

Burden of Dental Caries in India: Current Scenario and Future Strategies

Sanjay Miglani

ABSTRACT

Introduction: Dental caries, commonly known as tooth decay or cavity, is among the most widespread oral diseases globally. It is one of the prime causative agents of oral discomfort and reason for patients to visit dental clinics or hospitals. If detected timely, the tooth can be restored and if left untreated it can eventually lead to tooth loss or other serious sequelae.

Objective: This article draws attention to why dental caries is a global oral health concern and problems faced in India in managing this pandemic disease. It also attempts to suggest a few preventive strategies and future research directions needed to control this national oral health concern.

Materials and methods: A narrative overview of the current literature is presented and a few suggestions on preventive and research strategies are highlighted.

Results: Oral health that is an essential component of overall well-being is often neglected in India. Basic region-wise data in the form of well-controlled surveys regarding the prevalence of dental caries across India are also not available. This is needed to frame robust preventive strategies, policies, and manpower allocation, suitable for different subgroups of the population.

Conclusion: State-level data should be collected to know the prevalence of this disease, identify the high-risk areas and customize region-wise preventive and treatment strategies. India has the maximum number of dental schools, efforts at individual levels are needed since everything cannot be left for the government to work upon.

Keywords: Dental caries, Disease burden, Oral health, Preventive strategies, Research strategies.

International Journal of Clinical Pediatric Dentistry (2020): 10.5005/jp-journals-10005-1733

INTRODUCTION

In the year 2016, the first attempt was made to assess the state-wise global disease burden (GDB) of India. The results of this study showed that the five leading individual causes of disability-adjusted life years (DALYs) in India were ischemic heart disease, chronic obstructive pulmonary disease, diarrheal diseases, lower respiratory infections, and cerebrovascular disease.¹ Oral health was totally overlooked and not recorded in this survey. Many oral diseases like oral cancers, periodontal diseases, and dental caries have high prevalence in India and are a matter of concern. This article focuses on dental caries, commonly known as tooth decay or cavity, and is defined as "the localized destruction of susceptible dental hard tissues by acidic by-products from bacterial fermentation of dietary carbohydrates."² It can affect the deciduous or the permanent dentition, and both the coronal and radicular parts of the tooth. The interplay between host- and environment-related factors governs the development and progress of dental caries. There are many factors that may increase the susceptibility of an individual to dental caries or its sequelae.³ These include microbiological factors, behavioral and lifestyle-related factors like poor oral hygiene, inappropriate dietary habits like frequent intake of refined carbohydrates and sugars, frequent use of sugar-containing medications, and wrong feeding habits among infants.^{4,5} Host-related factors like diabetes, salivary flow, stress, altered immune response, and genetic polymorphism can also influence the patients' susceptibility to dental caries.⁶⁻¹⁰ Not only these but low socioeconomic status, less education, unavailability of dental insurance coverage, and prolonged orthodontic treatment especially with fixed braces and poorly fabricated partial dentures have also been associated with dental caries.^{3,11,12}

Department of Conservative Dentistry, Faculty of Dentistry, Jamia Millia Islamia, New Delhi, India

Corresponding Author: Sanjay Miglani, Department of Conservative Dentistry, Faculty of Dentistry, Jamia Millia Islamia, New Delhi, India, Phone: +91 9999208880, e-mail: smiglani@jmi.ac.in

How to cite this article: Miglani S. Burden of Dental Caries in India: Current Scenario and Future Strategies. *Int J Clin Pediatr Dent* 2020;13(2):155-159.

Source of support: Nil

Conflict of interest: None

Dental caries is one of the leading causative agents of oral agony and the prime reason for patients to visit dental clinics or hospitals. Unfortunately, the patients report at a stage when some amount of loss of the tooth structure has already taken place. In early stages, restorations can be done to save the tooth, but in later stages, root canal treatment or extractions are the only resorts. People are susceptible to dental caries throughout their lives. Simple measures, when taken timely and awareness among masses, can help prevent the occurrence of dental caries. In this article, we have highlighted the reasons why this disease needs attention, what is the current scenario in India, and how the preventive and research strategies need to be customized to tackle this problem in India.

