			
Lower	143 (45.8%)	108 (75.5%)	35 (24.5%)
Middle	122 (39.1%)	72 (59.0%)	50 (41.0%)
Upper	47 (15.1%)	18 (38.3%)	29 (61.7%)
Rural Residence	189 (60.6%)	131 (69.3%)	58 (30.7%)
Urban Residence	123 (39.4%)	67 (54.5%)	56 (45.5%)

SES = Socioeconomic Status (modified Kuppuswamy scale).

Prevalence and Severity of Dental Caries: The overall prevalence of dental caries was 63.5% (n=198; 95% CI: 57.9%–68.8%). Caries prevalence was highest in the 3–5 year age group (72.4%) and declined with increasing age. Table 2 presents the caries indices across age groups.

Table 2: Dental Caries Indices by Age Group (n=198 caries-positive children)

Caries Index	Mean ± SD	Median	Min	Max
dmft (primary dentition, 3–5 yr)	4.82 ± 2.41	5.0	0	12
dmft (primary dentition, 6–8 yr)	5.37 ± 2.73	5.0	0	14
DMFT (mixed/permanent, 9–12 yr)	2.14 ± 1.88	2.0	0	9
Significant Caries Index (SiC)	7.94 ± 1.62	8.0	6	14

dmft = decayed, missing, filled teeth (primary dentition); DMFT = permanent dentition; SiC = Significant Caries Index.

The mean dmft for the primary dentition was 5.07 ± 2.61. The SiC score for the highest-caries tertile was 7.94 ± 1.62, indicating a substantial burden of untreated caries in the most affected subgroup. Fluoride toothpaste use was reported by only 28.5% of caregivers.

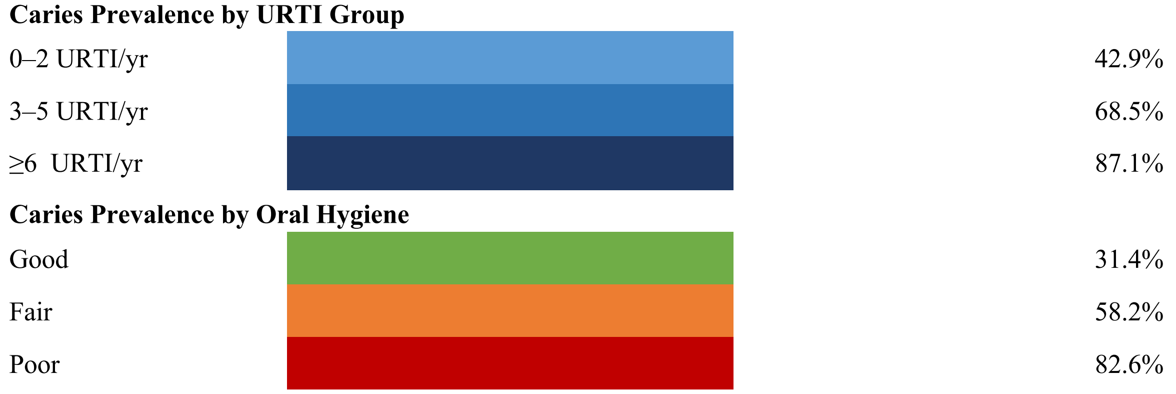
Association Between URTI Frequency and Dental Caries: Children with ≥6 URTI episodes per year had a caries prevalence of 87.1% compared to 42.9% in those with 0–2 episodes ($p<0.001$). The crude OR for the high-URTI group relative to the low-URTI reference group was 8.98 (95% CI: 3.99–20.2). Table 3 presents the stratified analysis

Table 3: Prevalence of Dental Caries by URTI Frequency Category (n=312)

URTI Episodes / Year	Caries n (%)	No Caries n (%)	OR (95% CI)	p-value
0–2 (Low)	48 (42.9%)	64 (57.1%)	Reference	—
3–5 (Moderate)	89 (68.5%)	41 (31.5%)	2.89 (1.67–5.01)	0.001
≥6 (High)	61 (87.1%)	9 (12.9%)	8.98 (3.99–20.2)	<0.001

OR = Odds Ratio; CI = Confidence Interval; Chi-square test for trend $p<0.001$.

Visual Summary of Key Associations: Figure 1 illustrates the gradient relationship between URTI frequency and caries prevalence, and the distribution of caries by oral hygiene status.



Bar length proportional to caries prevalence percentage. Values show percentage of children with dental caries in each subgroup.

