Journal of Chemical Health Risks
www.jchr.org
JCHR (2026) 16(1), 337-352 | ISSN:2251-6727

Prevalence and Predictors of Early Childhood Caries in Children aged between 48 to 71 months in District Hapur, Uttar Pradesh: An Epidemiological Study

Dr. Mudang Moniya[1], Dr. Manvi Malik[2], Dr. Prachi Arora[3], Dr. Kopal Singh[4], Dr. Urvashi Verma[5]

[1]M.D.S (PG III Year), Department of Pediatric and Preventive Dentistry, Shree Bankey Bihari Dental College and Research Centre, Ghaziabad, Uttar Pradesh, India (Corresponding Author)

[2]M.D.S, Professor & Head, Department of Pediatric and Preventive Dentistry, Shree Bankey Bihari Dental College and Research Centre, Ghaziabad, Uttar Pradesh, India

[3]M.D.S, Reader, Department of Pediatric and Preventive Dentistry, Shree Bankey Bihari Dental College and Research Centre, Ghaziabad, Uttar Pradesh, India

[4]M.D.S, Senior Lecturer, Department of Pediatric and Preventive Dentistry, Shree Bankey Bihari Dental College and Research Centre, Ghaziabad, Uttar Pradesh, India

[5]M.D.S, Reader, Department of Pediatric and Preventive Dentistry, ITS Dental College, Muradnagar, Ghaziabad, Uttar Pradesh, India

Corresponding Author: Dr. Mudang Moniya

(Received: 27 November 2025 Revised: 05 December 2025 Accepted: 10 January 2026)

KEYWORDS

Prevalence, Early Childhood Caries; Oral Hygiene Practices; Oral Health Literacy; SES; Fluoride Levels

ABSTRACT:

Background: Early Childhood Caries affects preschool children all over the world which directly has implications on a child's overall health and quality of life. Most studies on ECC have been focused on specific ethnic and lower social economics communities. However, there is shortage of epidemiological data and their association with its determinants regarding ECC in Hapur District.

Aim: The aim of this study was to assess the prevalence of ECC in District Hapur, Uttar Pradesh and its correlation with the predictors of ECC.

Methods: An epidemiological study was carried out on 2500 school going children from 10 schools located in urban and rural areas of 5 zones of Hapur district. A prior permission was taken from all the 10 schools and informed consent was sent to the schools prior to the day of examination. Among the study participants the presence of dental caries was assessed using, deft indices. Patients Oral hygiene practices and oral health literacy data of the parents was pre-evaluated through a questionnaire. Also, the socio-economic status of the participants was obtained through kuppuswamy scale. Lastly, drinking water was collected from each school of each zone and sent to the laboratory for estimating the fluoride level in each belt.

Results: The overall caries prevalence in 4-6 year age group was found to be 88.4%. There was statistically no significant difference found in gender-wise comparison (p=0.001) and SES comparison (p=0.961), but a significant difference was seen in oral hygiene practice (p=0.001), oral health literacy (p=0.001), was evaluated with caries prevalence. The mean water fluoride level in the surveyed area was found to be 0.8 ppm and was found to be significantly (p = 0.001) associated with caries prevalence.

Conclusion: An extremely high prevalence of ECC was seen in the Hapur district, UP. The risk factors, such as gender, oral hygiene practices, oral health literacy, SES of parents, and fluoride level of the area, were found to important determinants associated with the prevalence of dental caries in school-going children of 4-5 year age group.

Journal of Chemical Health Risks
www.jchr.org
JCHR (2026) 16(1), 337-352 | ISSN:2251-6727

BACKGROUND

The World Health Organization (WHO) classified dental caries as a chronic non-communicable disease, emphasizing the need for global efforts in its prevention and treatment affecting approximately 514 million children primary dentition.[1] American Academy of Pediatric Dentistry (2020) defines Early Childhood Caries (ECC) as "the presence of one or more decayed (non-cavitated or cavitated lesions), missing (due to caries), or filled tooth surfaces in any primary tooth in a child 71 months of age or younger."[2] ECC is a condition with multiple factors that results from the intricate interplay of several risk variables, such as age, gender, dietary habits such as the type of carbohydrates consumed, snacking patterns, frequency of sugar intake, oral hygiene practices, water fluoride levels, and socioeconomic status (SES).[3] Tooth decay is caused by a number of factors, including genetic susceptibility, malnutrition, compromised general health, unhealthy eating habits, the presence of cariogenic bacteria like streptococci, deficiency of fluoride and vitamin D, excessive sugar consumption, and prolonged bottle-feeding. While primary teeth are eventually replaced by permanent ones, ECC has been identified as a potential risk factor for the development of caries in the permanent dentition.[4] Early childhood caries in primary teeth can develop early in life and progress rapidly, especially in children at high risk and are often left untreated. By the time children reach toddler age, half of them have at least one decayed primary tooth. Despite this, the significance and treatment of primary teeth have been neglected for a very long time.[5] ECC is a condition with multiple factors that results from the intricate interplay of several risk variables, such as age, gender, dietary habits such as the type of carbohydrates consumed, snacking patterns, frequency of sugar intake, oral hygiene practices, water fluoride levels, and socioeconomic status (SES).[3] The 2015 Global Burden of Disease Study identified dental caries in primary teeth as the 12th most common disease, affecting 560 million children globally. The mean prevalence of caries in 3,4 and 5 year olds worldwide was 43%, 55% and 63% respectively. Several epidemiological studies have shown that schoolchildren, adolescents, and adults with a history of ECC had higher rates of caries in their permanent teeth, as well as higher levels of severity.[6] At International Association of Pediatric Dentistry Conference on Early Childhood Caries (2018), it was summarized that the findings of 72 studies published between 1998 and 2018. They reported a 4-year prevalence of ECC ranging from 12% to 98%. The prevalence of ECC in children at ages 1, 2, 3, 4, and 5 years was found to be 17%, 36%, 43%, 55%, and 63%, respectively.[7] The situation in India mirrors that of other developed and developing countries. A systematic review reported the pooled prevalence of dental caries in primary dentition i.e Early Childhood Caries in India as 46 %.Regional analysis showed Central India had the highest pooled prevalence at 62.3% followed by Northern India (51.6%), Eastern India (50.4%), Southern India (44.6%) and Western India (43.8%).[8] Approximately half of children globally had ECC with prevalence ranging from 2.1% to 85.5% in both developed and developing nations. However, ECC was frequently left untreated. Over 620 million children worldwide suffered from untreated ECC in 2015; the majority of those affected were between the ages of one and four.[12] The best practices for reducing the risk of ECC include brushing twice daily with fluoridated toothpaste for all children, regardless of whether they live in areas with adequate fluoride levels or those with fluoride deficiencies.[2] Appropriate public health policy programs are also required to bring down the prevalence of ECC[8] Early detection and treatment of dental caries is crucial. Given the high prevalence of ECC in India, it is crucial to implement strategies to control and prevent the condition. The World Health Organization's expert consultation on public health interventions for ECC suggests several strategies, including caries risk assessment, brushing with fluoride toothpaste, fluoride varnish applications, and behavioral interventions that promote preventive self-care. Early and regular dental visits can also play a significant role in preventing ECC.[9] Additionally, the World Health Assembly advocates for a shift from a curative approach to a preventive one, starting from families, schools, and workplaces, and integrating comprehensive and inclusive care within the primary health care system to improve oral health.[10] Therefore, it is crucial for dental healthcare providers to assess the prevalence of dental caries in order to evaluate effective health and preventive programs. To accurately forecast the risk of the disease, it is essential to conduct analyses that incorporate a combination of risk factors, rather than relying on studies focused on a single risk factor. Numerous epidemiological studies from around the

Journal of Chemical Health Risks
www.jchr.org
JCHR (2026) 16(1), 337-352 | ISSN:2251-6727

nation have been published that highlight risk variables. Nevertheless, there is a dearth of research on the prevalence of ECC in Hapur District, Uttar Pradesh. Thus, the current epidemiological study was created to investigate the prevalence of ECC in school-age children between the ages of 48 and 71 months as well as its relationship to ECC predictors such as deft, oral hygiene practices, oral health literacy, socioeconomic status and fluoride levels.