WHY DENTAL CARIES NEEDS ATTENTION?

High Prevalence and Incidence

The World Health Organization (WHO) estimated the global DMFT index of 188 countries for the 12-year-olds in 2004. They reported

that 200,335,280 teeth were affected by one of the features of DMFT among just that age group.¹³ In 2005, the bulletin of the WHO stated, "Worldwide, the prevalence of dental caries among adults is high as the disease affects nearly 100% of the population in the majority of countries."¹⁴

In 2010, a systematic review of untreated caries stated that worldwide, untreated dental caries in permanent teeth was the most prevalent oral disease affecting 240 crore adults. Whereas, in the primary dentition it was the 10th most prevalent condition, affecting 62.1 crore children. This article also pointed towards the fact that earlier more children were affected with dental caries but now more adults are affected by this condition with peaks seen in 6, 25, and 70 age groups.¹⁵

Looking at the global epidemiology, the United States has reported dental caries as the most common chronic disease of childhood, being five and seven times more common than asthma and hay fever, respectively.¹⁶ Also, more than 50% of children had at least one cavity or restoration and it increased to as high as 78% among 17-year-olds.¹⁷ In China, the prevalence is 55% in 3–5-year-olds¹⁸ and more than 4 out of 10 children are affected by dental caries in the United Kingdom. The prevalence at 8 years of age in the United Kingdom was found to be 57%.¹⁹ Looking at India, the literature documenting the prevalence or incidence of dental caries is scarce and limited to a few states. The prevalence of dental caries in a survey conducted by DCI in 2004 also pointed toward an increase in dental caries with age with prevalence increasing from 51.9% in 5-year-old children to as high as 85.0% in adults aged 65–74 years. Dental caries was also reported as the primary cause of edentulism in almost 30% of the senior citizens.²⁰

In a recent publication²¹ that secondarily analyzed the data provided in a publication in *Lancet* in 2017,²² it was stated that as compared to South Asians, Indians had a higher incidence of dental caries and more females suffered from this problem as compared to males.

Unfavorable Sequelae of Dental Caries

Untreated dental caries can lead to sequelae like severe pain, abscess, loss of the tooth, swelling, trismus, and systemic manifestations like fever and lymphadenopathy. In the worst cases, the infection can also spread to other anatomical spaces of the head and neck.

Increased Risk for Hospitalization

In many countries, some dental procedures are done under general anesthesia and dental caries has been reported to be a leading cause of hospitalization.²³ According to the Royal College of surgeons' report, tooth decay was the primary reason for hospitalization in the 5–9-year-old age group.²⁴

Impact on Quality of Life

Dental caries also detrimentally affect the quality of life as it can lead to problems in chewing, communication, disturbed sleep, and social interaction. This affects both children and adults. In children, it also governs eating habits, nutritional intake, gastrointestinal disorders, and may affect growth, early childhood development, and readiness for school and thus adding to absentia from school. Children with severe caries weigh less than controls and are at higher risk of developing caries in future. It has been reported that the inflammatory process initiated due to caries may lead to curbed growth through a metabolic pathway and can lead to reduced hemoglobin due to depressed erythrocyte production.²⁵

Rejection from Military Services

Tooth cavity and missing tooth have been reported to be the most common causes for not getting selected during medical screening prior to joining military services.²⁶

Disparities in Caries Distribution

It has been found that the prevalence of caries is not uniform throughout the subgroups of a country. Dental caries is more prevalent in poor and low socioeconomic groups. In United States, caries prevalence was found to be 1.8 times greater in poor children.²⁷ In India also, high caries prevalence has been reported in tribal groups.²⁸ This could be due to wrong brushing methods, dearth in the awareness on the significance of milk teeth, and deficiency of conveyance facilities and access to dental facilities. This clearly points that the one-size-fits-all approach cannot be implemented but different strategies are required depending on the population subgroups.