Figure 1: Prevalence of Dental Caries by URTI Frequency Category

Multivariable Logistic Regression: After adjustment for age group, sex, SES, rural residence, and oral hygiene, frequent URTI (≥6/year) remained strongly and independently associated with dental caries (aOR 6.72; 95% CI 2.91–15.5; $p<0.001$). Poor oral hygiene (aOR 3.18) and lower SES (aOR 2.41) were also significant independent predictors (Table 4).

Table 4: Multivariable Binary Logistic Regression — Predictors of Dental Caries (n=312)

Variable	Crude OR	Adjusted OR	95% CI	p-value
URTI ≥6/year	9.14	6.72	2.91–15.5	<0.001
URTI 3–5/year	2.89	2.34	1.32–4.16	0.004
Lower SES	3.27	2.41	1.38–4.21	0.002
Rural Residence	1.88	1.62	0.98–2.68	0.06
Poor Oral Hygiene	4.51	3.18	1.84–5.50	<0.001
Age 3–5 yr vs 9–12 yr	2.39	1.97	1.08–3.58	0.03

Hosmer-Lemeshow goodness-of-fit: $\chi^2=6.14$, df=8, p=0.63. Nagelkerke $R^2=0.41$. All p-values two-sided

Discussion

The present study found a dental caries prevalence of 63.5% among children aged 3–12 years a figure consistent with other hospital-based studies from Central and North India that report prevalences of 58%–72%.[3,4,15] The higher prevalence in younger children (72.4% in the 3–5-year group) likely reflects the combination of early dietary sugar exposure, immature enamel, and limited parental oral hygiene supervision, consistent with findings by Sogi et al.[16]

Our principal finding a strong, dose-dependent, and independently significant association between recurrent URTI and dental caries is biologically plausible. Several mechanisms may underlie this relationship. First, the oral cavity shares microbiological continuity with the nasopharynx through the Waldeyer's ring. Oral pathobionts, particularly S. mutans and Fusobacterium nucleatum, have been recovered from adenotonsillar tissue in children with recurrent tonsillitis, [7,17] suggesting direct microbial translocation from carious lesions to the upper airway.

Second, carious teeth harbor polymicrobial biofilms that may serve as reservoirs for respiratory pathogens, including Streptococcus pyogenes and non-typeable Haemophilus influenzae.[8] A study by Jiang et al. demonstrated that children with ≥4 carious teeth had significantly higher nasopharyngeal carriage rates of S. pneumoniae (OR 2.4), suggesting oral biofilm may contribute to colonization pressure in the upper respiratory mucosa.[18]

Third, the systemic inflammatory milieu of untreated dental caries characterized by elevated IL-6, TNF-α, and CRP may impair innate mucosal immunity in the upper airway, increasing vulnerability to viral and bacterial URTI.[9,19] Conversely, URTI-associated mouth-breathing dries the oral mucosa, reduces salivary flow, and alters pH, creating conditions favorable to cariogenic bacteria a bidirectional relationship that may amplify both conditions.[20]

The gradient relationship we observed (OR 2.89 for moderate URTI; OR 6.72 adjusted for high URTI) is consistent with a dose-response pattern, strengthening the causal inference. These figures are higher than those reported by Tandon et al. in Lucknow (aOR 3.1 for ≥6 URTI), possibly reflecting the greater burden of untreated caries and lower fluoride toothpaste use (28.5% in our cohort vs. 41% in their study).[15]

Poor oral hygiene emerged as the strongest modifiable risk factor (aOR 3.18), underscoring the importance of caregiver education. Lower SES was also independently associated, mirroring global inequities in dental health. The non-significant association with rural residence (aOR 1.62; p=0.06) may reflect residual confounding by SES and oral hygiene practice rather than a true geographical effect.

Limitations: The cross-sectional design limits causal inference; directionality cannot be established. Recall bias may affect reported URTI counts, although use of medical records partially mitigated this. Single-examiner design, while reducing inter-examiner variability, limits external validity. Radiographic confirmation of caries was not performed. Future longitudinal studies with microbiological sampling of oral and nasopharyngeal flora are needed to characterize mechanistic pathways.

Conclusions

Dental caries affects nearly two-thirds of children attending a tertiary care hospital in Rewa, Madhya Pradesh, with a high burden in the preschool age group. A strong, dose-dependent, and independently significant association between recurrent URTI (≥6 episodes/year) and dental caries was demonstrated, even after adjustment for key confounders. These findings advocate for:

1) Integrated paediatric-dental screening at outpatient visits, where paediatricians flag oral health concerns and refer to dental colleagues.
2) Caregiver education on fluoride toothpaste use, sugar restriction, and twice-daily toothbrushing, especially in lower-SES rural families.
3) Policy-level inclusion of oral health assessment in IMNCI (Integrated Management of Neonatal and Childhood Illness) protocols in MP.
4) Longitudinal research with microbiological endpoints to characterize the oral-respiratory axis in this population.

