

A Review of the Trends in Dental Caries of School-Going Children in Amritsar City Over 65 Years and Its Comparison with Other Regions of North India

ABSTRACT

Aims: This study aims to review the changing trends in prevalence of dental caries in school-going children of Amritsar city and its comparison with the existing prevalence studies of other regions of North India. **Materials and Methods:** A stratified random selection of seven schools, divided into Group 1 (government schools) and Group 2 (private schools), was carried out, further divided into age groups: 3–5, 6–9, and 10–14 years. The World Health Organization (2013) criteria were used to diagnose dental caries. The data obtained were put to statistical analysis. A review of literature was further carried out to compare the trends of dental caries with other regions of North India. **Results:** Overall caries prevalence was 53.63% (Group 1) and 35.33% (Group 2), with an increase in prevalence with advancing age in Group 1. Comparison of this data with retrospective studies of Amritsar city revealed a similar prevalence to that reported in 1952 (51.5%). A gradual rise in the prevalence of dental caries was evident in other regions of North India from 1970 to 2010 and declined thereafter till 2015 in all age groups. **Conclusion:** There is an urgent need to redirect dental services toward high-risk groups and develop intersectoral and risk factor-based approach for oral health promotion.

Key words: Dental caries, Government versus private schools, North India, Rural versus urban, Socioeconomic status, World Health Organization

INTRODUCTION

School health program is one of the important components of health-care delivery system which helps in keeping a close watch on oral and physical health of school-going children. It is an admitted fact that children are the future of the nation. If the children are healthy, the nation is bound to be strong. Government of India has emphasized the importance of medical and dental check-ups of primary and secondary school-going children. Keeping in view, the importance of this program, the state of Punjab, in the northern region of India, utilized the existing medical and paramedical facilities of primary health centers, school health clinics, and community health centers with effect from August 1, 1981.^[1]

Under this program, all school-going children up to secondary classes of government and private government-aided schools were examined for oral health at least once in the academic year and twice for children going to primary schools. However, the magnitude of handling more than 2,636,285 number of students studying in primary, middle, high school, and higher secondary classes as listed by epunjab.school.gov.in,^[2] has caused hurdles in implementation of the school health program scheme. The monitoring, supervision, and implementation in district headquarters and it's time to time review at state level, however, can only be reflected through the impact of these programs on the oral health status of school-

Hemal Bipin Patel¹, Navneet Grewal¹, Ankeeta Satish Khadilkar²

¹Department of Pedodontics and Preventive Dentistry, GDCH Amritsar, Amritsar, Punjab, India, ²Department of Dentistry, Hinduja Healthcare Surgical, Mumbai, Maharashtra, India

Corresponding Author:

Hemal Bipin Patel, Department of Pedodontics and Preventive Dentistry, GDCH Amritsar, Amritsar, Punjab, India.
E-mail: hemalp2285@gmail.com

going children and the knowledge, attitude, and practice (KAP) values of those who received the dental education.

Although many studies focusing on the impact and effectiveness of school-based dental health education (DHE) programs are conducted in southern part of India, few studies exist relatively in the northern region.^[3] Evaluation of oral health program is a powerful tool to identify the groups at high risk for acquiring a disease. This may bring forth the magnitude of the problems existing in these groups which is a basic step to bring a paradigm shift in approach for dental awareness among school-going children, their parents, and schoolteachers.

Epidemiological studies reviewing the trends in dental caries from the past 15 years revealed that the prevalence and weighted mean of dental caries for the north region of India is

more in all the index age groups as compared to the southern region.^[4] Hence, it was important to have a review of reports on caries prevalence in the northern regions of India with varying demographic parameters.

Hence, the present review was undertaken to report the prevalence of dental caries among school going children of Amritsar city in Northwest India, belonging to different socioeconomic status (SES) to identify the population at risk and compare with retrospective trends of dental caries over the past 65 years in the city. Further, the existing prevalence studies of other regions of North India were compared and analyzed for an overall trend of caries burden in children in the northern region of India.