Economic Impact of Dental Caries

The demand of restorative treatment in the developing countries is higher than the resources available for public health programs.²⁹ These funds are available only for emergency services like severe pain or trauma. If preventive and restorative procedures are carried out, the costs of treatment in children alone would exceed the total healthcare budget for children.¹⁴ In many industrialized countries, 5–10% of public health funds are directed toward oral health.¹⁴ In 2018, an estimate of the economic impact of three dental diseases, untreated dental caries, periodontitis, and tooth loss, was reported across the globe.³⁰ In India, it has been estimated that the dental or oral disease-related expenditure is very less, actually one of the lowest in the world. An average Indian expenditure due to dental disease per capita in U.S. dollars was 0.14 (Rs. 8.45, assuming 1 U.S. \$ is Rs. 65.00), as compared to US\$370.47 for the United States.³¹ This is not because the incidence of oral disease is low but because of lack of awareness or access to dental facilities. If the economics behind the met and unmet dental treatment needs is studied, it is found that for every rupee spent on dental treatment, about 14 rupees are saved.²¹

PROBLEMS IN INDIA IN MANAGING DENTAL CARIES

- Large population: India has a population of 1210.2 million and accounts for 17.5% of the world's total population.³² Data collection of such a large population is itself a tedious job. Not only that, though urbanization is happening at a good pace, still 68.84% of the Indian population resides in the villages³³ and does not have access to basic health facilities.
- Different religious beliefs and lifestyles: No "cookbook recipe" can be applied to all subgroups of populations, since they have genetically distinct ancestry and varied lifestyles. India is a vast country with great diversity in eating habits and behavioral practices.
- Different languages: India is like nations within a nation. To communicate with people with different languages, people native to that area have to be engaged.
- Lack of data and well-controlled studies for policies and manpower development: The first step towards formulating any preventive protocols or strategies is a collection of data as to what is the prevalence of the disease, is it the same all over

Table 1: Important points while designing an oral health survey

1	What is it that you are looking for enamel caries or obvious dental decay? In huge populations like India, the term “obvious dental decay” should be used rather than dental caries. Clearly define and train the evaluators as to what is obvious dental decay. Are enamel caries being included or not?
2	How are you detecting caries: visual-tactile examination alone or radiographs? Taking a bitewing radiograph of the whole population to diagnose interproximal caries is not possible. Thus, one would always underscore interproximal caries.
3	Training and calibration of the examiner and the recording assistant should be done by experts having a minimum of 5 years of experience.
4	To get the the exact number door to door survey should be conducted. If that is not possible, follow the WHO recommendation of 300–600 dental examinations of people aged 5, 12, 15, 35–44, and 65–74 years from a homogeneous region, as was done by the Dental Council of India. ²⁰
5	To prevent burnouts and decrease in the quality of data collected, the examiner should not assess more than 10 houses in a day. The single examiner should conduct the survey and an assistant should note the findings to remove bias.
6	At least one person from the team should have knowledge of the local language.
7	Social workers can be roped in to collect any further data.
8	Prior permissions to conduct the study from the concerned directorates should be taken.
9	If a college is conducting the survey, institutional ethical clearance should be taken.
10	A written informed consent should be taken by all participants.
11	Biostatistician inputs should be taken before commencing the survey.
12	If possible, get funding to conduct the survey so that there is no deficiency of armamentarium and manpower to conduct the study. Use disposable mirrors.
13	Divide each state into districts and then into blocks or talukas. Each block may further have its many gram panchayats and villages under one block/taluka.
14	Create apps to easily record the findings and not to miss on important findings.
15	Take intraoral photos and Aadhar card numbers of all the participants to ensure that the door-to-door study has been conducted.

the country, or is it more prevalent in particular subgroups. This is important because the same preventive protocol may not be applicable to all subgroups. When these data are available, then only strategies that are suitable to population subgroups can be formulated. The state-level estimates of the prevalence of dental caries, in both the dentitions, are the first thing that needs to be done.

