

Economic burden and economic impact of oral diseases in India: A systematic review and meta-analysis

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ABSTRACT

Objective: To quantify the economic burden and financial impact of oral diseases in India—on individuals, households, the health system, and society—focusing on direct and indirect costs and out-of-pocket expenditure (OOPE).

Methods: Following JBI methodology and PRISMA 2020, we conducted a three-step search of MEDLINE, Embase, Scopus, CINAHL, DOSS, Cochrane CENTRAL, and grey literature. We included India-based studies reporting economic burden/financial impact at individual, household, or population levels. Eligible designs were cost-of-illness, cost/expenditure analyses, and cohort or cross-sectional studies; mixed-methods with extractable quantitative data were included. Two reviewers independently screened, appraised (JBI tools), and extracted data on direct/indirect costs, OOPE, catastrophic expenditure (CHE), and hardship financing. Findings were narratively synthesized; meta-analysis was undertaken in JBI SUMARI where appropriate.

Results: Of 1684 records, 15 met inclusion criteria, mostly cross-sectional across states. OOPE varied widely; oral-cancer treatment often ranged from INR 80,000 to over INR 2,30,000. Direct costs were higher in private settings; indirect productivity losses were reported. CHE ranged from 0.6 % to 96 % across definitions; pooling studies using the ≥ 20 % income threshold yielded a CHE prevalence of 18.8 %. Insurance coverage was low (<15 %) with limited protection. Up to one-third of patients relied on hardship financing (borrowing or asset sales).

Conclusion: Oral diseases impose a substantial economic burden in India, characterised by high OOPE, elevated CHE risk (pooled 18.8 %), and frequent distress financing. Priorities include stronger national data, standardised costing/reporting (price year, components, variance), and expanded financial protection to reduce household hardship and advance universal oral health coverage.

Systematic review registration number: The protocol is prospectively registered in the International Prospective Register of Systematic Reviews database (PROSPERO ID: CRD420251030651).

1. Introduction

Oral health remains a critically neglected global health priority, affecting 44.5 % of the world's population—approximately 3.5 billion people suffering from dental caries, periodontal disease, oral cancer, and edentulism—and ranking as the fourth most expensive healthcare intervention to treat in developed nations.^{1–3} India's contribution is disproportionate: the nation accounts for 18 % of global permanent and

deciduous tooth caries and over 20 % of severe periodontal disease cases.⁴ This burden is amplified by multiple systemic failures: limited access to quality oral healthcare, minimal insurance coverage (restricted to select government employees and formal-sector workers), and chronic underfunding at both national and state levels.^{5,6} Although oral health has been nominally integrated into India's Comprehensive Primary Health Care agenda, coverage remains limited to a restricted tertiary package without dedicated budget lines, perpetuating a

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treatment-focused, reactive approach to a largely preventable disease burden.^{7,8}

Recent evidence indicates that out-of-pocket (OOP) payments for oral health care contribute to financial hardship across health systems worldwide, including in low-, middle-, and high-income countries.⁹ The WHO Regional Office for Europe determined OOP payments for OHC to be a major driver of “catastrophic health spending” in the European region from 2011 to 2016.¹⁰ Out-of-pocket expenditures (OOPEs) constitute a substantial 58.7 % of India's national health expenditure, often leading to catastrophic financial consequences or impoverishment. This heavy reliance on OOPE disproportionately impacts low-income populations, deepening income inequality and trapping many in a cycle of medical poverty.¹¹ The proportion of OOPE allocated to non-medical expenses, such as **travel, lodging, and food — constituted an average of 23.6 % of inpatient OOPE and 14.6 % of outpatient OOPE in India, significantly adding to financial stress among low-income households.**¹¹

According to the WHO Oral Health Country Profile for India (2022), as of 2019, the per capita expenditure on dental healthcare in India was merely USD \$0.05—a decrease from USD \$0.14 in 2015—while total productivity losses due to five major oral diseases (caries, periodontal disease, edentulism, oral cancer, and cleft lip/palate) reached USD \$7249 million.^{12–14}

Despite the high burden, there is a noticeable lack of economic evaluations related to dental health, especially in the Indian context.¹⁵ While global evidence increasingly quantifies the economic burden of oral diseases, comparable estimates specific to India remain sparse. This lack of context-specific data limits the ability of policymakers to prioritize oral health in national planning and budget allocation. Common economic metrics are rarely applied or reported in existing studies, highlighting a need for more robust, India-specific research. Although several individual studies^{16–18}, have examined out-of-pocket expenditure (OOPE) and other economic aspects of dental care in India, these are isolated in scope and methodology. An initial search confirmed the existence of such studies; however, there is no pooled data or comprehensive synthesis that brings together these findings to offer nationally relevant insights, highlighting a clear gap in consolidated evidence.

A preliminary search of PROSPERO, MEDLINE, the Cochrane Database of Systematic Reviews, and *JB1 Evidence Synthesis* was conducted, and no current or in-progress systematic reviews on the topic were identified. In light of this evidence vacuum, a systematic synthesis is needed to estimate the direct and indirect economic burden of oral diseases in India and to understand their financial impact at the individual, household, and health system levels. Such insights are essential for designing targeted, equitable, and cost-effective oral health financing and policy strategies. Therefore, the objective of this review is to identify the economic burden and financial impact of oral diseases on individuals, households, the healthcare system, and society in India, with a particular focus on direct and indirect costs and the impact of out-of-pocket expenditure (OOPE).

2. Methodology

2.1. Protocol and registration

The review followed JBI methodology for economic evidence¹⁹ and adhered to PRISMA 2020²⁰ reporting guidelines to ensure transparency. The protocol was registered with PROSPERO (CRD420251030651). The protocol for this review is published prospectively in BMJ OPEN.²¹

2.2. Inclusion criteria

2.2.1. Participants

This review will include studies focusing on individuals or households affected by oral diseases in India. Individuals of any age, gender, socioeconomic status, or region were eligible, whether they sought oral

healthcare services in public or private settings. Household-level studies examining the economic burden or financial consequences—such as out-of-pocket payments, catastrophic health expenditure, or hardship financing—were included.

2.2.2. Outcomes

Studies must report at least one relevant outcome related to economic burden or financial impact. Economic burden includes both direct and indirect costs. Direct costs cover medical expenses (such as consultations, diagnostics, treatment, surgeries, and dental procedures) and non-medical expenses (such as transportation, accommodation, food, and caregiver costs) across inpatient and outpatient care. Indirect costs include productivity losses due to missed work or reduced efficiency (absenteeism and presenteeism) and measures such as Disability-Adjusted Life Years (DALYs), where available. Financial impact outcomes include the proportion of households incurring catastrophic health expenditure (where health costs exceed a significant portion of income), financial hardship or distress financing (such as borrowing money or selling assets to pay for treatment), and the impact on poverty (households pushed below the poverty line due to healthcare spending).