METHODS

Study Design and Setting

This epidemiological study was carried out in the Department of Pediatric and Preventive Dentistry, Shree Bankey Bihari Dental College and Research Center, Ghaziabad, Uttar Pradesh. It was carried out across 10 schools situated in both urban and rural areas, covering 5 distinct zones of Hapur district. According to the results of the pilot study, conducted on 100 students pursuing education in schools located in Hapur district, the sample size was calculated where the prevalence were calculated to be 54% using the following formula, $n = [Z_{1-\alpha/2}- * p * (1-p) / d2]$Where, p: Expected prevalence = 0.54 or 54%, d: absolute precision required on either side of prevalence= 0.23 or 2%, Z: 1.96.The nMaster software (version 2, CMC, Vellore) was used to estimate the sample size of this study. A sample size of 2386, rounded off to 2500 was determined to be adequate, with the expectation of a 54% prevalence of DMFT among children aged 4 to 6 years in the Hapur district, an absolute precision of 2% and a 95% Confidence range, and a design effect of 4.

Participants

Children aged 3 to 5 years who were cooperative and without systemic diseases were eligible for participation. Parents of all children in the selected schools were invited via letters to provide consent for participation, explaining details on the study's purpose and methodology. Participants whose parents were willing to fill the consent were included in the study. Exclusion criteria comprised uncooperative children or children absent on examination day, as well as those lacking parental consent. Children with special needs were also excluded.

Study Measures

The study consisted of 2 parts, first the clinical examination of the children, recording oral hygiene practices/frequency of brushing and second collecting data from the parents/ caregivers regarding oral health literacy and their socio-economic status through questionnaire.

Ethical Consideration

Before commencement of the study, approval was taken from the Institutional Ethical Committee.(IECPROTOCOLNO: SBBDC/2023/382).

Statistical Analysis

Microsoft Excel spreadsheet was used to enter the data for this study, and SPSS statistical software, version 21.0, was used for analysis. Shapiro Wilk test was used to check which all variables were following normal distribution. Data was normally distributed therefore; inferential statistics were performed using the parametric test. For comparison of continuous quantitative data among more than two groups, ONE WAY ANOVA followed by Tukeys test was used. Association among categorical variables was assessed using chi-sqaure test. Level of statistical significance was set at p-value less than 0.05 (*).

Figure 1: Dental School Camp held at different schools of Hapur District

Journal of Chemical Health Risks
www.jchr.org
JCHR (2026) 16(1), 337-352 | ISSN:2251-6727

Figure 2: Oral Screening of School Children

Figure 3: Armamentarium including: Kidney Tray, Savlon, Mouth-mask, Cheek Retractor, Diagnostic Set, Disposable Gloves, Cotton, Evaluation Sheet

Results

In the present study, a total of 2500 school going children from 10 Schools in 5 zones of Hapur district was included based on the selection criteria. All Data was collected and compiled on Microsoft excel XP software and were analyzed using Statistical Package for Social Sciences (SPSS) version 21. The DMFT index was used to evaluate presence of dental caries in this study.

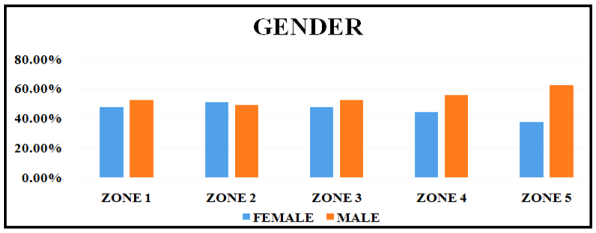
I. Zone-wise distribution of gender (Table 1)

			Sex		Total
			F	M	
ZONE	1	N	238	262	500
		%	47.6%	52.4%	100.0%
	2	N	255	245	500
		%	51.0%	49.0%	100.0%
	3	N	238	262	500

Journal of Chemical Health Risks
www.jchr.org
JCHR (2026) 16(1), 337-352 | ISSN:2251-6727

		%	47.6%	52.4%	100.0%
	4	N	221	279	500
		%	44.2%	55.8%	100.0%
	5	N	188	312	500
		%	37.6%	62.4%	100.0%
Total		N	1140	1360	2500
		%	45.6%	54.4%	100.0%
P VALUE					0.112

Graph 1: Zone wise distribution of gender

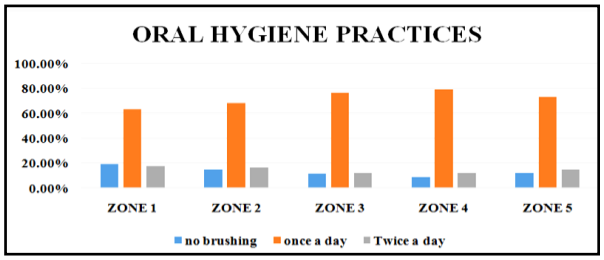


Among 2500 children included in the study, 1360 (54.4%) participants were male and 1140 (45.6%) participants were females. The gender distribution varied across zones, with Zone 5 having the highest proportion of males (312, 62.4%) while Zone 2 showed highest proportion of females. The difference in gender distribution across zones was not statistically significant (**p=0.112**) indicating an equal distribution of the participants across different zones. (Table 1, Graph 1)

II. Zone-wise distribution of Oral Hygiene Practice (Table 2, Graph 2)

			Brushing			Total
			No Brushing	Once A Day	Twice A Day	
ZONE	1	N	97	316	87	500
		%	19.4%	63.2%	17.4%	100.0%
	2	N	75	342	83	500
		%	15.0%	68.4%	16.6%	100.0%
	3	N	59	381	60	500
		%	11.8%	76.2%	12.0%	100.0%
	4	N	43	396	61	500
		%	8.6%	79.2%	12.2%	100.0%
	5	N	60	366	74	500
		%	12.0%	73.2%	14.8%	100.0%
Total		N	334	1801	365	2500
		%	13.4%	72.0%	14.6%	100.0%
P value						0.001

Graph 2: Zone-wise distribution of oral hygiene practice



Among the 2500 individuals, most participants brushed twice day (365, 14.6%), while fewer brushed once a day (1801, 72.0%) or did not brush at all (334, 13.4%). The highest proportion of individuals brushing once a day was in Zone 4 (396, 79.2%), whereas Zone 1 had the highest percentage of individuals not brushing (97, 19.4%). The variation in oral hygiene practices across zones was statistically significant (**p=0.001**) (Table 2, Graph 2)