When conducting a survey, the standardized diagnostic criteria for detecting dental caries should be followed as even small variations in diagnostic norms can produce a considerable difference in the prevalence recorded. Some important factors that should be kept in mind while designing a survey are mentioned in Table 1.

Table 2: Research questions that are still unanswered for India

1	What is the difference in the prevalence of dental caries in rural and urban India?
2	Has there been increase or decline in the prevalence of dental caries over the past 5–10 years?
3	As life expectancy is increasing, what is the prevalence of geriatric dental caries?
4	Which are the high-risk populations in India?
5	Which regions do not have access to basic dental amenities?
6	In India, is dental caries found in specific teeth or tooth types in both the dentitions? Which surfaces are more prone to caries?
7	Do different eating habits and lifestyles across India influence the prevalence of dental caries?
8	What is the level of awareness in regard to dental caries among the masses?
9	Are carious teeth being restored or extractions are preferred?
10	What is the effect of dental caries on the overall quality of life?
11	Are school preventive programs being implemented?

- Lack of evidence: Well-controlled studies are required to answer the questions mentioned in Table 2.

PREVENTIVE STRATEGIES

- Oral health needs to be linked with general health.
- Cooperation and training of medical professionals, Anganwadi, and social workers required in emphasizing and promoting oral health care. Also, they can be trained to diagnose early carious lesions.
- It has been reported that the four most prevalent noncommunicable diseases, cardiovascular diseases, diabetes, cancer, and chronic obstructive pulmonary diseases, have the same risk factors as oral diseases and can be controlled by lifestyle changes.¹⁴ Thus, lifestyle changes can be promoted by dental and medical professionals.
- School teachers can play a crucial role in awareness and implementation of preventive strategies, especially focusing on good dietary and brushing habits, and in promoting the importance of milk teeth.
- Social workers should be engaged in monitoring oral health especially in the underprivileged and special children.
- India has the maximum number of dental colleges in the world; this huge workforce should be engaged to tackle this pandemic disease.
- Government support would be required in planning and implementing the strategies.
- Timely surveillance of fluoride levels in water needs to be done.
- Fluoride toothpaste, gels, and varnishes that have been clearly documented as effective preventive measures toward dental caries should be practiced.^{34–36}
- Schools should be targeted for water fluoridation or sealant applications.
- When any survey is conducted, one should try to train and educate the mother or at least one family member for the detection of carious lesions or signs of early demineralization.

FUTURE RESEARCH DIRECTIONS

- Surveys to collect basic interstate data on prevalence through well-controlled studies should be done.
- Future research should be focused on preventive strategies and their effectiveness in the progression or regression of the carious lesions.
- New fluoride-releasing materials or probiotic materials or other Ayurvedic agents that have anticariogenic activity should be explored.
- Newer technologies should be employed for easy, early, and confirmative diagnosis of dental caries.
- The use of biotechnology in biofilm or genetic modification can be explored.
- Nanotechnology can be used to invent newer and more effective materials and to restore the affected tooth.
- The role of fluorides and saliva stimulation and the significance of bacteriology can be explored.
- We are moving toward an era of a customized treatment plan. Do dental caries have a genetic susceptibility in different populations? Or can we identify high-risk patients based on their genetic makeup?
- Main etiological factors for dental caries need to be identified across different age groups and states across the country.
- The use of information technology to easily locate dental facilities or to connect to masses through apps needs to be explored. These apps can be a huge asset in awareness programs.