2.2.3. Context

Eligible studies had to be conducted within India, reflecting the diverse settings, population groups, and health system structures. Where relevant, national or state-level secondary data and statistics from government sources were also included to provide broader economic and epidemiological context.

2.2.4. Type of studies

Both primary observational and secondary quantitative studies were eligible. Primary studies included cost-of-illness studies, cross-sectional surveys, cohort or longitudinal studies, and economic modelling studies that reported individual- or household-level economic outcomes related to oral diseases. Secondary studies included secondary analyses of large survey or administrative datasets (e.g., national health surveys, World Health Survey) and narrative economic commentaries using nationally representative or macroeconomic data, provided they reported extractable economic outcomes. Mixed-methods studies were eligible only if they contained extractable quantitative economic data. All included studies were required to present data specific to Indian populations affected by oral diseases, including oral cancer.

2.3. Search strategy

A preliminary search of MEDLINE (Ovid) and Embase was conducted to identify relevant keywords and index terms, which were then used to develop database-specific search strategies. The search was adapted for MEDLINE(Ovid), Scopus, Embase, Dentistry and Oral Sciences Source (DOSS), CINAHL (Ovid), Web of Science Core Collection, and Cochrane CENTRAL. Grey literature was searched through ProQuest Dissertations, OAlster, and the first 20 pages of Google Scholar. reference lists of included studies were also screened. Search time frame was from inception to 12-05-2025. Where feasible, non-English articles were translated using DeepL; however, formal validation was not conducted due to time constraints. Public datasets (e.g., NSO/NSSO, National Health Accounts, WHO Global Health Expenditure Database, World Bank, IHME) were consulted for supplementary economic data and to support currency conversion and inflation adjustments. Full search terms and results for each database are provided in the [Supplementary Table S1](#).

2.4. Study selection

Search results were uploaded and duplicates were removed using Zotero software. Two reviewers independently screened titles and abstracts, followed by full texts using JBI SUMARI. Disagreements were

resolved by a third reviewer. A PRISMA flow diagram (Fig. 1) documented the selection process.

2.5. Data extraction

Two reviewers independently extracted data using a standardised form, including study design, setting, sample details, cost estimates, and financial impact measures (OOPE, catastrophic expenditure, hardship financing, poverty impact). Authors were not contacted for additional information, as there were no missing data requiring clarification.

2.6. Risk of bias and reporting bias assessment

Two reviewers independently appraised study quality using relevant JBI critical appraisal tools for each study design (JBI Checklists). For studies based on secondary data analysis, the underlying study design was used to select the appropriate JBI critical appraisal checklist. Studies using cross-sectional national survey data were appraised with the JBI Analytical Cross-Sectional Studies Checklist,²² with additional consideration given to the appropriateness and limitations of the original dataset. For the single text and opinion paper, checklist for textual evidence: expert opinion was used.²³ Disagreements were resolved by discussion or a third reviewer. Appraisal findings informed the interpretation of results but did not lead to exclusions. In addition, critical evaluation of the underlying economic outcomes was performed using the consensus-based checklist for cost-of-illness studies.²⁴

2.7. Data synthesis, results, and summary measures

Data were analysed and presented using a combination of narrative synthesis and meta-analysis, as appropriate. Costs reported in Indian Rupees were converted to 2023 USD equivalents using the CCEMG-EPPI Centre cost conversion tools to aid comparability.²⁵ All cost estimates extracted in Indian Rupees (INR) were standardised and reported in

three forms: (i) the original value in INR and price year as reported by the source study, (ii) 2023 Indian Rupees (INR) for India-specific policy relevance, and (iii) 2023 purchasing power parity-adjusted US dollars (PPP-USD) to facilitate international comparison. Standardisation was implemented using the CCEMG-EPPI Centre Cost Converter (version 1.7). In the first stage, the tool updates each original INR cost from its study price year to 2023 using the gross domestic product (GDP) deflator index for India, which serves as a general inflation measure across sectors. In the second stage, it converts the 2023 INR value to PPP-USD using GDP-based purchasing power parities, thereby adjusting for cross-country differences in price levels rather than relying on market exchange rates. For non-medical cost components such as travel, accommodation, and food, where health-specific price indices are not reported separately in Indian national statistics, we applied the general Consumer Price Index (CPI) as a proxy deflator to adjust values to the 2023 price year. This approach aligns with good-practice guidance for costing studies in low- and middle-income countries, which recommends using broadly based CPI indices when more granular health-sector indices are unavailable.²⁶ A narrative synthesis grouped the 15 included studies by cost categories (direct, indirect, and out-of-pocket expenditure), disease type (e.g., oral cancer, dental caries, general dental care), and population focus (e.g., households, specific patient groups). Average costs, ranges, and key cost drivers were summarised for each outcome. Where data were sufficiently homogeneous, such as studies reporting catastrophic health expenditure using a common threshold, pooled estimates were calculated using a random-effects model in JBI SUMARI. The decision to pool CHE estimates was based on restricting meta-analysis to studies using a common ≥ 20 % income threshold, consistent with methodological approaches applied in recent CHE meta-analyses.^{27,28} Heterogeneity was assessed using the I^2 statistic, and any subgroup patterns by region, population group, or disease condition were explored where data allowed.