MATERIALS AND METHODS

Target population

Amritsar is a northwestern city of India with a population of 1,219,478 and literacy rate of 85.27% (male = 88.09% and female = 82.09%).^[5] A cross-sectional study design was carried out targeting a total of seven schools. Government (four schools) and private (non-government aided – three schools) were divided into Group-1 ($n = 3731$) and Group-2 ($n = 1582$), representing the middle and upper middle SES, respectively, as per the fee structure. A stratified random sampling method was carried out while selecting the schools to include schools from all geographical directions (north, south, east, west, and central zone). The study sample was further divided into age groups: 3–5, 6–9, and 10–14 years in both the groups [Table 1]. Based on the population, at a confidence interval (CI) of 95% and alpha error = 0.025, total sample size representative of the population was calculated to be 1535. In the present study, 3731 children from government and 1582 children from private schools were examined.

Recruitment of sample

Before the start of the study, official permission was obtained from all the concerned authorities. Each school principal was asked about the extent of inclusion of DHE in the school curriculum. They were invited to participate in the project after informing about the aims and objectives of the study. A participant information statement was provided to the class teachers before the day of the survey. The nature of the survey

was explained and written informed consent for participation was taken from the parents/caretakers. Visit to the school was made on pre-decided dates and all the students present on the day were examined.

Clinical examination

A clinical oral examination was carried out to assess dental caries experience in the primary dentition and young permanent first molars as per the WHO guidelines (2013).^[6] The children were examined with a lightweight portable examination light (in the blue-white color spectrum), seated in an ordinary chair with a high backrest and the examiner standing behind the chair. Dental caries assessment was based on visual examination of cavitation with a plane mouth mirror. Probing into the cavity was avoided as it would have affected the behavior of children. Children found to have even one decayed tooth were counted under the percentage affected with dental caries for calculating the prevalence. A questionnaire with ten questions on oral hygiene practice and knowledge pertaining to oral health was filled by each individual.

Intra- and inter-examiner variability

Assessment of intra- and inter-examiner variability was carried out before examination on initial 10% of the subjects to ensure calibration of all three examiners for uniform interpretation and understanding of the criteria of dental caries. Coefficient of observer variability was checked by paired *t*-test, ANOVA, intraclass correlation coefficient (ICC), and Cronbach's alpha test computed at 95% CI.

The findings were recorded on a computerized pro forma as per the WHO guidelines. Motivational pamphlets that included the required preventive measures of dental caries were handed over to the children [Figure 1]. The purpose was to give information to the parents about their child's oral health status and preventive measures available for them. Survey findings were reported to respective school authorities on the spot.

Data analysis

The statistical software Statistical Package for the Social Sciences (SPSS) PC 22.0 (Statistical Package for the Social Sciences, Inc., Chicago, IL) was used for statistical analysis of data and Pearson's Chi-square test was applied at $P < 0.05$ or at 5% level of significance.

Table 1: Prevalence of dental caries in different age groups in Group I and Group II

Age (years)	Group I – government schools			Group II – non-government aided private schools		
	Total examined (n=)	Total sample with carious teeth	Caries prevalence (%)	Total examined (n=)	Total sample with carious teeth	Caries prevalence (%)
3–5	651	317	48.70	493	182	36.90
6–9	1935	973	50.30	446	142	31.80
10–14	1146	711	62.00	643	235	36.50
P-value		<0.001**			0.188 ^{NS}	