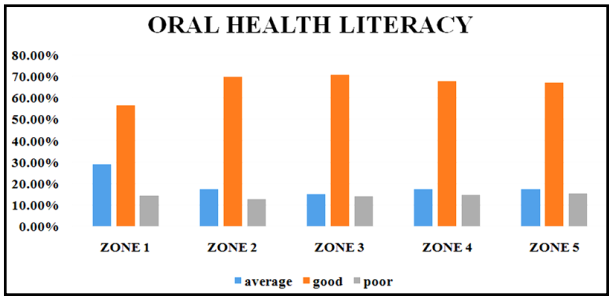
III. Zone-wise distribution of Oral Health Literacy (Table 3, Graph 3)

	Oral Health Literacy	Total			
	Average	Good	Poor		
ZONE	1	N	146	282	72	500
		%	29.2%	56.4%	14.4%	100.0%
	2	N	87	349	64	500
		%	17.4%	69.8%	12.8%	100.0%
	3	N	76	353	71	500

Journal of Chemical Health Risks
www.jchr.org
JCHR (2026) 16(1), 337-352 | ISSN:2251-6727

		%	15.2 %	70. 6%	14. 2%	100 .0%
	4	N	87	339	74	500
		%	17.4 %	67. 8%	14. 8%	100 .0%
	5	N	87	335	78	500
		%	17.4 %	67. 0%	15. 6%	100 .0%
Total	N	483	165 8	35 9	250 0	
	%	19.3 %	66. 3%	14. 4%	100 .0%	
P Value					0.0 01	

Graph 3: Zone-wise distribution of Oral Health Literacy

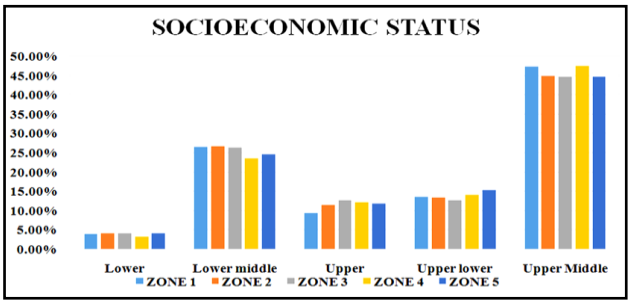


Good oral health literacy was observed in 1658 (66.3%) individuals, while 483 (19.3%) had average and 359 (14.4%) had poor literacy. Zone 3 had the highest percentage of individuals with good OHL (353, 70.6%), whereas Zone 1 had the lowest OHL (282, 56.4%). The differences in oral health literacy across zones were statistically significant (**p=0.001**). (Table 3, Graph 3)

IV. Zone-wise distribution of Socioeconomic status (Table 4, Graph 4)

			SES					Total
			Low er	Lowe r Mi	Uppe r	Uppe r Lo	Uppe r Mi	
ZON E	1	N	19	132	46	67	236	500
		%	3.8%	26.4 %	9.2%	13.4 %	47.2 %	100. 0%
	2	N	20	133	57	66	224	500
		%	4.0%	26.6 %	11.4 %	13.2 %	44.8 %	100. 0%
	3	N	20	131	63	63	223	500
		%	4.0%	26.2 %	12.6 %	12.6 %	44.6 %	100. 0%
	4	N	16	117	60	70	237	500
		%	3.2%	23.4 %	12.0 %	14.0 %	47.4 %	100. 0%
	5	N	20	122	59	76	223	500
		%	4.0%	24.4 %	11.8 %	15.2 %	44.6 %	100. 0%
Total		N	95	635	285	342	1143	2500
		%	3.8%	25.4 %	11.4 %	13.7 %	45.7 %	100. 0%
P Value								0.96 1

Graph 4: Zone-wise distribution of Socioeconomic status



Among the participants, the majority belonged to the upper middle SES (1143, 45.7%), followed by lower middle (635, 25.4%), upper lower (342, 13.7%), and upper SES (285, 11.4%). The lower SES group comprised only 3.8% (95 individuals). The distribution across zones was relatively uniform, with no statistically significant difference (**p=0.961**).(Table 4, Graph 4.

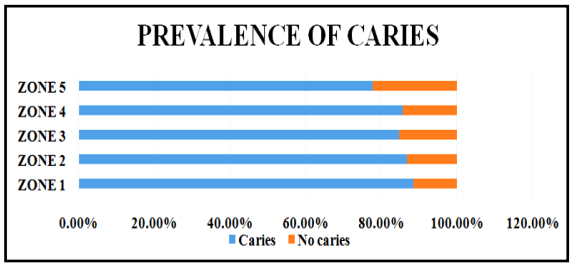
V. Prevalence of ECC in different zones (Table 5, Graph 5)

	Prevalence	Total			
	Caries	No Caries			
ZONE	1	**N**	**4**	58	500

Journal of Chemical Health Risks
www.jchr.org
JCHR (2026) 16(1), 337-352 | ISSN:2251-6727

			42		
		%	88.4%	11.6%	100.0%
	2	N	434	66	500
		%	86.8%	13.2%	100.0%
	3	N	424	76	500
		%	84.8%	15.2%	100.0%
	4	N	428	72	500
		%	85.6%	14.4%	100.0%
	5	N	389	111	500
		%	77.8%	22.2%	100.0%
Total	N	2117	383	2500	
	%	84.7%	15.3%	100.0%	
P value				0.001	

Graph 5: Prevalence of ECC in different zones



The overall prevalence of caries was 84.7% (2117 individuals), with Zone 5 having the lowest prevalence (77.8%) and Zone 1 the highest (88.4%). The prevalence of ECC across different zone was in the following descending order: Zone 1 (88.4%) >Zone 2 (86.8%) >Zone 4 (85.6%) >Zone 3 (84.8%) > Zone 5 (77.8%). The difference in ECC prevalence across zones was statistically significant (**p=0.001**).(Table 5, Graph 5)

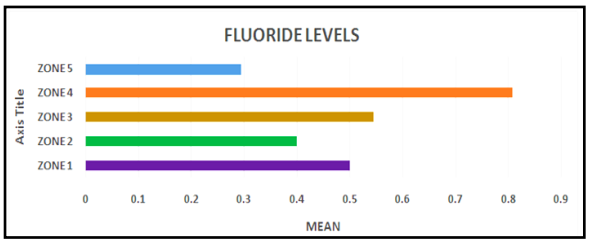
VI. Zone-wise distribution of Fluoride Levels (Table 6, Graph 6)

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
1	2	0.5000	0.08008	0.00358	0.4930	0.5070	0.42	0.58
2	2	0.4000	0.06130	0.00274	0.3946	0.4054	0.33	0.45
3	2	0.54555	0.04555	0.00204	0.5415	0.5495	0.50	0.59
4	2	0.8083	0.07234	0.00324	0.8019	0.8147	0.73	0.88
5	2	0.2940	0.06907	0.00309	0.2879	0.3001	0.23	0.36
Total	2	0.5096	0.18513	0.00370	0.5023	0.5168	0.23	0.88
P value								0.001

Journal of Chemical Health Risks
www.jchr.org
JCHR (2026) 16(1), 337-352 | ISSN:2251-6727