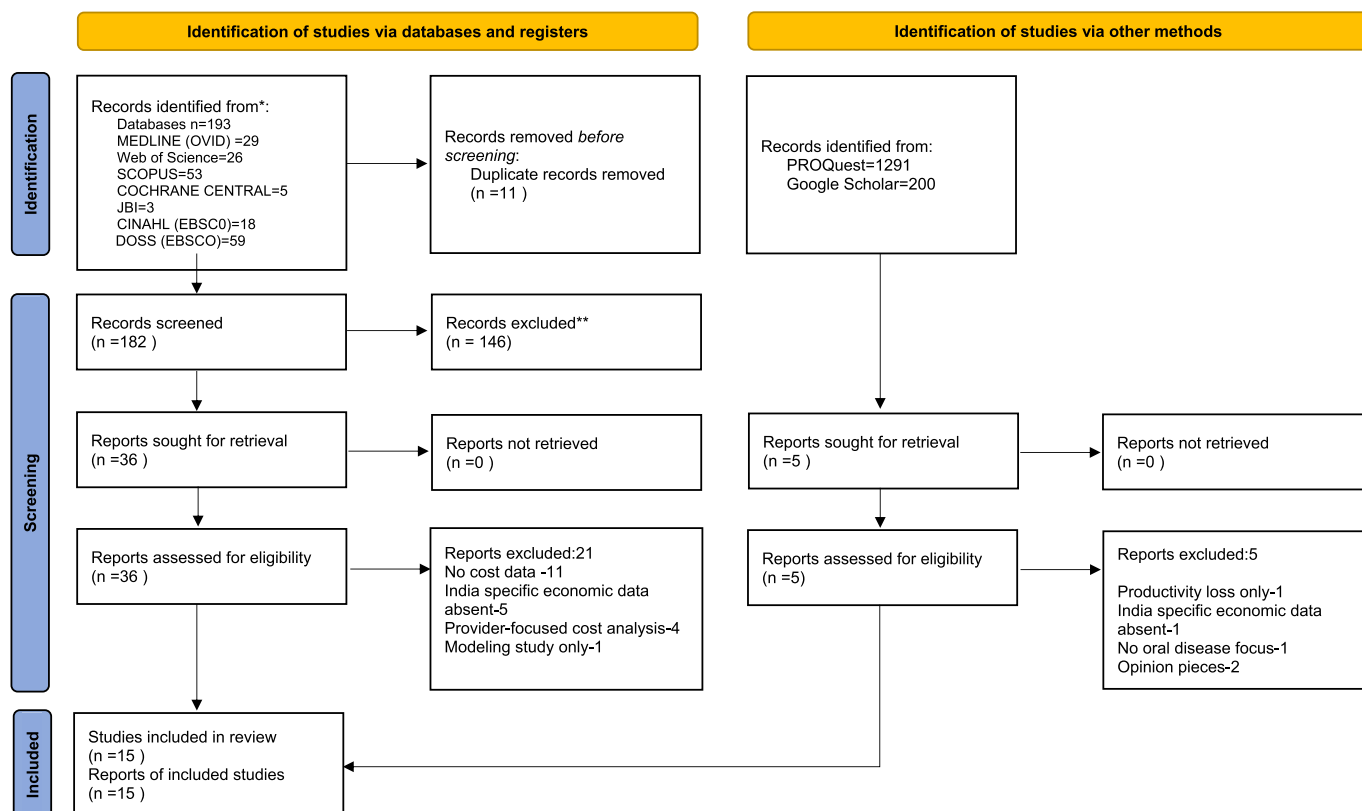


Fig. 1. PRISMA flow diagram.

3. Results

The study selection process is shown in the PRISMA flow diagram (Fig. 1). The systematic search yielded a total of 1684 records across multiple electronic databases. Specifically, records were identified from MEDLINE (n = 29), Web of Science (n = 26), SCOPUS (n = 53), Cochrane CENTRAL (n = 5), JBI (n = 3), CINAHL (n = 18), DOSS (n = 59), ProQuest (n = 1291), and Google Scholar (n = 200).

After the removal of 11 duplicate records, 1673 unique records remained for screening. Titles and abstracts were screened for relevance, leading to the exclusion of 1491 records that did not meet the inclusion criteria based on their abstracts or titles (e.g. irrelevant populations, unrelated outcomes, non-economic studies). This left 182 records for more detailed evaluation. Of these, 36 full-text articles were retrieved

and assessed for eligibility. During full-text screening, 21 articles were excluded for the following reasons: Absence of cost data (n = 11), Lack of India-specific economic data (n = 5), Studies focusing only on provider costs without patient-level economic outcomes (n = 4), Studies reporting solely on economic modelling without empirical cost data (n = 1). List of excluded studies are available as [Supplementary Table S2](#). Consequently, 15 studies met all inclusion criteria and were included in the final systematic review. These studies formed the basis for the qualitative synthesis of evidence on the economic aspects of oral health conditions in India.

3.1. Characteristics of included studies

The study characteristics are summarised in [Table 1](#). This review

Table 1
Characteristics of included studies.

Study	Year	Location	Study Design	Population	Oral Disease Focus	Economic Outcomes Reported	Cost Type	Data Source
Nobelika et al. ³¹	2020	Coimbatore, Tamil Nadu	Cross-sectional survey	Sanitary workers	General oral health expenditure	Catastrophic dental health expenditure, Out-of-pocket spending, Health insurance awareness	Direct medical, Direct non-medical	Primary interview survey
Ramireddy et al. ³²	2017	Vellore, Tamil Nadu (multi-state patient sample)	Retrospective observational study	Oral cancer patients	Oral cancer	Direct and indirect costs; treatment discontinuation due to cost; source of funds	Direct medical, Indirect (travel, lodging, income loss)	Hospital records and patient interviews
Verma et al. ³³	2018	Durg, Chhattisgarh	Cross-sectional household survey	Household heads	General oral healthcare	Annual expenditure, emergency dental care cost, socioeconomic correlation	Direct medical, Preventive expenditure	Questionnaire
Goswami et al. ³⁴	2023	Rural India	Cross-sectional survey	Households	Oral cancer	Financial impact on household; distress financing	Direct medical, Direct non-medical, Indirect	Primary survey
Singh et al. ¹⁷	2015	Modinagar, UP	Cross-sectional	Residents	General dental expenses	Out-of-pocket expenditure	Direct medical	Questionnaire
Prasad et al. ¹⁸	2021	National (NSS data)	Secondary data analysis	Households (poor vs. non-poor)	General oral diseases	Catastrophic expenditure, impoverishment	OOPE	NSSO unit-level data
Balaji SM (12)	2018	India (general)	Narrative synthesis/Economic commentary	Not specified	Dental caries	Productivity loss, National cost estimate	Indirect	National data estimates
Meenal et al. ³⁵	2017	Chennai, Tamil Nadu	Cross-sectional study	Adults seeking dental care	General dental services (private vs. public)	Out-of-pocket costs, time cost, satisfaction	Direct medical, Direct non-medical, Time cost	Questionnaire survey
Syamkumar et al. ³⁶	2022	Kerala	Cross-sectional survey	General population	Oral hygiene and dental expenditure	Annual household expenditure, correlation with SES	Direct medical, Out-of-pocket	Self-administered validated questionnaire
Bernabe et al. ²⁹	2017	40 LMICs (Global)	Secondary data analysis (World Health Survey)	Households	Dental care expenditure and financial impact	Catastrophic health expenditure, impoverishment	Out-of-pocket (OOP)	WHO World Health Survey
Kandwal et al. ³⁷	2020	Uttarakhand, India (3 health centres)	Cross-sectional multicentric study	Adult dental patients (N = 600)	Dental caries, oral hygiene	Projected per capita cost of oral treatment; financial burden	Direct medical	Clinical examination and cost estimation
Masood et al. ³⁰	2015	41 LMICs (including India)	Cross-sectional using WHO World Health Survey	Households in LMICs	General dental care	Catastrophic dental health expenditure (CDHE); determinants and prevalence	Out-of-pocket expenditure	WHO World Health Survey data
Singh et al. ³⁸	2021	Mumbai, India	Prospective cost of illness study	Oral cancer patients	Oral cancer	Direct healthcare costs (early vs. advanced stage); unit cost; potential savings from prevention	Direct medical	Hospital costing and patient tracking
Bhat et al. ³⁹	2023	Manipal, Karnataka	Retrospective observational study	Patients admitted for oral surgical procedures	Oral surgical conditions (including cancer, trauma, etc.)	Utilization of health insurance, out-of-pocket expenditure, reimbursement amount	Direct medical, Out-of-pocket, Reimbursement amount	Hospital billing and medical records
Patel et al. ⁴⁰	2021	Bhavnagar, Gujarat	Cross-sectional study	Patients with oral potentially malignant disorders (OPMD)	Oral potentially malignant disorders	Total costs, direct non-medical, indirect costs, cost predictors	Direct medical, Direct non-medical, Indirect	Patient interviews using adapted WHO cost tool