Declarations

Funding: This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Conflict of Interest: The authors declare no conflict of interest.

Ethical Approval: IEC/SSMC/2023/112, Shyam Shah Medical College, Rewa. All procedures conform to the Declaration of Helsinki.

Data Availability: Anonymised data are available upon reasonable request to the corresponding author.

Author Contributions: PSP: Conceptualization, data collection (pediatric), writing (original draft), supervision. NS: Dental examination, data collection, methodology, writing (review & editing). Both authors approved the final manuscript.

Corresponding Author: Dr. Pushkar Singh Parihar, Department of Paediatrics, Shyam Shah Medical College, Rewa, MP 486001, India. E-mail:

References

1. GBD 2019 Diseases and Injuries Collaborators. Global burden of 369 diseases and injuries in 204 countries and territories, 1990–2019. Lancet. 2020;396(10258):1204-1222.
2. World Health Organization. Oral Health: Key Facts. WHO Fact Sheet No. 318. Geneva: WHO; 2023. Available from: https://www.who.int/news-room/fact-sheets/detail/oral-health
3. Rao A, Sequeira PS, Peter S. Prevalence of dental caries among school children of Moodbidri. J Indian Soc Pedod Prev Dent. 1999;17(2):45-48.
4. Gambhir RS, Sohi RK, Nanda T, Sawhney GS, Setia S. Impact of school-based oral health education programmes in India: a systematic review. J Clin Diagn Res. 2013;7(12):3107-3110.
5. World Health Organization. Acute Respiratory Infections in Children. Geneva: WHO Programme for the Control of Acute Respiratory Infections; 2020.
6. Heikkinen T, Järvinen A. The common cold. Lancet. 2003;361(9351):51-59.
7. Zautner AE, Krause M, Stropahl G, Hagen R, Hahn AM, Scheithauer S, et al. Intracellular persisting Staphylococcus aureus is the major pathogen in recurrent tonsillitis. PLoS One. 2010;5(5):e9452.
8. Scannapieco FA, Papandonatos GD, Dunford RG. Associations between oral conditions and respiratory disease in a national sample survey population. Ann Periodontol. 1998;3(1):251-256.
9. D'Aiuto F, Nibali L, Parkar M, Suvan J, Tonetti MS. Short-term effects of intensive periodontal therapy on serum inflammatory markers and cholesterol. J Dent Res. 2005;84(3):269-273.
10. Nair M, Bharath HA, Kumari V, Prasad S, Shetty P. Oral health status and treatment needs of children in Dakshina Kannada: a cross-sectional study. J Indian Assoc Public Health Dent. 2016;14:53-57.
11. Kuppuswamy BL. Manual of Socioeconomic Scale (Urban). New Delhi: Manasayan; 2020.
12. World Health Organization. Oral Health Surveys: Basic Methods. 5th ed. Geneva: WHO; 2013.
13. Bratthall D. Introducing the Significant Caries Index together with a proposal for a new global oral health goal for 12-year-olds. Int Dent J. 2000;50(6):378-384.
14. Greene JC, Vermillion JR. The simplified oral hygiene index. J Am Dent Assoc. 1964;68:7-13.
15. Tandon S, Gupta K, Rao SR, Tiwari S. Prevalence of dental caries and its correlation with recurrent upper respiratory tract infections in schoolchildren: a cross-sectional study from Lucknow, India. Indian J Dent Res. 2019;30(4):520-525.
16. Sogi GM, Bhaskar DJ. Dental caries prevalence among children of Davangere: a cross-sectional survey. J Indian Soc Pedod Prev Dent. 2002;20(3):92-96.
17. Gordils-Perez J, Rajchel AL, Strauss M, Aber RC. In vitro growth inhibition of group A beta hemolytic streptococcus (GAS) by Streptococcus mutans from adenotonsillar tissue. Am J Otolaryngol. 1995;16(2):136-138.
18. Jiang Y, Qian HY, Michailides TJ, Luo Y. Associations between early childhood caries and nasopharyngeal carriage of Streptococcus pneumoniae. J Oral Microbiol. 2021;13(1):1904434.
19. Noack B, Genco RJ, Trevisan M, Grossi S, Zambon JJ, De Nardin E. Periodontal infections

contribute to elevated systemic C-reactive protein level. J Periodontol. 2001;72(9):1221-1227.

20. Kanehira T, Fujinami Y, Wada N, Maetani T, Ito K, Sano K. The relationship between caries and mouth-breathing in children with adenotonsillar hypertrophy. Int J Paediatr Dent. 2017;27(6):474-479