REFERENCES

1. Dandona L, Dandona R, Anil Kumar G, et al. Nations within a nation: variations in epidemiological transition across the states of India, 1990–2016 in the global burden of disease study. *Lancet* 2017;390(10111):2437–2460. DOI: 10.1016/S0140-6736(17)32804-0.
2. Marsh P, Martin MV. *Oral Microbiology*. 4th ed., Oxford: Wright; 1999.
3. Curzon ME, Preston AJ. Risk groups: nursing bottle caries/caries in the elderly. *Caries Res* 2004;38(Suppl. 1):24–33. DOI: 10.1159/000074359.
4. Ramos-Gomez FJ, Weintraub JA, Gansky SA, et al. Bacterial, behavioral and environmental factors associated with early childhood caries. *J Clin Pediatr Dent* 2002;26(2):165–173. DOI: 10.17796/jcpd.26.2.t6601j3618675326.
5. Touger-Decker R, van Loveren C. Sugars and dental caries. *Am J Clin Nutr* 2003;78(4):S881–S892. DOI: 10.1093/ajcn/78.4.881S.
6. Hassell TM, Harris EL. Genetic influences in caries and periodontal diseases. *Crit Rev Oral Biol Med* 1995;6(4):319–342. DOI: 10.1177/10454411950060040401.
7. Siqueira JF, Rôças IN. Microbiology and treatment of acute apical abscesses. *Clin Microbiol Rev* 2013;26(2):255–273. DOI: 10.1128/CMR.00082-12.
8. Fouad AF, Burlison J. The effect of diabetes mellitus on endodontic treatment outcome: data from an electronic patient record. *J Am Dent Assoc* 2003;134(1):43–51. DOI: 10.14219/jada.archive.2003.0016.
9. Marotta PS, Fontes TV, Armada L, et al. Type 2 diabetes mellitus and the prevalence of apical periodontitis and endodontic treatment in an adult Brazilian population. *J Endod* 2012;38(3):297–300. DOI: 10.1016/j.joen.2011.11.001.
10. De Sá AR, Moreira PR, Xavier GM, et al. Association of CD14, IL1B, IL6, IL10 and TNFA functional gene polymorphisms with symptomatic dental abscesses. *Int Endod J* 2007;40(7):563–572. DOI: 10.1111/j.1365-2591.2007.01272.x.
11. Featherstone JD, Adair SM, Anderson MH, et al. Caries management by risk assessment: consensus statement, April 2002. *J Calif Dent Assoc* 2003;31(3):257–269.
12. Krol DM. Dental caries, oral health, and pediatricians. *Curr Probl Pediatr Adolesc Health Care* 2003;33(8):253–270. DOI: 10.1016/s1538-5442(03)00093-2.
13. Bratthall D. Estimation of global DMFT for 12-year olds in 2004. *Int Dent J* 2004;55:14–18.
14. Petersen PE, Bourgeois D, Ogawa H, et al. The global burden of oral diseases and risks to oral health. *Bull World Health Organ* 2005;83(9):661–669. DOI: /S0042-96862005000900011.
15. Kassebaum NJ, Bernabé E, Dahiya M, et al. Global burden of untreated caries: a systematic review and metaregression. *J Dent Res* 2015;94(5):650–658. DOI: 10.1177/0022034515573272.
16. US Department of Health and Human Services. *Oral Health in America: A Report of the Surgeon General—Executive Summary*. Rockville, MD: National Institute of Dental and Craniofacial Research; 2000.
17. Bagramian RA, Garcia-Godoy F, Volpe AR. The global increase in dental caries. A pending public health crisis. *Am J Dent* 2009;22(1):3–8.
18. Du M, Luo Y, Zeng X, et al. Caries in preschool children and its risk factor in 2 provinces in China. *Quintessence Int* 2007;38(2):143–151.
19. Pitts NB, Chestnutt IG, Evans D, et al. 1 Verifiable CPD paper: the dental caries experience of children in the United Kingdom, 2003. *Br Dent J* 2006;200(6):313. DOI: 10.1038/sj.bdj.4813377.
20. National Oral Health Survey and Fluoride Mapping. *An Epidemiological Study of Oral Health Problems and Estimation of Fluoride Levels in Drinking Water*. Dental Council of India, New Delhi, 2004.
21. Balaji SM. Burden of dental diseases in India as compared to South Asia: an insight. *Indian J Dent Res* 2018;29(3):374–377. DOI: 10.4103/ijdr.IJDR_333_18.