comprises 15 studies published between 2015 and 2023 that assess the economic burden associated with oral health conditions. These studies were conducted in various geographical settings, predominantly within India, covering both urban and rural areas across states such as Tamil Nadu, Uttar Pradesh, Chhattisgarh, Uttarakhand, Kerala, Karnataka, Gujarat, and Maharashtra. Two studies^{29,30} extended their focus to a global or multi-country level, encompassing LMICs, including India. Refer [Table 1](#). Supplementary File [Fig. 1](#).

The majority of the included studies ($n = 10$) employed a cross-sectional design, utilizing structured questionnaires or interviews to collect primary data on dental health-related expenditures and outcomes. Several studies conducted primary surveys targeting specific population groups. Retrospective observational designs were used in some studies, drawing on hospital records and clinical documentation to estimate treatment-related costs.^{32,39} One study adopted a prospective cost-of-illness approach, tracking patient expenses over time at a tertiary cancer care center. Three^{18,29,30} of the most comprehensive and data-rich studies leveraged nationally and internationally available survey datasets respectively. Prasad et al. used unit-level data from the National Sample Survey Office (NSSO) of India, which is a premier governmental statistical agency collecting detailed household-level data across socioeconomic domains, including health care. Two studies^{29,30} utilized data from the World Health Survey (WHS) conducted by the World Health Organization. WHS includes standardized, cross-country health expenditure data, enabling comparative insights into catastrophic dental health expenditure (CDHE) and impoverishment effects across 40–41 LMICs, including India study¹² contributed as narrative synthesis, reflecting on macroeconomic costs using national data.

The data collection methods varied across studies. Most studies relied on primary data collection through household or patient interviews.^{8,9,12} Others,⁷ used hospital-based costing tools and patient records to assess real-time expenses. Few Studies^{1,2,5} derived findings from large-scale national or international databases (NSSO, WHO-WHS), ensuring representativeness across income groups and regions. Self-administered tools¹³ and clinical examination-based estimations¹⁴ were also used to enhance accuracy. Populations investigated ranged from households and community members to patients with specific oral health conditions. Four studies focused on oral cancer patients,^{32,34,38,39} while others examined sanitary workers,³¹ adults seeking dental care,³⁵ patients with oral potentially malignant disorders,⁴⁰ and general dental service users. Several studies,^{18,33} explored household-level expenditures, distinguishing between socioeconomic strata (e.g., poor vs. non-poor), while two studies^{29,30} evaluated data from thousands of households across LMICs.

while five studies focused on the economic burden of oral cancer, including costs related to diagnosis, treatment discontinuation, and disease staging^{29,32,34,38,39} the majority of the remaining studies explored non-cancer aspects of oral health. These included evaluations of general oral health services,^{18,33} the cost implications of managing dental caries with a focus on preventive versus emergency care¹² and the economic impact of routine oral hygiene practices.^{36,37} Refer [Table 1](#).

3.2. Methodological quality of studies

For the 14 analytical observational studies appraised using JBI checklist, all studies clearly defined their inclusion criteria, described subjects and settings in detail, and used valid, reliable measurements for exposure and outcomes. However, several studies showed limitations in addressing confounding factors: while confounders were identified in most studies, strategies to manage them were often unclear or not stated.^{32,33} Overall, quality scores for these studies were high for core domains but variable for confounding, which may introduce residual bias. All 14 studies were included in the synthesis regardless of their scores, as they provided relevant data on direct and indirect costs, out-of-pocket expenditure, and catastrophic health spending. [Supplementary Table S3](#)

For the single text and opinion paper,¹² the source and field expertise were clearly established, and the paper drew on relevant literature to support its viewpoints. However, the analytical process underlying the author's position and the discussion of inconsistencies with existing evidence were not fully transparent. Despite these limitations, the paper was included as it provided important contextual insights into the economic burden of oral diseases in India. Please refer [Supplementary Table S4](#).

In addition, 13 of these studies were critically appraised using the consensus-based checklist for cost-of-illness studies.²⁴ The appraisal showed that while objectives and populations were generally well defined, major gaps remained in reporting perspectives, cost components, and indirect cost assessment, which may have led to underestimation of the true economic burden. Two studies, one based on resource utilization⁴⁰ and the other on expenditure analysis¹⁸ (e.g., NSSO dataset), were not subjected to this checklist, as they did not constitute full cost-of-illness studies. Refer [Supplementary Table S5](#).

3.3. Results of individual studies

3.3.1. Out-of-pocket expenditure (OOPE) for oral healthcare in India

Out-of-pocket expenditure (OOPE) for oral healthcare in India varies widely depending on the type of service, disease condition, and source of care. For high-cost conditions such as oral cancer, reported OOPE can be substantial, with Goswami et al. estimating around INR 100,000 for treatment, though no variance or breakdown was provided³⁴ similarly, Bhatt et al. reported OOPE for oral surgical procedures ranging from INR 4170.9 for government-supported patients to INR 39,087.6 for those without insurance, underscoring the significant financial burden faced by the uninsured.⁴¹ Preventive and restorative services such as oral prophylaxis, restorations, and dental prostheses were reported to cost between INR 400 and INR 6,280, though these were presented as point estimates without accompanying variability.³⁷

Among the few studies that reported OOPE with statistical variability, Meenal et al.,³⁵ cost components differed between public and private facilities: public-sector OOPE consisted almost entirely of direct non-medical costs (travel), as consultation and procedure fees were free, whereas private-sector OOPE included direct medical costs (visiting and procedure fees) in addition to travel expenses. In public facilities, the average OOPE was INR 115.85 (± 74.58), compared to INR 5617.44 (± 7900.14) in private settings, illustrating both the protective effect of subsidized care and the high cost variability in the private sector.³⁵ The results reflect both the protective effect of subsidized care and non-comparability of certain cost components across settings. Please refer [Table 2](#). To enable like-for-like comparisons, we expressed all OOPE in 2023 INR and 2023 PPP-USD (international dollars) using the standardisation approach described in Methods section 2.7. This removes inflation and local price-level effects, showing the true gradient across services and payers: oral cancer remains highest ($\approx$ INR 100,000; $\approx$ PPP-USD 4950), oral surgery spans government-insured ($\approx$ INR 4171; $\approx$ PPP-USD 206) to uninsured ($\approx$ INR 39,088; $\approx$ PPP-USD 1935), and preventive/restorative care remains lowest ($\approx$ INR 485–INR 7612; $\approx$ PPP-USD 24–377). The public–private OPD gap persists after conversion ($\approx$ INR 154 vs INR 7463; $\approx$ PPP-USD 7.6 vs 369), confirming substantially greater household burden in private settings. Refer [Table 2](#).