NS: $P > 0.05$; not significant; ** $P < 0.001$; highly significant

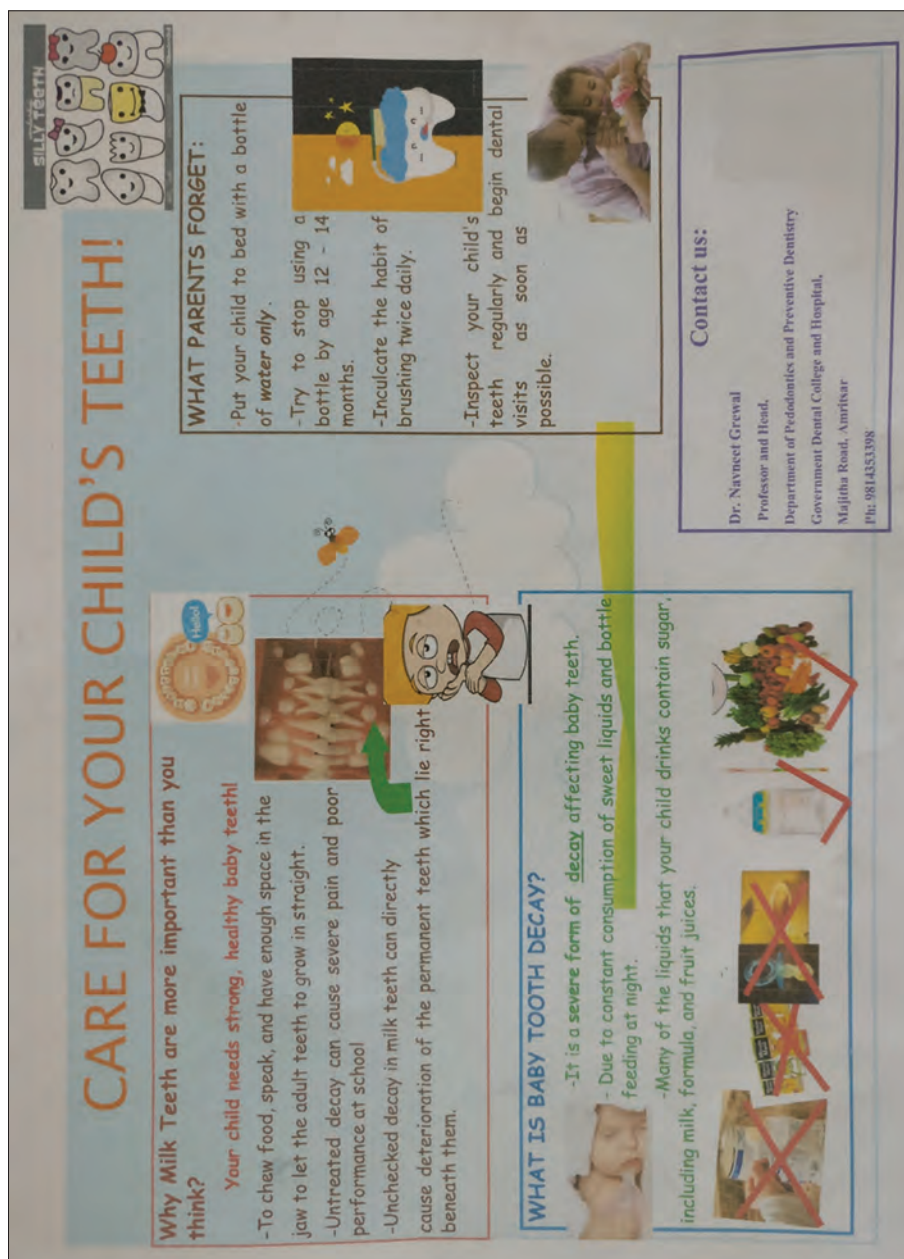


Figure 1: Motivational pamphlet showing preventive measures of dental caries

RESULTS

Intraexaminer reliability was found to be optimum (ICC=0.987, 0.989, and 0.992 for three observers). Cronbach’s alpha test value of 0.984 (0.969–0.992) indicated optimum interexaminer variability when computed at 95% CI.

When the distributions of demographic and social characteristics of children sampled from school backgrounds representing different SES of the society were compared, significant differences were detected in the prevalence of dental caries in children from low SES showing 53.63% prevalence versus 35.33% in children from high SES ($P < 0.001$). Data

were collected from different geographical zones of the city to identify and target the high-risk groups.

In the sample of 2223 males and 1508 females, in Group 1, aged 3–14 years, caries lesion group included 1216 (54.67%) males and 785 (52.06%) females. Dental caries lesion prevalence (male and female) was 48.70%, 50.30%, and 62% in 3–5, 6–9, and 10–14 years age group, respectively, representing government schools [Table 2].