22. Vos T, Abajobir AA, Abate KH, et al. Global, regional, and national incidence, prevalence, and years lived with disability for 328 diseases and injuries for 195 countries, 1990–2016: a systematic analysis for the global burden of disease study 2016. *Lancet* 2017;390:12111–12159.
23. Griffin SO, Gooch BF, Beltran E, et al. Dental services, costs, and factors associated with hospitalization for Medicaid-eligible children, Louisiana 1996–97. *J Public Health Dent* 2000;60(1):21–27. DOI: 10.1111/j.1752-7325.2000.tb03287.x.
24. Country, NHS Trusts, Hospital Trusts, Provider, Regions; Hospital admitted patient care activity 2018–2019. [Internet]. England: NHS Digital; [updated Sep 2019; Cited Oct 2019]. Available from: <https://digital.nhs.uk/data-and-information/publications/statistical/hospital-admitted-patient-care-activity/2017-18>.
25. Sheiham A. Dental caries affects body weight, growth and quality of life in pre-school children. *Br Dent J* 2006;201(10):625–626. DOI: 10.1038/sj.bdj.4814259.
26. Beltrán-Aguilar ED, Barker LK, Canto MT, et al. Centers for disease control and prevention (CDC). surveillance for dental caries, dental sealants, tooth retention, edentulism, and enamel fluorosis—United States, 1988–1994 and 1999–2002. *MMWR Surveill Summ* 2005;54(3):1–43.
27. Vargas CM, Crall JJ, Schneider DA. Sociodemographic distribution of pediatric dental caries: NHANES 111, 1988–1994. *J Am Dent Assoc* 1998;129(9):1229–1238. DOI: 10.14219/jada.archive.1998.0420.
28. Das D, Suresan V, Jnaneswar A, et al. Oral health status and treatment needs among the Juang tribe—a particularly vulnerable tribal group residing in Northern Odisha, India: a cross-sectional study. *Health Soc Care Community* 2019;27(5):e752–e759. DOI: 10.1111/hsc.12788.
29. Robert Y, Sheiham A. The burden of restorative dental treatment for children in third world countries. *Int Dent J* 2002;52(1):01–09. DOI: 10.1111/j.1875-595X.2002.tb00589.x.
30. Righolt AJ, Jevdjevic M, Marcenes W, et al. Global, regional, and country level economic impacts of dental diseases in 2015. *J Dent Res* 2018;97(5):501–507. DOI: 10.1177/0022034517750572.
31. Balaji SM. Economic impact of dental caries in India. *Indian J Dent Res* 2018;29(2):132. DOI: 10.4103/ijdr.IJDR_253_18.
32. Chandramouli DrC, . Size, growth rate and distribution of population in India. Chapter 3-Provisional population Totals [Internet] Registrar General & Census Commissioner, India Ministry of Home Affairs; [updated July 2011, Cited Oct 2019] Available from: <http://censusindia>.

- gov.in/2011-prov-results/data_files/india/Final_PPT_2011;chapter3.pdf.
33. Chandramouli DrC, Rural urban distribution of population. Provisional population totals [internet] Registrar General & Census Commissioner, India Ministry of Home Affairs: [updated July 2011, cited oct 2019]; available from: http://censusindia.gov.in/2011-prov-results/paper2/data_files/india/Rural_Urban_2011.pdf.
 34. Marinho VCC, Higgins JPT, Logan S, et al. Fluoride toothpastes for preventing dental caries in children and adolescents. *Cochrane Database Syst Rev* 2003;1(1):CD002278. DOI: 10.1002/14651858.CD002278.
 35. Marinho VCC, Higgins JPT, Logan S, et al. Fluoride gels for preventing dental caries in children and adolescents. *Cochrane Database Syst Rev* 2002;2(2):CD002280. DOI: 10.1002/14651858.CD002280.
 36. Marinho VCC, Higgins JPT, Logan S, et al. Fluoride varnishes for preventing dental caries in children and adolescents. *Cochrane Database Syst Rev* 2002;3(3):CD002279. DOI: 10.1002/14651858.CD002279.