3.3.2. Direct cost for oral healthcare in India

Direct medical costs for oral health care in India demonstrate substantial variation depending on the condition and treatment modality. Hospital-based management of oral cancer incurs significant expenses, with surgical interventions ranging from INR 137,565 to INR 237,357 when combined with radiotherapy, while conventional radiotherapy alone costs INR 29,782 and advanced IMRT approaches reach INR 118,245. Goswami et al.³⁴ reported comprehensive oral cancer care at INR 80,273 ($\pm 56,254$). For oral surgery, Bhatt et al. documented costs of INR 39,087.6 in non-insured tertiary care, INR 64,216.3 in subsidized

Table 2

Out-of-pocket expenditure (OOPE) for oral healthcare in India.

Study	Year	Location	Population/ Disease	Intervention/Service	Mean OOPE	OOPE Adjusted (2023 INR)	OOPE Adjusted in (2023 USD)	SD/ Range	Cost Components Included	Notes
Goswami et al. ³⁴	2023	Maharashtra	Oral Cancer	Not specified	100,000	100000	4949.87	N/R	Assumed: treatment + non-medical	Point estimate only; no SD
Kandwal et al. ³⁷	2020	Uttarakhand	Dental diseases	Oral prophylaxis	400	484.84	24	N/R	Not reported	Point estimate only
Kandwal et al. ³⁷	2020	Uttarakhand	Dental diseases	Restoration of decayed teeth	1036	1255.73	62.16	N/R	Not reported	Point estimate only
Kandwal et al. ³⁷	2020	Uttarakhand	Dental diseases	Dental prosthesis (removable)	942	1141.8	56.52	N/R	Not reported	Point estimate only
Kandwal et al. ³⁷	2020	Uttarakhand	Dental diseases	Dental prosthesis (fixed)	6280	7611.98	376.78	N/R	Not reported	Point estimate only
Bhatt et al. ³⁹	2023	Karnataka	Oral surgical procedures	General oral surgery	39,087.6	39087.6	1934.78	N/R	Not specified	No variance reported
Bhatt et al. ³⁹	2023	Karnataka	Oral surgical procedures	General oral surgery	4170.9	4170.9	206.45	N/R	Not specified	Lower cost, likely subsidized
Bhatt et al. ³⁹	2023	Karnataka	Oral surgical procedures	General oral surgery	11,938.3	11938.3	590.93	N/R	Not specified	Mid-range cost among categories
Meenal et al. ³⁵	2017	Tamil Nadu	General dental care	Outpatient dental services (Public facility) (travel only; treatment = INR 0)	115.85	153.91	7.62	±74.58	Consultation, minor procedures	Only study with variance in public setting
Meenal et al. ³⁵	2017	Tamil Nadu	General dental care	Outpatient dental services (Private Facility) (consultation + procedures + travel)	5617.44	7463.08	369.41	±7900.14	Consultation, procedures	Highest SD among included studies

Original costs are reported in INR and in the study's price year; '2023 INR' and '2023 PPP-USD' were calculated using the CCEMG–EPPI Centre Cost Converter (GDP-deflator-based inflation adjustment plus PPP conversion), as described in Methods section 2.7.

government hospitals, and INR 50,726.7 in private facilities.

Subgroup comparison showed substantial variation in oral cancer costs by disease stage and treatment modality. In Singh et al., early-stage management averaged INR 117,135, whereas advanced disease averaged INR 202,892, indicating a ~42 % higher cost burden.³⁸ Treatment modality produced similarly large gradients: Ramireddy et al. reported costs of INR 29,782 for conventional radiotherapy, INR 118,245 for IMRT/3D-CRT, and INR 237,357 for surgery plus radiotherapy, with surgery alone ranging from INR 18,000–76,200(31). These patterns show that multimodality and technology-intensive treatments can cost 3–8 times more than single-modality care.

Routine dental services, as reported by Kandwal et al.³⁷, were markedly lower, including INR 400 for prophylaxis, INR 1036 for restorations, INR 942 for removable prostheses, and INR 6280 for fixed prostheses. Singh et al.¹⁷ noted a mean cost of INR 2135.94 (±656.81) for general dental surgery. Collectively, these data highlight the wide cost spectrum in oral health services, driven by disease severity, technological complexity, and care settings.

Standardized direct costs (2023 INR; PPP-USD). After conversion, oral cancer costs span PPP-USD ~1959–15,609 (conventional RT to surgery + RT; 2017), with 2023 comprehensive care ≈ PPP-USD 3973. For oral surgery admissions (2023), non-insured ≈ PPP-USD 1934.78, government-supported ≈ 3178.62, and private ≈ 2510.90. Preventive/restorative items are lowest (PPP-USD ~24–376.78), and routine OPD care averages PPP-USD 7.62 (public) vs PPP-USD 383.81 (private) Refer Table 3.

3.3.3. Indirect costs

Indirect costs associated with oral diseases in India primarily arise from productivity losses, including wages lost by patients and caregivers during the course of illness or treatment. Goswami et al. reported an average indirect cost of INR 13,320 (±29,952) for oral cancer care, causing both patient and caregiver wage losses.³⁴ For oral potentially malignant disorders, Jay R. Patel et al. noted a median wage loss of INR

200, though the absence of variability measures limits further interpretation.⁴⁰ In a separate report, Balaji estimated indirect productivity loss at INR 434.85 (approximately USD 6.69), suggesting relatively low—but still relevant—economic burden even in non-cancer dental conditions.¹² Overall, while indirect costs were less frequently reported and generally lower than direct costs, they represent an important and often overlooked dimension of the total economic burden of oral diseases, particularly when caregiver losses are considered.

3.3.4. Catastrophic health expenditure

Across the limited body of evidence, reported rates of catastrophic health expenditure (CHE) for oral health care in India range from negligible to nearly universal, largely reflecting the threshold used to define “catastrophic” and the clinical context. At the most severe end, Goswami et al. found that 96 % of households with an oral-cancer patient spent ≥10 % of their annual income on treatment, underscoring the ruinous financial impact of cancer care.³⁴ In contrast, community-based studies applying higher thresholds recorded much lower rates: Nobleika et al. reported 15.4 % of households exceeding a 20 %-of-income cut-off,³¹ while Bernabé et al. and Mazood et al.—both using the WHO “capacity-to-pay” definition of ≥40 %—found 19.4 % and only 0.6 % respectively.^{29,30} Such disparity highlights how the choice of denominator (total income vs. discretionary capacity) and cut-off level can radically alter the apparent burden. Please refer Table 4.