In the sample of 985 males and 579 females, in Group 2, whose ages ranged from 3 to 14 years, caries lesion group included 330 (33.50%) males and 229 (39.55%) females. Dental caries lesion prevalence was 36.90%, 31.80%, and

Table 2: Age-wise and gender prevalence of dental caries

Age (years)	Group I		Group II		P-value
	Total sample with carious teeth	Caries prevalence (%)	Total sample with carious teeth	Caries prevalence (%)	
3-5					
Males	192	47.40	109	38.24	0.017*
Females	125	50.81	73	35.10	0.001*
6-9					
Males	600	52.82	81	27.84	<0.001**
Females	373	46.68	61	39.35	0.094 ^{NS}
10-14					
Males	424	62.07	140	34.23	<0.001**
Females	287	61.99	95	40.60	<0.001**
Overall prevalence	2001	53.63	559	35.33	<0.001**

NS: $P > 0.05$; not significant; * $P < 0.05$; significant; ** $P < 0.001$; highly significant

36.50% in 3–5, 6–9, and 10–14 years age group, respectively, representing private schools [Table 2].

Age-wise analysis revealed increase in prevalence with advancing age of children in Group-1 which was highly significant ($P < 0.001$). However, difference in prevalence between the age groups in Group-2 was not found to be statistically significant [Table 1].

Comparison with retrospective studies carried out by the same institution showed no change in the caries prevalence value in the year 1952 when compared with the current results (age group 6 years and above). Although, in the present study conducted in 2015-2016 a decline to 51.7% was noted from 71.09% in the year 2010 [Figure 2]. The first cross-sectional study conducted in 1952 in school-going children aged 8–13 years by Vacher,^[7] reported a prevalence of 51.5%. Prevalence of dental caries in children aged 6–15 years, in the year 1983 (63.27%), was found to be similar as compared to 1988 (64.6%).^[8,9] Five yearly surveys have been conducted in school-going children belonging to middle SES since 2000 by the department of pedodontics in the central zone. Overall prevalence was found to be 73.41%, 69.30%, and 83.34% in the year 2000, 2005, and 2010, respectively [Table 3].

A review of literature was further carried out to compare the trends in dental caries of Amritsar city with other regions of North India.

Search strategy for identification of studies

Studies fulfilling a priori set of inclusion criteria, that is, prevalence studies carried out in the northern region of India only in the age groups of 3–14 years (1952 to December 2016) were included in the review. Studies carried out in other regions of India or on the WHO index age groups were excluded from the study. Included studies were accessed primarily through an electronic search of Medline (PubMed and Google Scholar). The search terms included MeSH headings, text words, and/or keywords relevant to the following terms: Dental caries, children,

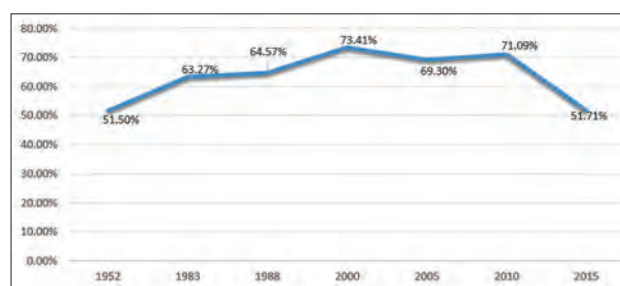


Figure 2: Trends of dental caries prevalence in Amritsar city

preschool, North India, socioeconomic status, rural versus urban, government versus private schools, etc. Reference lists from all identified appropriate papers and review papers were examined followed by a hand search for other identified studies. One reviewer (H.P.) screened all identified titles and abstracts for relevance. Two reviewers (N.G and H.P.) assessed potentially relevant studies for inclusion independently. Any disagreements were resolved by discussion and only when there was 100% agreement between the two reviewers were the articles included. A total of 25 articles were included in the review [Figure 3].