Post hoc								Zone 4>3>1>2>5

Graph 6: Zone-wise distribution of fluoride levels

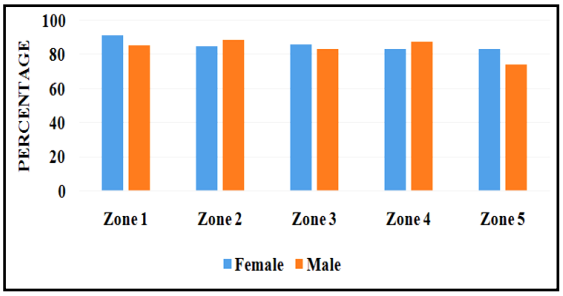


The mean fluoride level varied significantly across zones (**p=0.001**), with Zone 4 having the highest mean fluoride level (0.8083 ± 0.0723) and Zone 5 the lowest (0.2940 ± 0.0691). The post hoc analysis showed a descending trend: **Zone 4 (0.50 ± 0.08 ppm) > Zone 3 (0.54 ± 0.04 ppm) > Zone 1 (0.50±0.08 ppm) > Zone 2 (0.40 ± 0.06 ppm) > Zone 5 (0.29± 0.06 ppm)**.(Table 6, Graph 6)

VII. Correlation of gender with ECC according to different zone (Table 7, Graph 7)

	Female	**Male**	**Total**	**P-Value**
Zone 1	218 (91.6%)	224 (85.5%)	442 (88.4%)	0.033
Zone 2	217 (85.1%)	217 (88.6%)	434 (86.8%)	0.251
Zone 3	205 (86.1%)	219 (83.6%)	424 (84.8%)	0.428
Zone 4	184 (83.3%)	244 (87.5%)	428 (85.6%)	0.184
Zone 5	157 (83.5%)	232 (74.4%)	389 (77.8%)	0.017

Graph 7: Correlation of gender with ECC according to different zones



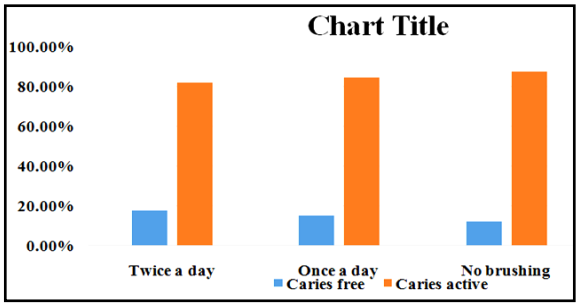
The correlation of gender with prevalence of ECC showed a higher prevalence among females in Zone 1 [Females (91 %)> males (85.5%)] and Zone 5 [females (83.5 %) > males (74.4%)] with a statistically significant difference (p<0.05). Zone 3 also showed a higher prevalence of ECC among females [Females (86.1%) > males (83.6%)] but the difference was not statistically significant (p>0.05). A higher prevalence of ECC was seen among males in Zone 2 [males (88.6%) > females (85.1%)], and Zone 4 [males (87.5%) > females (83.3%)]. However, the difference was not statistically significant. (p>.05).

VIII. Correlation of oral hygiene practice with ECC according to different zone. (Table 8, Graph 8)

			CARIES		Total
			Caries Free	With Caries	
Oral Hygiene Practice Brushing	Twice A Day	N	59	275	334
		%	17.7%	82.3%	100.0 %
	Once A Day	N	279	1522	1801
		%	15.5%	84.5%	100.0 %
	No Brushing	N	45	320	365
		%	12.3%	87.7%	100.0 %
Total		N	383	2117	2500
		%	15.3%	84.7%	100.0 %
P Vaue					0.137

Journal of Chemical Health Risks
www.jchr.org
JCHR (2026) 16(1), 337-352 | ISSN:2251-6727

Graph 8: Correlation of oral hygiene practice with ECC according to different zones

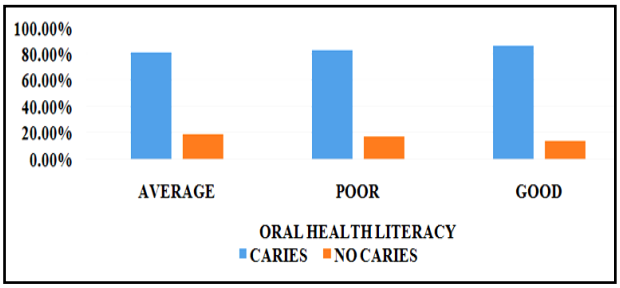


The highest proportion of ECC was found in individuals who did not brush at all (87.7%) followed by those who brushed once a day (84.5%) and those who brushed twice daily (82.3%). However, the difference in correlation of oral hygiene practices and ECC according to different zones was not statistically significant. (Table 8, Graph 8)

IX. Correlation of Oral Health Literacy with ECC according to different zone (Table 9, Graph 9)

			ECC		Total
			Caries	No Caries	
Oral Health Literacy	Good	N	392	91	483
		%	81.2 %	18.8%	100.0 %
	Average	N	299	60	359
		%	83.3 %	16.7%	100.0 %
	Poor	N	1426	232	1658
		%	86.0 %	14.0%	100.0 %
Total			2117	383	2500
			84.7 %	15.3%	100.0 %
P Value					0.025

Graph 9: Correlation of oral health literacy with ECC according to different zones



The participants with poor oral health literacy had a higher prevalence of ECC (86.0%) compared to those with average (83.3%) or good (81.2%) literacy levels. The overall prevalence of ECC in the study population was 84.7%, while 15.3% had no caries. The p-value of 0.025 suggests a statistically significant association between oral health literacy and ECC, indicating that literacy levels may influence caries risk and oral health outcomes.

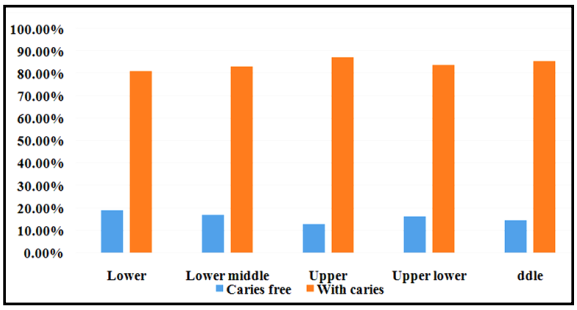
X. Correlation of Socioeconomic status with ECC according to different zones (Table 10, Graph 10)

			Caries		Total
			Caries free	With caries	
SES	Lower	N	18	77	95
		%	18.9%	81.1%	100.0%
	Lower mi	N	107	528	635
		%	16.9%	83.1%	100.0%
	Upper	N	36	249	285
		%	12.6%	87.4%	100.0%
	Upper lo	N	55	287	342
		%	16.1%	83.9%	100.0%
	Upper Mi	N	167	976	1143
		%	14.6%	85.4%	100.0%
Total			383	2117	2500
			15.3%	84.7%	100.0%

Journal of Chemical Health Risks
www.jchr.org
JCHR (2026) 16(1), 337-352 | ISSN:2251-6727

P value				0.368

Graph 10: Correlation of SES with ECC according to different zones



The association between socioeconomic status (SES) and caries status was analyzed among 2500 individuals, revealing that 84.7% (2117 individuals) had caries, while 15.3% (383 individuals) were caries-free. The prevalence of caries was highest in the upper SES group (87.4%) and lowest in the lower SES group (81.1%). Among individuals in the upper middle SES, 85.4% had caries, while the lower middle SES group had a slightly lower proportion (83.1%). The lower SES group had the highest proportion of caries-free individuals (18.9%), followed by the lower middle SES (16.9%) and the upper lower SES (16.1%). However, the association between SES and caries status was not statistically significant (p=0.368), suggesting that SES alone may not be a major determinant of caries prevalence in this population. (Table 10, Graph 10)