Using the three studies that employed the ≥20 % of household income definition,^{18,31} a random-effects meta-analysis yielded a pooled prevalence of catastrophic dental spending of 18.8 % (95 % CI 15 %–22.9 %). Between-study heterogeneity was moderate ($I^2 \approx 37$ %), reflecting differences in survey round, sampling frame and disease mix. Study-specific estimates ranged from 15.4 %³¹ to 22 %,¹⁸ with overlapping confidence intervals, indicating broadly comparable—but not identical—burdens across data sources. Forest plot depicted in Fig. 2.

Because only three data points met the common 20 % threshold and came from heterogeneous population surveys, this pooled figure should

Table 3

Direct Cost for oral healthcare in India.

Study	Year	Condition/Service	Direct Medical Cost (INR)	Direct Cost Adjusted (2023 INR)	Direct Cost Adjusted (2023 USD)	Standard Deviation/Range	Setting/Category	Notes
Rami Reddy et al. ³²	2017	Oral Cancer – Surgery	137,565	182762.7	9046.51	Not reported	Hospital-based treatment	Includes medical + surgical costs
Rami Reddy et al. ³²	2017	Oral Cancer – Conventional Radiotherapy	29,782	39567.02	1958.52	Not reported	Hospital-based treatment	Standard radiotherapy approach; relatively lower-cost modality.
Rami Reddy et al. ³²	2017	Oral Cancer – 3D or IMRT	118,245	157095	7775.99	Not reported	Hospital-based treatment	Advanced radiotherapy
Rami Reddy et al. ³²	2017	Oral Cancer – Surgery with Radiotherapy	237,357	315341.8	15609	Not reported	Hospital-based treatment	Highest cost among reported interventions
Goswami et al. ³⁴	2023	Oral Cancer – Comprehensive care	80,273	80273	3973.41	±56,254	Hospital-based	Includes hospitalization, diagnosis, medicines
Bhatt et al. ³⁹	2023	Oral Surgery – Non-insured	39,087.6	39087.6	1934.78	Not reported	Tertiary care (non-insured)	Paid entirely out-of-pocket; lects costs in absence of any coverage.
Bhatt et al. ³⁹	2023	Oral Surgery – Government	64,216.3	64216.3	3178.62	Not reported	Public hospital (with subsidy)	Costs incurred at public hospitals; may include partial subsidies.
Bhatt et al. ³⁹	2023	Oral Surgery – Private	50,726.7	50726.7	2510.9	Not reported	Private hospital	Costs at private hospitals; often higher than public care, even without subsidies.
Kandwal et al. ³⁷	2020	Oral Prophylaxis	400	484.84	24	Not reported	Not specified	Preventive dental procedure
Kandwal et al. ³⁷	2020	Restoration of Decayed Teeth	1036	1255.73	62.16	Not reported	Not specified	Basic restorative care
Kandwal et al. ³⁷	2020	Removable Dental Prosthesis	942	1141.8	56.52	Not reported	Not specified	Prosthetic care
Kandwal et al. ³⁷	2020	Fixed Dental Prosthesis (Crown/Bridge)	6280	7611.98	376.78	Not reported	Not specified	Prosthetic care
Singh et al. (2015)(17)	2015	Dental Surgery – General	2135.94	3046.92	150.82	±656.81	Not specified	Includes consultation and minor/major surgeries
Meenal et al. ³⁵	2017	General Dental Care – Public	115.85	153.91	7.62	±74.58	Public outpatient setting	Lowest cost, likely subsidized
Meenal et al. ³⁵	2017	General Dental Care – Private	5836.4	7753.98	383.81	±7900	Private outpatient setting	Highest SD reported

Original costs are reported in INR and in the study's price year; '2023 INR' and '2023 PPP-USD' were calculated using the CCEMG–EPPI Centre Cost Converter (GDP-deflator–based inflation adjustment plus PPP conversion), as described in Methods section 2.7.

Table 4

Catastrophic health expenditure for oral healthcare in India.

Study	Population/Disease	CHE Definition/Threshold	Sample Size	CHE (%)	Notes
Goswami et al. ³⁴	Oral cancer	≥10 % of total annual family income	100	96.0	Focused on oral cancer treatment; very high CHE burden
Prasad et al. (71st round) ¹⁸	Oral diseases (mixed)	≥20 % of annual consumption expenditure spent on care	204	20.0	Overall CHE across public/private users
Prasad et al. (75th round) ¹⁸	Oral diseases (mixed)	≥20 % of annual consumption expenditure spent on care	155	22.0	Overall CHE; highest rates among poor and private-sector users
Nobelika et al. ³¹	Oral diseases (general)	≥20 % of income spent on dental care and medication	246	15.4	Catastrophic dental health expenditure (CDHE)
Bernabé et al. ²⁹	Oral diseases (global estimate)	≥40 % of household capacity to pay (WHO method)	Not reported	19.4	CHE based on WHO's recommended threshold
Mazood et al. ³⁹	Oral diseases – full sample	≥40 % of household capacity to pay (WHO method)	6053	0.6	CHE among entire sample; 8.7 % among those with any dental expenditure

be interpreted cautiously; nonetheless, it provides the best available single summary of catastrophic expenditure risk for oral-health care under a unified definition. Future research would benefit from standardized CHE thresholds, clearer reporting of confidence intervals, and disaggregation by socioeconomic status to improve comparability and policy relevance.

Studies reporting catastrophic health expenditure (CHE) identified several consistent socioeconomic and behavioural predictors. In an oral cancer-specific analysis, Goswami et al. showed that although CHE affected all socioeconomic groups, households in lower socioeconomic strata incurred a disproportionately higher burden relative to income,

with some spending more than twice their annual household income. Robust regression identified lower socioeconomic status as a significant predictor of CHE, while insurance coverage was protective.³⁴ In a community-based study, Nobelika et al. found that CHE (≥20 % income threshold) was significantly associated with lower income, larger household size, lower socioeconomic status, longer work loss, self-reported dental problems, irregular dental visits, self-medication, and postponement of dental care. These findings indicate that delayed care-seeking and informal treatment practices increase CHE risk.³¹

Multi-country LMIC analyses provide contextual support, with Bernabé et al. and Masood et al. reporting associations between CHE and