Trends of dental caries in North India

Prevalence studies on early childhood caries (ECC) (age 2–6 years) showed varied trends in different regions of North India [Table 4]. A gradual rise was seen from 1970 to 2000 followed by a sharp decline in 2001. A slow rise from 2001 to 2010 was observed and then a slow decline after 2010. A similar trend with rise after 1970 was evident in older age group of 6–14 years with decline being observed after 2010 [Table 5].^[19-31]

DISCUSSION

According to Ripa^[32] and Reisine and Psoter,^[33] the major risk factor for childhood caries is a low socioeconomic status. It

has been well documented that lower SES and educational level of most of the respondents are commonly associated with poorer oral health and less favorable attitude toward dental care in India.^[34-36] Average literacy rate of Amritsar as per census 2011 was 76.27, wherein male and female literacy was 80.15 and 71.96,^[37] respectively. The literacy rate has increased to 85.27% in 2017.^[38] In the present study, majority of the children in private schools had sought some form of dental treatment for carious teeth while those in government schools had untreated carious teeth.

Age-wise analysis revealed the prevalence of ECC to be statistically highly significant in Group-1 (government

Table 3: Data of 5 yearly survey carried out in school-going children belonging to middle socioeconomic status

Year	Age group								
	3-5 years			6-9 years			10-14 years		
	N	C	P (%)	N	C	P (%)	N	C	P (%)
2000	458	331	72.27	971	747	76.93	884	620	70.14
2005	166	132	79.52	480	357	74.38	429	256	59.67
2010	376	343	91.22	732	644	87.98	591	429	72.59

N: Total no. examined, C: Total no. affected with caries, P: Prevalence of dental caries

schools) as compared to Group-2 for all age groups [Table 2]. Caries being a continuous and cumulative process, prevalence was found to increase with advancing age in Group-1 [Table 1]. Furthermore, the first permanent molars being the most susceptible to caries and exposed in the oral cavity for 2-3 years may have attributed to increase in prevalence at the age of 10-14 years. This in accordance with other authors, Tiwari and Chawla^[39] and Goyal *et al.*^[40] who reported a similar finding in North Indian population.

Large disparities exist between health care utilizations and socioeconomic background of the people in India.^[41] Financial, social, and material disadvantages that compromise their ability to care for themselves and obtain professional health-care services as stated by Chen^[42] were found to be the reason for similar findings in our study.

In India, low SES individuals have more fatalistic beliefs about their health and have a lower perceived need for care, leading to less self-care and lower utilization of preventive health services. Parental KAPs were not recorded in this screening. Recording of these parameters in future studies would exhibit a better insight about parents' limited knowledge and casual attitudes toward oral health, which possibly reflects on the children.