DISCUSSION

Epidemiological research conducted worldwide has consistently shown that dental caries is one of the most prevalent dental diseases. Early Childhood Caries (ECC) affects more than 530 million children worldwide, making it one of the most common and widespread diseases in young children globally. The widespread nature of ECC, combined with its potential long-term effects on both dental and general health, underscores the importance of preventive care, early detection, and effective treatment strategies to improve the quality of life for affected children. While developed countries have seen a decline in the prevalence of dental caries, the rate of ECC remains unchanged in both undeveloped and developing nations.[11]Several epidemiological studies have shown that schoolchildren, adolescents, and adults with a history of ECC had higher rates of caries in their permanent teeth, as well as higher levels of severity. It is widely acknowledged as a significant public health concern across various nations, with prevalence rates varying: from 11.4% in Sweden to 7%–19% in Italy, and reaching as high as 76% and 83% in Palestine and the United Arab Emirates, respectively. National surveys in countries like Greece (36%), Brazil (45.8%), and Israel (64.7%) have reported inconsistent prevalence rates of ECC.[8] Numerous credible studies have examined the prevalence of tooth decay in various regions of India. The situation in India mirrors that of other developed and developing countries.[12] Studies by Tewari et al (2001)[13] in Rohtak (Haryana), Goel et al (2000)[14] in Puttur (Karnataka), Moses et al[15] in Chidambaram (Tamil Nadu), Shingare et al[16] in Uran (Raigad District, Maharashtra), Ingle et al[17] in Bharatpur (Rajasthan), and Patloth et al[18] in Mahabubnagar District (Telangana) in 2017 all indicate that dental decay remains a significant public health concern in the country. A systemic review, conducted in 2016, estimated that every second preschool student experienced ECC in India while another one reported an overall prevalence of 54.16% and that of 3–18 years to be 57%.[7] Despite the availability and implementation of evidence-based preventive measures, the incidence of dental caries continues to increase in India, signaling a gap in the effectiveness of current oral health strategies and policies. So, it is crucial for dental professionals to regularly assess the prevalence of dental caries within the population to accurately gauge the extent of the issue and to design and implement health programs that are both effective and tailored to the specific needs of different communities. To predict the risk of dental caries more accurately and ensure that interventions are well-suited to individuals, it is essential for risk assessments to take into account a wide range of factors. These factors include, but are not limited to, dietary habits, oral hygiene practices, socio-economic conditions, access to dental care, and genetic predispositions, as focusing on just one or a few risk factors may overlook the complex nature of caries development. By adopting a more comprehensive approach to evaluating risk, dental professionals can better identify at-risk populations and create more effective prevention and treatment strategies, ultimately reducing the burden of dental caries in India. While various studies have identified risk factors across the

Journal of Chemical Health Risks
www.jchr.org
JCHR (2026) 16(1), 337-352 | ISSN:2251-6727

country, there is limited data on Early Childhood Caries (ECC) in Hapur district, Uttar Pradesh. This study aims to assess ECC prevalence in schoolchildren aged 48-71 months and its correlation with related predictors. The present study found that the prevalence of ECC among children in various schools of Hapur district was 86.8%. In comparison, several other studies conducted in India, involving children from diverse populations, reported the following prevalence rates: 54.6% in Ghaziabad (Uttar Pradesh)[19], 27.5% in Bengaluru urban (Karnataka),[20] 32% in Rohtak (Haryana),[21] 42.03% in Bahadurgarh (Haryana),[22] 54.1% in Hubli-Dharwad city (Karnataka),[23] and 47.2% in Bhubaneswar.[23]The increased prevalence of dental caries in preschool-aged children can likely be linked to inadequate oral hygiene, a lack of awareness regarding proper oral care, and negligence by parents and caregivers, particularly among children from low socioeconomic backgrounds.[24]

Gender with ECC

In the present study, the correlation of gender with prevalence of ECC showed a higher prevalence among females in Zone 1 and Zone 5 with a statistically significant difference ($p<0.05$). Zone 3 also showed a higher prevalence of ECC among females but the difference was not statistically significant ($p>0.05$) (Table 7, Graph 7). Similarly, Yavagal et al (2020)[24], Gaidhane AM et al (2013)[25] and Virdi et al (2010)[22] found a higher prevalence of ECC among females in Davangere city, Wardha District and Bahadurgarh (Haryana) respectively. Also, studies by Rai et al (2007)[26] and Al-Samadani, (2017)[27] exhibited higher mean DMFT scores in females compared to males. Also, higher prevalence of ECC was seen among males in Zone 2 and Zone 4 in the results of the current study with no statistically significant difference. ($p>0.05$) (Table 7, Graph 7). Similar findings were reported by Koya et al[28] where ECC prevalence was higher in boys. Likewise, studies in Narmada, Gujarat[29] and Trivandrum, Kerala, also observed a higher prevalence of ECC in boys. Regardless of financial background, India's cultural preference for boys over girls may be the reason for the higher prevalence of dental caries in men.[18] Some researchers suggests that the higher prevalence of dental caries in boys may be linked to their tendency to consume sugary snacks and soft drinks during prolonged periods spent outdoors. However, research by Amanlou et al[30] and Toutouni et al[31] in Iran found no significant link between gender and ECC and the study by Chevvuri R et al[32] which noted a minimal difference of only 0.8% in ECC prevalence between genders. On the other hand, the findings on gender differences in caries prevalence across various studies are inconsistent, indicating the need for further research to establish stronger evidence and explanations for this variations.[24]

Oral Hygiene Practice with ECC

Maintaining proper oral hygiene is essential to prevent ECC. In the current study, the majority of participants brushed their teeth once a day (72.0%), while fewer brushed twice a day (14.6%) or did not brush at all (13.4%). (Table 2, Graph 2). Out of all the Zones, Zone 4 had the highest proportion of individuals brushing once a day (79.2%), followed by Zone 3 (76.2%) > Zone 5 (73.2%) >Zone 2 (63.2%) > Zone 1 (63.2%). Also, Zone 1 had the highest percentage of individuals not brushing (19.4%). The variation in oral hygiene practices across zones was statistically significant. (Table 2, Graph 2) Among all participants, 87.7% of children who did not brush at all had caries, compared to 82.3% of those who brushed twice a day and 84.5% of those who brushed once a day (Table 8, Graph 8).The findings indicated that children who did not brush their teeth had a strong positive correlation with the development of dental caries.[33]A similar result was observed in a study by Prakash P et al[20], Jamshidi M et al[34] , Chugh VK et al[33], where children who did not brush their teeth had a higher likelihood of developing dental caries compared to those who brushed under parental supervision.[20] In our study, most children brushed their teeth once a day, and those who brushed more than once had significantly lower caries prevalence. The brushing habits also reflect the mother's education and awareness about oral hygiene. A study by Jose et al[35] reported that 60% of children who brushed their teeth were free from caries. Numerous studies across different populations have shown that ECC is closely linked to poor oral hygiene.[36] The American Dental Association and other global health organizations recommend brushing at least twice a day, especially after meals, to effectively remove plaque, food particles, and bacteria that accumulate throughout the day. This limited brushing routine could be more common in populations where resources, access to dental education, or access to dental care are limited. In

Journal of Chemical Health Risks
www.jchr.org
JCHR (2026) 16(1), 337-352 | ISSN:2251-6727

such communities, people may not be fully aware of the risks associated with inadequate oral hygiene practices or the benefits of more frequent brushing. To improve overall oral health, it's essential to not only change the routine to at least twice daily brushing but also to educate individuals on why more frequent brushing is necessary for preventing dental issues and maintaining good oral hygiene.