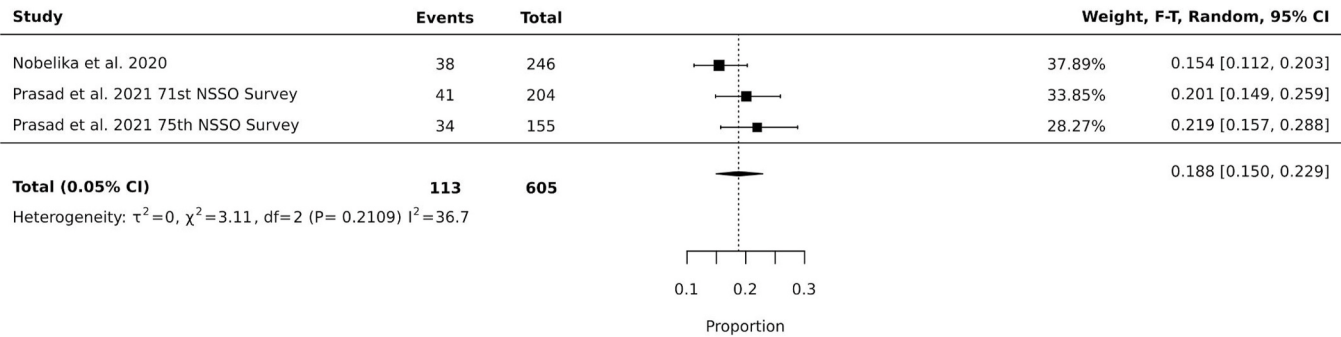


Fig. 2. Pooled prevalence of catastrophic dental health expenditure (≥20 % of household income) in India.

income, education, household composition, urban residence, and service utilization, reflecting structural determinants relevant to India.^{29,30} (Coping strategies explicitly reported included borrowing money, selling assets, cutting household expenditure, self-medication, and delaying care.^{34,31}

3.3.5. Insurance

Evidence from these studies suggests that health insurance plays only a marginal role in offsetting oral healthcare costs. In a study on oral cancer patients, Goswami et al. found that just 13.4 % had any insurance coverage, and even among the insured, catastrophic out-of-pocket (OOP) expenses remained common, indicating limited financial protection.³⁴ Similarly, Ramireddy et al. reported that only 3 % of dental patients utilized insurance to cover the treatment costs, with the vast majority relying on personal funds.³² Notably, those with coverage were more likely to be from higher-income groups, underscoring inequities in access.

Bhat et al.’s nationally representative survey corroborates these trends: only 5.2 % of dental service users reported insurance coverage, while 58.5 % paid entirely OOP.³⁹ Publicly funded services accounted for some relief, but the study found no strong link between insurance status and reduced financial burden or higher utilization. Overall, these studies highlight that dental insurance in India—where available—is sparsely used, inequitably distributed, and insufficient to shield households from the high costs of oral healthcare.

3.3.6. Hardship financing

Beyond insurance shortfalls, several studies highlighted the reliance on distress strategies to afford dental care. Goswami et al. reported that 29 % of patients had to borrow money from moneylenders, 33 % resorted to selling assets, and an additional 32 % reported cutting down on family expenses to meet treatment costs—clear indicators of financial distress.³⁴ Ramireddy et al. similarly noted that a significant share of patients used loans or personal savings, with negligible use of pre-paid schemes.³² These findings underscore that in the absence of effective financial protection, many Indian households face economic strain, deepening inequality and perpetuating cycles of health-related poverty.

3.3.7. Distress financing

Across studies, patients frequently resorted to distress financing methods to meet oral healthcare costs. Goswami et al. found that 29 % of patients borrowed money from moneylenders, 33 % sold assets, and 32 % cut down on family expenditures to afford treatment—lecting the catastrophic economic consequences of cancer care.³⁴ Similarly, while Ramireddy et al. did not report exact figures, their qualitative findings indicate that many patients faced substantial financial strain, often exhausting savings or seeking external help to cover dental expenses.³² These patterns underscore the inadequacy of formal financial protection mechanisms and the resulting dependence on high-risk coping strategies, particularly among vulnerable populations.

3.3.8. Poverty Impact

In Bernabé et al.’s multi-country analysis, dental out-of-pocket (OOP) expenditures were found to have a substantial poverty impact in India. Specifically, 9.2 % of Indian households were pushed below the poverty line due to dental care expenses—a rate considerably higher than the global median of 0.8 % reported across 41 countries.²⁹ In this study, poverty impact was assessed using a poverty headcount (impoverishment) approach, whereby households were considered impoverished if post-health expenditure consumption fell below a relative poverty line (subsistence expenditure).This highlights the disproportionate burden of dental spending in India, especially among lower-income households with limited access to financial protection.

4. Discussion

This systematic review is the first to synthesize and critically appraise available evidence on the economic burden and financial impact of oral diseases in India. By consolidating findings from 15 studies, using a comprehensive search strategy of academic and non-academic databases and grey literature, our review highlights clarifies important trends in out-of-pocket spending, catastrophic expenditure, and distress financing, and identifies areas where national health systems can respond more effectively.

Our findings confirm that direct medical costs for oral diseases — especially high-cost conditions like oral cancer — are substantial, with mean out-of-pocket expenditure (OOPE) estimates for oral cancer treatment ranging widely from around INR 80,000 to over INR 230,000. These estimates are consistent with disease-specific costs reported in other low- and middle-income countries (LMICs), where cancer-related OOPE frequently pushes households into catastrophic spending.^{42,43} Notably, our synthesis shows that non-medical costs — such as travel, accommodation, and food for patients and caregivers — also represent a significant share of the total burden. This dimension is often overlooked in national costing exercises⁴⁴ and our findings underscore the need to integrate these expenses into national accounts.

Beyond prevalence, our review highlights that CHE is strongly patterned by socioeconomic vulnerability and financial protection status. Evidence from oral cancer-specific and community-based studies indicates that lower socioeconomic status and lack of insurance substantially increase the risk of CHE, while insurance coverage—where present—has a protective effect.^{34,31} Importantly, delayed care-seeking behaviours such as postponement of dental treatment and self-medication were themselves associated with higher catastrophic expenditure, suggesting a cycle in which financial barriers exacerbate disease progression and subsequent costs.³¹

A key contribution of our review is the quantitative estimate of catastrophic health expenditure (CHE) associated with oral diseases. We found that for oral cancer, up to 96 % of households spent more than 10 % of annual income on treatment, with a pooled prevalence of catastrophic spending risk at approximately 19 % (95 % CI 15 %–23 %) using a ≥20 % income threshold. While these figures align with studies

on other non-communicable diseases in India,^{45,46} the magnitude for oral health is striking and has rarely been synthesized in this way. This adds robust evidence to international comparisons that already show India's CHE for dental care exceeds the LMIC average.²⁹ Our results further illustrate the widespread reliance on distress financing: borrowing money, selling assets, or cutting essential family spending remains a common coping strategy for Indian households facing dental costs. Such patterns mirror evidence from broader health financing literature in South Asia,^{47,48} where the absence of financial protection mechanisms drives households deeper into debt cycles. Yet, unlike other areas of healthcare, dental insurance coverage remains almost negligible: our review found coverage rates as low as 5 %, consistent with national household survey data showing low uptake of dental insurance benefits.⁴⁴ This raises critical questions for policymakers about the sustainability of OOPE-led financing for oral health services. Importantly, none of the included studies measured the depth or severity of poverty impact attributable to oral healthcare spending; poverty effects were limited to impoverishment headcount measures in a small number of studies, indicating a critical gap in the evidence base.