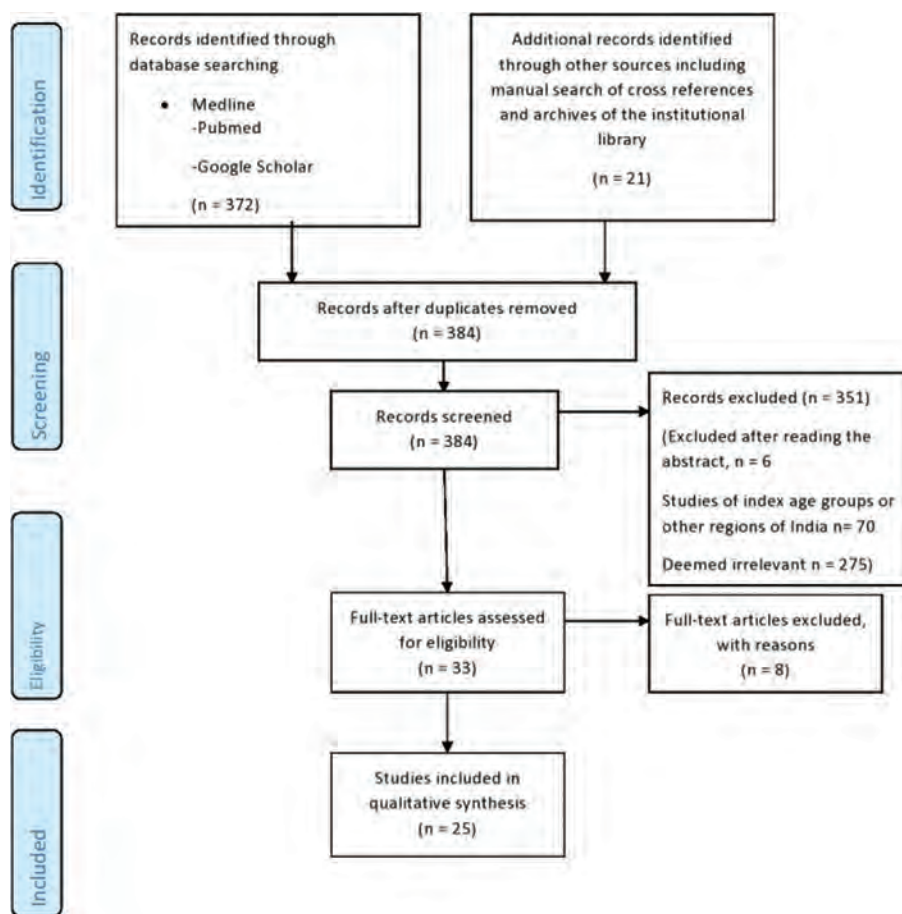


Figure 3: Flowchart showing the method of extraction of articles

Table 4: Prevalence of dental caries in preschool children in North India

Author/year/region	Age group/population/socioeconomic status (SES)	Prevalence
Singh, 1970, Amritsar ^[10] (M.D.S Thesis-Guru Nanek Dev University)	3–6 years/urban schools/mixed SES	52.16% 3 years=45.33% 6 years=64%
Tewari and Tewari, 2001, Haryana ^[11] (J Indian Soc Pedo Prev Dent)	3–7 years/rural schools/middle-high SES	33.80% Statistically significant increase ($P<0.05$) in caries experience at the age of 6 years (38%) when compared with the age of 3 years (19.4%) and no statistically significant differences in caries experience was found between 3–4 years, 3–5 years, and 3–7 years of age
Simratvir et al., 2009, Ludhiana ^[12] (J Indian Soc Pedod Prevent Dent)	3–6 years/urban schools/middle SES	52.01%
Kalra, 2011, Haryana ^[13] (Indian J Dent Sci)	2–6 years/urban schools/middle SES	68.7%
Raj, 2013, Chandigarh ^[14] (Int J Public Health Dent)	3–6 years/upper middle, lower middle, and upper lower and lower SES/children attending Anganwadi schools of rural, periurban, and urban areas	48.3%
Shrutha 2013, Kanpur ^[15] (ISRN Dentistry)	3–5 years/urban schools/public and private schools from four geographical zones were selected. (Although preschools are in urban areas, children attending these schools were drawn from across the district areas, living in rural home addresses).	48%
Narang, 2013, Lucknow ^[16] (J Clin Diag Res)	2–6 years/urban schools/upper, upper middle, lower middle, and upper lower class	33.1%
Gupta et al., 2015, Uttarakhand ^[17] (North Am J Med Sci)	3–5 years/rural schools	45.1%
Sachdeva et al., 2015, Haryana ^[18] (J Int Soc Prev Community Dent)	Up to 5 years old/rural/children attending the OPD	33.85%

As shown in Figure 2, a steady rise in the prevalence of dental caries since 1952 up to 2010 indicated less significant impact of the school health programs in controlling caries prevalence. However, a trend toward decline from 2010 to 2016 may be attributed to the awareness created by the strategic methodological regular dental health check-up camps along with parental/schoolteacher interaction undertaken targeting high-risk groups every year by the department of pedodontics [Table 6].

Prevalence studies on dental caries in India have shown a result ranging from 31.5% to 89%.^[43,44] India is a country with diverse culture, staple diet, SES, and habits in general. All of these have an inevitable effect on the incidence and severity of dental caries. Therefore, studies conducted in one region cannot be compared, for assessing the trends, with those in another region. Hence, prevalence in the present study was compared with the previous studies conducted in the same region of India.