Oral Health Literacy with ECC

In the current study, 81.2% of caries active participants demonstrated good oral health literacy, 83.3 % had average oral health literacy, while 86.0% had poor oral health literacy. (Table 9, Graph 9). Across all the zones, Zone 3 displayed the highest proportion of individuals with good Oral Health Literacy (OHL), with 70.6% of participants demonstrating a strong understanding of oral health practices. This was closely followed by Zone 4, where 67.8% of individuals exhibited good OHL, and Zone 5, with 67.0%. Zone 2 had a slightly higher percentage of individuals with good OHL at 69.8%. On the other hand, Zone 1 had the lowest percentage, with only 56.4% of participants displaying a good level of oral health literacy. These findings suggest notable variations in oral health knowledge across the zones, with Zone 1 lagging behind the others in terms of OHL. (Table 3, Graph 3). This indicates that while parents or caregivers generally had a reasonable understanding of the importance of milk teeth and oral hygiene practices, ECC still affected many children. A study by Kuriakose et al. (2015) found a link between caries incidence and the parents' education level. This suggests that lower awareness of oral health practices, particularly among parents of rural children, may contribute to the disease process.[37] The importance of educating parents and caregivers about the consequences of Early Childhood Caries (ECC) is underscored by studies that show individuals with a better understanding of the causes and risks of dental caries are more likely to take proactive steps to prevent it. Parents and caregivers play a critical role in the prevention of ECC, as they are responsible for the child's daily oral care routines and nutritional choices. By raising awareness and providing the necessary tools and knowledge, parents and caregivers can significantly reduce the risk of ECC in children, leading to better oral health outcomes and overall well-being.[38]Therefore, it is crucial to emphasize educating parents and caregivers on preventive measures to reduce the risk of dental caries.

SES with ECC

Socioeconomic status (SES) is widely acknowledged as a key factor influencing an individual's or a family's health. Research has shown that both the SES and the demographic characteristics or attitudes of parents significantly impact a child's oral health.[39] Low income, for instance, can limit access to education, health resources, healthcare information, and influence lifestyle choices, thus increasing the likelihood of developing caries. A strong correlation has been observed between the prevalence of dental caries and low socioeconomic status (SES), especially when measured by income levels. Research consistently shows that individuals from lower-income households tend to have higher rates of dental caries compared to those from higher-income backgrounds. In the present study, a higher prevalence of ECC was found in the upper SES group,(Table 4) which aligns with findings from Popoola et al[40] who also noted a higher prevalence of ECC in children from upper socioeconomic backgrounds, followed by those from middle and low SES groups. Numerous studies have identified low socioeconomic status as a major risk factor for ECC. Similarly, research by Sharma et al[41]Saldūnaitė et al[42] Gao et al[43] and Tiberia et al[44] indicated that higher socioeconomic status is associated with lower caries prevalence. A popular technique for determining socioeconomic status (SES) in urban populations is the Kuppuswamy scale, which is based on three factors: schooling of parents, revenue from the family, and the occupation of the household's head.[19] Children were categorized into various SES groups in this study using an altered version of the Kuppuswamy scale. Higher SES groups saw the most drop in caries prevalence, according to Patloth et al.[18] Several researchers have found similar findings, notably Thyath et al.[38] Katageri et al[45] Ingle et al.[17] Gupta et al.[46] Saravanan et al.[47] Moses et al (2011)[15] and Datta et al.[48] This might be because people from lower socioeconomic origins have material, social, and financial obstacles that make it difficult for them to take care of themselves and get expert medical care. Additionally, it has been shown that people from lower socioeconomic categories tend to have fatalistic attitudes toward their health and may believe they don't require dental care, which can result

Journal of Chemical Health Risks
www.jchr.org
JCHR (2026) 16(1), 337-352 | ISSN:2251-6727

in poor self-care habits and a decreased usage of preventative healthcare services.

Fluoride content and ECC

Water fluoridation, a public health measure introduced in the mid-20th century, is regarded as one of the top 10 public health achievements. The identification of fluoride's protective effect in drinking water against dental caries is widely recognized as one of the most significant public health advancements of this century.[49] A Cochrane review found that water fluoridation leads to a reduction of 1.81 in the decayed, missing, and filled teeth (DMFT) score for deciduous teeth, with a 15% decrease in primary dentition and a 14% reduction in permanent dentition. The U.S. Public Health Service currently suggests an optimal fluoride concentration of 0.7 mg/L for community water systems that add fluoride to drinking water.[50] There is limited research examining the link between dental caries prevalence and water fluoridation; thus, this study included fluoride levels in drinking water as one of the risk factors. Desai et al[51] reported a lower caries prevalence (17.2%) in areas with optimal fluoride levels in Nalgonda district and noted that the prevalence of dental caries decreased as fluoride concentration in drinking water increased, up to 5 ppm. Kotecha et al[52] reported a lower prevalence of dental caries in regions with higher fluoride concentrations in the drinking water of Gujarat. Similarly, several studies, including those by Acharya and Anuradha[53] in Davangere (India), Yiamouyiannis in the United States, and Schluter et al.[54] in New Zealand, found that the rate of decay in deciduous teeth was notably lower in areas with fluoridated water compared to those without it. In this study, the average fluoride concentration in drinking water across the surveyed areas was found to be 0.8 ppm (parts per million). This level is below the optimal fluoride concentration recommended by the World Health Organization (WHO), which is typically around 1.0 ppm. Fluoride, when present in the right concentration in drinking water, plays a key role in preventing dental caries by strengthening tooth enamel and making it more resistant to decay. Comparable fluoride concentrations in drinking water were also observed in other cities of Uttar Pradesh. Rai and Singh[55] reported fluoride levels ranging from 0.28 to 0.58 ppm in Lucknow, while Bhalla et al[56] found the average fluoride content in the drinking water of Mathura to be 0.64 ppm. Fluoride levels below 1 ppm in drinking water have been reported in several Indian states, including Uttar Pradesh (44.6%), Jammu and Kashmir (48.5%), Himachal Pradesh (93.6%), Haryana (80.7%), Delhi (99.6%), Madhya Pradesh (90%), Assam (98.8%), Orissa (85.9%), Maharashtra (54.6%), Karnataka (31%), Andhra Pradesh (72.3%), Tamil Nadu (57.2%), and Kerala (68.8%).[50] However, fluoride levels in drinking water did not significantly association with the occurrence of dental cavities in this study ($p = 0.001$). This might be explained by the small number of samples gathered from the locations under examination, which might not fully represent the actual fluoride concentrations in the sources of drinking water. The study also determined the relationship between the prevalence of dental caries in school-aged children (4-6 years old) and risk factors such as parental socioeconomic level, gender, oral hygiene habits, and oral health literacy. Given all of these particular risk factors, the study emphasizes that dental caries is a serious health concern for school-age children, highlighting the pressing need to provide children in schools with accurate and pertinent oral health information. Promoting community-based preventive oral health initiatives that emphasize good oral hygiene, healthy diet, and increasing dental knowledge is essential given India's fast urbanization. In order to address the growing problem of dental caries among schoolchildren, these programs ought to be included into school curricular and services. Additionally, educating the population about the impact of a healthy diet, which includes limiting sugar intake and consuming more fruits and vegetables, is vital for preventing tooth decay. Increasing awareness about oral health through these initiatives can empower individuals to make informed decisions about their dental care, leading to healthier outcomes. These community-based programs are especially important in urban settings, where access to dental care may be limited for some populations. By focusing on prevention and education, such initiatives can help create a lasting impact on the oral health of the community as a whole.