Importantly, comparisons of out-of-pocket expenditure (OOPE) between public and private dental settings must be interpreted with caution due to inherent differences in cost components as concluded by Meenal et al.³⁵ In many public facilities, treatment fees are fully subsidized, resulting in OOPE that consists almost entirely of direct non-medical expenses such as travel and incidental costs. In contrast, private-sector OOPE includes both direct medical costs (consultation, procedures, investigations) and direct non-medical costs, leading to substantially higher and more variable financial burden.

This systematic review highlights the significant risk of catastrophic health expenditure (CHE) related to oral diseases in India, with a pooled prevalence of 18.8 % at the ≥ 20 % threshold and individual estimates reaching as high as 96 % for oral cancer. However, existing studies largely apply basic incidence-based measures of CHE without examining its underlying drivers or subgroup distribution. Recent methodological developments, such as the Watts-type CHE measure proposed by Ogwang and Mwangi (2025),⁴⁹ offer an important advancement for health economics and policy. This measure is both additively and multiplicatively decomposable, enabling the overall CHE burden to be broken down by population subgroups (e.g., by income, rural–urban residence) and by the three 'Ts' of CHE: incidence, intensity, and inequality. Incorporating such decomposable measures into future oral health cost studies and national household surveys (e.g., NSSO health rounds) would allow policymakers to identify which groups contribute most to CHE, target financial protection more equitably, and monitor progress toward Universal Health Coverage (UHC). Therefore, we recommend that future economic burden studies in India adopt robust, decomposable CHE metrics to inform more precise, equity-oriented oral health financing reforms.

Importantly, our review highlights that some robust national data sources do exist — notably the National Sample Survey Office (NSSO) health rounds and the World Health Survey — which have enabled a few studies to produce nationally representative estimates. However, these sources are not regularly updated, and oral health is often captured only superficially, with insufficient disaggregation by disease type, socio-economic status, or geographic region. This contrasts with best practice from countries like Thailand and Brazil, which have integrated dental modules into their periodic national health surveys.⁵⁰

While this review provides the most detailed estimates for the economic burden of oral cancer, it also brings attention to other common but under-researched conditions such as dental caries and periodontitis. Some included studies reported out-of-pocket expenses ranging from INR 400 to INR 6000 for preventive and restorative treatments, such as oral prophylaxis, fillings, and prostheses.³⁷ Although these costs are lower than cancer treatment costs, they still pose a significant burden for low-income households given the high prevalence of dental caries and periodontitis in India. Untreated dental caries remains widespread

among children and adults, and periodontitis is a major cause of tooth loss, yet few studies calculate their full direct, indirect, and household-level economic burden.⁵¹ This underscores the need for condition-specific cost estimates to support preventive care strategies and resource allocation for conditions that, while individually less expensive, add up to a major cumulative burden on families and the health system.

While we recognise the methodological heterogeneity, our study demonstrates that meaningful synthesis is possible, especially when studies are grouped by cost categories, disease types, and population subgroups. This creates a foundation for benchmarking, policy dialogue, and more granular economic evaluations in the future. The diversity in methods and settings also reflects India's complex health system — urban vs rural, private vs public — and these nuances are valuable for shaping region-specific strategies.

Comparisons with other countries suggest that India's heavy reliance on OOPE for dental care is not unique but the scale of impoverishment and catastrophic expenditure appears more severe. In LMIC contexts, pooled risk protection for dental care remains rare, but countries with more integrated primary oral healthcare and subsidized treatment pathways have shown better financial protection outcomes.^{52,53} Future research could use lessons from these contexts to inform feasible financing reforms for India.

What is urgently needed, as our review shows, is more systematic, standardized, and up-to-date data collection. Future national surveys should include detailed oral health expenditure modules, capturing direct, non-medical, and indirect costs. Longitudinal studies would provide better insight into the cumulative burden over the life course, particularly for chronic and high-cost conditions like oral cancer. There is also a need to standardize thresholds for defining catastrophic and impoverishing expenditure, as inconsistent definitions limit comparability and policy uptake.

In the **absence of improved data**, the economic burden of oral diseases will continue to be underestimated, risking further neglect in policy and financing priorities. This review shows that the consequences for households are already severe: high out-of-pocket costs, financial distress, and poverty impacts that surpass the global median for dental spending.²⁹ Failure to address these gaps will likely perpetuate cycles of inequity and poor access to essential oral health services.

5. Conclusion

In conclusion, this systematic review brings together evidence from 15 studies, highlighting the significant and unequal economic burden of oral diseases in India. Out-of-pocket expenditure remains the main source of payment, with direct medical costs for conditions like oral cancer reaching up to INR 230,000, and non-medical and indirect costs adding further strain.

Our synthesis shows that up to 96 % of households with oral cancer patients face catastrophic health spending, and around 19 % risk catastrophic dental expenditure overall, while insurance coverage remains minimal. Many households rely on distress financing, deepening financial hardship.

Despite gaps in national data, this review demonstrates that meaningful synthesis is possible and urgently needed to inform policy. Better national data, standardized cost reporting, and stronger financial protection measures are essential to reduce OOPE, prevent impoverishment, and advance universal oral health coverage in India.

Patient and public involvement

Patients and the public will not be involved in the design, conduct, reporting or dissemination plans of this research.

Ethics and dissemination

This review does not involve the collection or analysis of individual patient data. Instead, it has utilized data from publicly available economic research studies. All data sources were appropriately cited. As this is a secondary analysis of published literature, ethical approval was not required.

Acknowledgements and declaration

Nil. We do not have any acknowledgement or anything to declare.

Ethical clearance declaration

This review does not involve the collection or analysis of individual patient data. Instead, it has utilized data from publicly available economic research studies. All data sources were appropriately cited. As this is a secondary analysis of published literature, ethical approval was not required.

Patient's/guardian's consent declaration

Since this is a systematic review, this was not applicable.

Declarations

Nil.

Author contributions

Methodology and drafting of the protocol: VK, CJ, DJ. Search strategy development and database screening: VK. Critical review and editing of the manuscript: VK and AR. Supervision and overall guidance: CJ. Methodology and guarantor: DJ. All authors have read and approved the final version of the manuscript.

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Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.jobcr.2026.01.006>.

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