Another difficulty in comparing the prevalence and assessing the trends of dental caries in other regions is that epidemiological studies in India have been conducted on different age groups and have employed different caries recording criteria (indices). Hence, this article presents a broad analysis of studies on prevalence of dental caries in preschool and school-going children [Tables 4 and 5].

In the present study, dental caries was diagnosed entirely on visual examination as per the WHO 2013. To aid higher level of reproducibility and reliability, the diagnostic criterion in this study was limited to cavitation level. No attempt was made to use a dental explorer to confirm cavitation of the lesions due to the young age of the children. This ensured their compliance with the examination without adversely affecting their cooperation and behavior in the dental environment in future. However, visual examination may have resulted in an underestimation of the actual caries status.

Over the past few decades, a trend of declining caries in developed countries and an increasing caries experience in developing countries has been reported.^[45-47] The trend may continue to rise in the future due to growing globalization. Change to a more refined high-sugar diet is associated with economic growth, consequentially leading to deterioration of dental health.^[46]

A very extensive and comprehensive National Health Survey conducted in 2004,^[48] reported a prevalence of 51.9% and 53.8% at the age of 5 and 12 years, respectively. Studies reviewed from 2004 to 2016 (one decade) in the region of North India revealed a prevalence ranging from 33.85% to 68.7% for preschool children and 43.9–77.7% for school-going children (6 years and above). This points toward the need for initiation of a comprehensive caries preventive program to address and target the high-risk groups.

Table 5: Prevalence of dental caries in school-going children of North India (6 years above)

Author/year/region	Age group/population/socioeconomic status	Prevalence
Vacher, 1952, Amritsar ^[7] (J Indian Dent Assoc)	8–13 years/urban schools/mixed SES	49.5%
Chaudhry et al., 1957, Lucknow ^[19] (J Indian Dent Assoc)	5–16 years/14-day schools in urban Lucknow/mixed SES	Boys=44.5% Girls=44.4%
Gill and Prasad, 1968, Lucknow ^[20] (J Indian Dent Assoc)	6–15 years/rural schools/low SES	48.03%
Tiwari & Chawla, 1977, Chandigarh ^[21] (J Indian Dent Assoc)	6–16 years/urban schools/mixed SES	81.60%
Singh et al., 1977, Patiala ^[22] (J Indian Dent Assoc)	Primary schoolchildren in a total of 63 schools/mixed SES	46.34%
Taneja et al., 1978, Meerut ^[23] (Western Uttar Pradesh) (Indian J Pediatr)	9–17 years (maximum belonged to the age group: 9–11 years – 48.18% and 12–14 years – 47.18%) Two urban schools (as a part of medical examination)	3% (incidence reported was much lower. Since the finding was a part of general medical examination, no inference could be drawn)
Chandra and Chawla, 1979, Lucknow ^[24] (J Indian Dent Assoc)	4–15 years/high, medium, and low SES	49.85% High SES – 58.42% Medium SES – 46.12% Low SES – 45%
Dhar et al., 1979, Kashmir ^[25] (Indian J Public Health)	4–14 years (majority belonged to: 6–11 years)/urban schools/mixed SES	26.51%
Chopra, 1983, Amritsar ^[8] (J Indian Dent Assoc)	6–14 years/urban schools/mixed SES	63.27%
Singh et al., 1985, Faridkot ^[26] (J Indian Dent Assoc)	Primary schoolchildren in a total of 17 urban schools/middle and low SES	Middle SES=30.63% Low SES=33.08%
Guaba et al., 1986, Villages of district Ludhiana ^[27] (J Indian Dent Assoc)	7–17 years/rural schools/mixed SES	61.96% at 7 years Increased to 87.95% at 13 years and steady up to 17 years
Gill, 1988, Amritsar ^[9] (M.D.S Thesis- Guru Nanak Dev University)	6–15 years/urban schools/mixed SES	64.6%
Grewal et al., 2009, Uttaranchal ^[28] (J Indian Soc Pedod Prevent Dent)	7–12 years/rural schools	77.7%
Grewal et al., 2011, Delhi ^[29] (Indian J Dent Res)	9–12 years/three educational zones (i.e., Central, South, and North-West) of urban Delhi/mixed SES	52.3%
Chaturvedi et al., 2012, Varanasi ^[30] (Indian J Prev Soc Med)	6–10 years/urban and suburban three educational zones (east, central, and south)/mixed SES	67.9%
Ravindra, 2014, Lucknow ^[31] (Unique J Med Dent Sci)	6–12 years/urban schools (selected based on convenience)	43.9%