CONCLUSION

The overall caries prevalence in the 4-6 years-old school children in Hapur District, UP, was found to be 84.7%. Caries prevalence was more in children who brushed once a day. Though 66.3% participants had good oral health literacy but still the prevalence of ECC remained

high. Among the various SES, the prevalence of dental caries was found higher in children from lower class SES followed by upper lower, lower middle class, upper middle, and upper class, respectively. Mean fluoride content in drinking water of areas surveyed in different schools from each zone was found to be 0.8 ppm, and the caries prevalence was not significantly related to mean fluoride content of drinking water of surveyed areas. The predictors of ECC such oral hygiene practices, oral health literacy, SES of family, and fluoride levels from each schools were found to be associated with the prevalence of ECC in school-going children of 4-6 year age group.

REFERENCES

1. Pitts NB, Twetman S, Fisher J, Marsh PD. Understanding dental caries as a non-communicable disease. Br. Dent J. 2021; 231: 749– 753.
2. American Academy of Pediatric Dentistry. Policy on early childhood caries (ECC): Classifications, consequences, and preventive strategies. The Reference Manual of Pediatric Dentistry. Chicago, Ill.: AAPD; 2020:79-81.
3. Wagle M, D'Antonio F, Reierth E, Basnet P, Trovik TA, Orsini G, Manzoli L, Acharya G. Dental caries and preterm birth: a systematic review and metaanalysis. BMJ Open. 2018;8(3):e018556.
4. Thomson WM, Poulton R, Milne BJ, Caspi A, Broughton JR, Ayers KM. Socioeconomic inequalities in oral health in childhood and adulthood in a birth cohort. Community Dent.Oral Epidemiol. 2004 Oct;32(5):345-53.
5. Wen PY, Chen MX, Zhong YJ, Dong QQ, Wong HM. Global burden and inequality of dental caries, 1990 to 2019. J. Dent Res. 2022 Apr;101(4):392-9.
6. Hallett KB, O'Rourke PK. Pattern and severity of early childhood caries. Community Dent.Oral Epidemiol.. 2006 Feb;34(1):25-35.
7. Tinanoff N, Baez RJ, Diaz Guillory C, Donly KJ, Feldens CA, McGrath C, Phantumvanit P, Pitts NB, Seow WK, Sharkov N, Songpaisan Y. Early childhood caries epidemiology, aetiology, risk assessment, societal burden, management, education, and policy: Global perspective. Int. J. Paediatr. Dent. 2019 May;29(3):238-48.
8. Devan I, Ramanarayanan V, Janakiram C. Prevalence of early childhood caries in India: a systematic review and meta-analysis. Indian J. Public Health. 2022 Nov 1;66(Suppl 1):S3-11.
9. World Health Organization. WHO expert consultation on public health intervention against early childhood caries: report of a meeting, Bangkok, Thailand, 26-28 January 2016. WHO; 2017.
10. Anil S, Anand PS. Early childhood caries: prevalence, risk factors, and prevention. Frontiers in pediatrics. 2017 Jul 18;5:157.
11. He S, Choong EK, Duangthip D, Chu CH, Lo EC. Clinical interventions with various agents to prevent early childhood caries: A systematic review with network meta-analysis. Int. J. Paediatr. Dent. 2023 Sep;33(5):507-20.
12. Sharma V, Gupta N, Arora V, Gupta P, Mehta N. Caries experience in permanent dentition among 11–14 years old school children in Panchkula district (Haryana) India. Int J Sci Study 2015;3:112-5.
13. Tewari S. Caries experience in 3-7 year-old children in Haryana (India).\. J. Indian Soc Pedod. Prev Dent. 2001 Jun 1;19(2):52-6.
14. Goel P, Sequeira P, Peter S. Prevalence of dental disease amongst 5-6 and 12-13 year old school children of Puttur municipality, Karnataka State-India. J. Indian Soc. Pedod. Prev.Dent. 2000 Mar 1;18(1):11-7.
15. Moses J, Rangeeth BN, Gurunathan D. Prevalence of dental caries, socio-economic status and treatment needs among 5 to 15 year old school going children of Chidambaram. J Clin Diagn Res. 2011 Feb;5(1):146-51.
16. Shingare P, Jogani V, Sevekar S, Patil S, Jha M. Dental caries prevalence among 3 to 14 year old school children, Uran, Raigad district, Maharashtra. J Contemp Dent. 2012 May;2(2):11-4.
17. Ingle NA, Dubey HV, Kaur N, Gupta R. Prevalence of dental caries among school children of Bharatpur city, India. J. Int. Soc Preve. Community Dent. 2014 Jan 1;4(1):52-5.
18. Patloth T, Reddy S, Puppala R, Kethineni B, Peddi R. Prevalence of dental caries among 5-12 year old school going children in urban and rural areas of Mahabubnagar District, Telangana, India.
19. Kumar D, Gandhi K, Maywad S, Malhotra R, Ahuja S, Kapoor R. Prevalence and correlation of dental caries with its specific risk factors in 5–15-year-old school-going children in urban population of

Ghaziabad. Int. J. Clin. Pediatr. Dent. 2020 Jan;13(1):72.
20. Prakash P, Subramaniam P, Durgesh BH, Konde S. Prevalence of early childhood caries and associated risk factors in preschool children of urban Bangalore, India: A cross-sectional study. Euro. J Dent. 2012 Apr;6(02):141-52.
21. Ghanghas M, Kumar A, Manjunath BC, Narang R, Shyam R, Piplani A. Dental caries experience among 3-5 years old preschool children in India. Austin J Public Health Epidemiol. 2017;4:1063-66.
22. Virdi M, Bajaj N, Kumar A. Prevalence of severe early childhood caries in pre-school children in Bahadurgarh, Haryana, India. Internet J Epidemiol. 2010;8(2).
23. Mahejabeen R, Sudha P, Kulkarni SS, Anegundi R. Dental caries prevalence among preschool children of Hubli: Dharwad city. J. Indian Soc. Pedod. Preve Dent. 2006 Jan 1;24(1):19-22.
24. Yavagal PC, Velangi CS, Singh I, Desai P, Sunny CH. Prevalence of early childhood caries among children attending Anganwadis in Davangere city: A cross sectional survey. Journal of Indian Association of Public Health Dentistry. 2020 Jul 1;18(3):199-203.
25. Gaidhane AM, Patil M, Khatib N, Zodpey S, Zahiruddin QS. Prevalence and determinant of early childhood caries among the children attending the Anganwadis of Wardha district, India. Indian J Dent Res. 2013 Mar 1;24(2):199-205.
26. Rai B, Jain R, Kharb S, Anand SC. Dental caries and oral hygiene status of 8 to 12 year school children of Rohtak: a brief report. The Internet J. Dent. Sci. 2007;5(1):1-3.
27. Al-Samadani KH, Ahmad MS, Bakeer HA, Elanbya MO. Oral health knowledge and practice among 9-12-year-old schoolchildren in the region of Madinah, Saudi Arabia, and its impact on the prevalence of dental caries. Eur. J. Gen Dent. 2017 Jan;6(01):54-8.
28. Koya S, Ravichandra KS, Arunkumar VA, Sahana S, Pushpalatha HM. Prevalence of early childhood caries in children of West Godavari District, Andhra Pradesh, South India: an epidemiological study. Int. J. Clin. Pediatr. Dent. 2016 Sep 27;9(3):251.
29. Dixit A, Aruna DS, Sachdev V, Sharma A. Prevalence of dental caries and treatment needs among 3-5 year old preschool children in Narmada, Gujarat. IOSR J Dent Med Sci. 2015;14(1):97-101.
30. Amanlou M, Jafari S, Afzalianmand N, Omrany ZB, Farsam H, Nabati F, Bagherzadeh K. Association of Saliva Fluoride level and socioeconomic factors with dental caries in 3-6 years old children in Tehran-Iran. Iranian J. Pharm Res: IJPR. 2011;10(1):159.
31. Toutouni H, Nokhostin MR, Amaechi BT, Zafarmand AH. The prevalence of early childhood caries among 24 to 36 months old children of Iran: using the novel ICDAS-II method. J. Dent. 2015 Dec;16(4):362.
32. Chevvuri R, Sharma H, Gupta R, Tiwari A, Singh GB, Singh A. Prevalence and determinants of early childhood caries among children enrolled in anganwadi centres in Bhilai of Central India: A cross-sectional study. Indian J. Dent. Res. 2022 Jul 1;33(3):297-300.
33. Chugh VK, Sahu KK, Chugh A. Prevalence and risk factors for dental caries among preschool children: a cross-sectional study in eastern India. Int. J Clin. Pediatr Dent. 2018 May;11(3):238.
34. Jamshidi M, Sistani MM, Boushehri N, Hamzeh M. Prevalence of early childhood caries and the related factors among 3-5-year-old children in Babol, Iran. J. Dent. 2022 Jun;23(2):137.
35. Barjatya K, Nayak UA, Vatsal A. Association between early childhood caries and feeding practices among 3–5-year-old children of Indore, India. J. Indian Soc. Pedod. Prev Dent. 2020 Apr 1;38(2):98-103.
36. Correa-Faria P, Martins-Junior PA, Vieira-Andrade RG, Marques LS, Ramos-Jorge ML. Factors associated with the development of early childhood caries among Brazilian preschoolers. Brazilian oral research. 2013 Jun 14;27:356-62.
37. Kuriakose S, Prasannan M, Remya KC, Kurian J, Sreejith KR. Prevalence of early childhood caries among preschool children in Trivandrum and its association with various risk factors. Contemp. Clin. Dent. 2015 Jan 1;6(1):69-73.
38. Jose B, King NM. Early childhood caries lesions in preschool children in Kerala, India. Pediatric dentistry. 2003 Nov 1;25(6).
39. Thyath MN, Nishad SG, Sharma M, Zaidi I. Impact of socioeconomic status and parental factors on child oral health-a review of literature. Journal of Advanced Medical and Dental Sciences Research. 2015 Apr 1;3(2):153.

40. Popoola BO, Denloye OO, Iyun OI. Influence of parental socioeconomic status on caries prevalence among children seen at the university college hospital, Ibadan. Annals of Ibadan postgraduate medicine. 2013;11(2):81-6.
41. Sharma K, Gupta KK, Gaur A, Sharma AK, Pathania V, Thakur VB. A cross-sectional study to assess the prevalence of early childhood caries and associated risk factors in preschool children in district Mandi, Himachal Pradesh. J. Indian Soc. Pedod. Preve Dent. 2019 Oct 1;37(4):339-44.
42. Saldūnaitė K, Bendoraitienė EA, Slabšinskienė E, Vasiliauskienė I, Andruškevičienė V, Zūbienė J. The role of parental education and socioeconomic status in dental caries prevention among Lithuanian children. Medicina. 2014 Jan 1;50(3):156-61.
43. Gao X, Di Wu I, Lo EC, Chu CH, Hsu CY, Wong MC. Validity of caries risk assessment programmes in preschool children. J. Dent. 2013 Sep 1;41(9):787-95.
44. Tiberia MJ, Milnes AR, Feigal RJ, Morley KR, Richardson DS, Croft WG, Cheung WS. Risk factors for early childhood caries in Canadian preschool children seeking care. Pediatric dentistry. 2007 May 1;29(3):201-8.
45. Katageri AA, Arora R, Bhayya D, Patil K. Prevalence of dental caries and its association to maternal education as a risk indicator: A Cross section study in Udaipur–Rajasthan. Scholars Journal of Applied Medical Sciences. 2014 Aug 20;2(3):983-6.
46. Gupta R, Gaur KL, Sharma AK, Zafer S, Kewalramani S. Comparison of associating factors of dental caries in urban and rural children in Jaipur,(Raj) India. IOSR J Dent Med Sci. 2013;3(9):55-6.
47. Maj Saravanan SP, Lokesh S, Polepalle T, Shewale A. Prevalence, severity, and associated factors of dental caries in 3–6-year-old children–a cross-sectional study. Int J. 2014;2(6A):5-11.
48. Datta P, Datta PP. Prevalence of dental caries among school children in Sundarban, India. Epidemiology 2013;3: 2161-1165. 9.
49. Butler WJ, Segreto V, Collins E. Prevalence of dental mottling in school-aged lifetime residents of 16 Texas communities. American journal of public health. 1985 Dec;75(12):1408-12.
50. Iheozor-Ejiofor Z, Worthington HV, Walsh T, O'Malley L, Clarkson JE, Macey R, Alam R, Tugwell P, Welch V, Glenny AM. COCHRANE REVIEW OF WATER FLUORIDATION. Fluoride. 2015 Jul 1;48(3).
51. Desai VC. Prevalence of Dental caries at Different Levels of Fluoride ion concentrations among the school children in Nalgonda district.
52. Kotecha PV, Patel SV, Bhalani KD, Shah D, Shah VS, Mehta KG. Prevalence of dental fluorosis & dental caries in association with high levels of drinking water fluoride content in a district of Gujarat, India. Indian J. Med Res. 2012 Jun 1;135(6):873-7
53. Acharya S, Anuradha KP. Correlation between water fluoride levels and dental caries in Davangere District, India. Indian J. Dent. Res: official publication of Indian Society for Dental Research. 2003 Jul 1;14(3):146-
54. Schluter PJ, Lee M. Water fluoridation and ethnic inequities in dental caries profiles of New Zealand children aged 5 and 12–13 years: analysis of national cross-sectional registry databases for the decade 2004–2013. BMC Oral Health. 2016 Dec;16:1-0.
55. Rai V, Singh M. Fluoride concentration in drinking water of Lucknow city, India: A case study. Hydrol Current Res. 2014;5(4):1-3.
56. Bhalla M, Ingle NA, Kaur N, Gupta R, Ingle E. Estimation of Fluoride Concentration in Municipal Water Supply and Commercially Available Packaged Drinking Water in Mathura City. A-Comparative Study. Journal of Oral Health & Community Dentistry. 2014 Sep 1;8(3).