Table 6: School oral health programs and activities conducted in Amritsar city

Age (years)	Oral health topics	Materials and visual aids	Setting/year
Birth-3	Anticipatory guidance to parents in collaboration with Health Care Professionals Information to parents about oral health, teething, tooth brushing, breastfeeding, dummies/bottles, nutrition, caries, medicine, dental trauma	Picture posters, booklets Videos	Day-care centers, local pediatricians, gynecologists, and health-care professionals Day-care centers (2010–2012)
3–5	Same as above	Oral health cartoon videos for children, specially designed information pamphlets for parents	School oral health check-up camps (2010–2016)
6	Importance of first permanent molars, oral hygiene, nutrition/ food pyramid.	PowerPoint ppts for parents	Parent – Teacher meetings (2010–2016)
7–9	Dentition, function and structure of teeth, brushing technique, caries process, trauma	Models, videos, interactive sessions with students.	Classroom/class teachers/principles (2010–2016)
10–14	Hidden sugars, plaque, caries process, reinforcement for good oral hygiene practices	Models, videos, interactive sessions with students	Classroom/class teachers/principles (2010–2016)

Tables 4 and 5 reflect on the several factors influencing the prevalence of dental caries in India such as population (urban vs. rural), gender differences, caries diagnostic criteria, dietary habits, tooth cleaning habits, parental awareness and educational level, and socioeconomic status. The National Oral Health Policy in 1995^[49] aimed to bring down the incidence of oral and dental diseases to less than 40%. However, the above review shows that not much work has been done to reduce the morbidity of the oral-related diseases.

The need for systematic methods of identification of high-risk groups based on demographic logistics would be a good proposition. Based on the guiding principles of the Ottawa Charter for Health Promotion and the recommendations of WHO's Expert Committee on Comprehensive School Health Education and Promotion, an initiative aiming to foster health-promoting schools (HPSs) that constantly strengthen their capacity as a healthy setting for living, learning, and working (WHO, 1998)^[50] is a pressing need for oral health to be promoted in schools in India.

To become a HPS as recommended by the WHO, schools need to commit to work jointly toward the following goals for oral health:

- Engaging health and education officials, teachers, students, parents, and community leaders in efforts to promote health
- Providing a safe and healthy physical and psychosocial environment which would indirectly influence dental trauma experience of children
- Providing effective skill-based health education and access to health services through involvement of pediatric dentists, both academicians and practitioners.

Using the structures and systems already in place, school is an efficient setting for the promotion of oral health not only for the students but also for the staff, families, and members of the community. The Indian community still holds many myths regarding dental treatment and does not consider primary dentition to be an important component of the oral cavity.^[51] A better understanding of these beliefs may also help providers explain the goals, risks, and benefits of treatment to the parents as well as to their families, which play an important role in the decision making.

Moreover, all epidemiological studies conducted in the country may adopt any one internationally accepted index for recording and reporting so that comparisons can be made in the future. Such comparisons will be helpful in identifying the high-risk groups and areas. This will further help in redirecting dental services to the needy rather than concentrating in existing educated areas.

CONCLUSION

The potential for developing a comprehensive program using the HPS approach is considerable. There is a need for commitment from central and local government to develop an evaluation and feedback system to fill the lacunae in the

existing oral health programs. It is imperative for public health authorities and health professionals to provide sustainable support, in terms of technical assistance, funding, and/or learning materials to facilitate schools becoming HPSs.

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