

Review Article

Social Determinants of Oral Health and Access to Dental Care in Southern India: A Narrative Review

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Abstract

Background: This narrative review examines social determinants of oral health and dental-care access in Southern India to identify priorities for equitable public dental services.

Methods: English-language literature published from January 2000 to 4 October 2026 was identified through PubMed/MEDLINE, Google Scholar, World Health Organization, and Government of India sources. Evidence was synthesized narratively, informed by the Scale for the Assessment of Narrative Review Articles.

Results: Evidence was geographically uneven. National estimates for 2019 indicated untreated permanent-tooth caries in 28.8% of people aged ≥5 years and severe periodontal disease in 21.8% of those aged ≥15 years. In a Mysore municipal-employee sample, caries prevalence was 43.3% in the upper and 78.6% in the lower socioeconomic category. A national meta-analysis estimated adult dental-service utilization at 23.96%, decreasing to 17.65% after trim-and-fill adjustment for publication bias. The South-zone estimate was 30.02% (95% confidence interval: 19.14–40.90); heterogeneity was very high and geographic-zone differences were nonsignificant. In Prakasam, 13.9% used community health centre dental services, while 91.1% were unaware that care was free.

Conclusion: State and district programmes should prioritize functional dental teams, primary-care referral pathways, public communication of free services and financial protection for disadvantaged groups. Implementation should track unmet need, service utilization and out-of-pocket expenditure across socioeconomic groups; locally evaluated approaches are needed before wider adoption.

More Information

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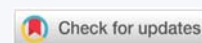
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Keywords: Oral health; Social determinants of health; Dental health services; Healthcare disparities; Healthcare accessibility; Southern India



Introduction

Oral health is an important component of general health and quality of life and influences eating, speaking, social interaction and psychological well-being. Despite the largely preventable nature of many oral diseases, dental caries, periodontal diseases, tooth loss and oral cancer continue to contribute substantially to disease burden in India [1–4].

World Health Organization estimates based on 2019 data indicate that untreated caries in permanent teeth affected approximately 28.8% of people aged five years and above in India, while severe periodontal disease affected approximately 21.8% of people aged 15 years and above [3].

The National Oral Health Survey and Fluoride Mapping 2002–2003 provided an important nationwide epidemiological assessment of oral-health conditions [4]. Because these findings are more than two decades old,

they should be interpreted primarily as historical baseline information rather than estimates of current prevalence.

Oral diseases are not distributed independently of social circumstances. Socioeconomic position, education, material conditions, employment, behavioural exposures and healthcare systems influence both the likelihood of developing disease and the ability to obtain timely preventive or therapeutic care.

The conceptual framework developed by Solar and Irwin for the World Health Organization distinguishes structural determinants, including socioeconomic and political context and socioeconomic position, from intermediary determinants, including material circumstances, psychosocial factors, behaviours, biological factors and the health system [5]. This framework is relevant to oral health because behaviours often considered individual choices are themselves shaped by broader social and economic circumstances.



Indian literature has similarly emphasized that oral-health inequalities cannot be adequately understood through individual behaviour alone [6]. A national scoping review identified persistent inequalities related to socioeconomic position and healthcare access and highlighted the need for stronger equity-oriented oral-health research and policy [7].

Dental-service utilization in India appears relatively low. A meta-analysis of 21 studies published between 2011 and 2022 estimated pooled adult dental-care utilization at 23.96% (95% confidence interval (CI): 16.81–31.11) [8]. Heterogeneity was extremely high ($I^2 = 98.93\%$), and publication bias was detected using Egger's test ($p = 0.02$). Following trim-and-fill adjustment, the estimate decreased to 17.65% (95% CI: 8.97–26.33) [8].

The pooled South-zone estimate was 30.02% (95% CI: 19.14–40.90; $I^2 = 98.63\%$), and differences between geographic zones were not statistically significant ($p = 0.09$) [8]. The South-zone subgroup included heterogeneous study populations, including dental-hospital attendees, outreach attendees, information-technology professionals and perinatal women. The pooled estimate should therefore not be interpreted as a precise utilization rate for Southern India or as evidence that utilization is consistently higher than in other regions.

This review examines the social determinants of oral health and access to dental care in Southern India, synthesizes available regional evidence and discusses implications for policy and future research.

Methods

This narrative review synthesizes evidence concerning social determinants of oral health, oral-health inequalities and access to dental services in Southern India.

Its conduct and reporting were informed by the Scale for the Assessment of Narrative Review Articles (SANRA), which addresses the importance and aims of a review, description of the literature search, referencing, scientific reasoning and presentation of relevant evidence [9].

PubMed/MEDLINE and Google Scholar were searched for English-language publications from January 2000 to 4 October 2026. World Health Organization and Government of India sources were additionally reviewed for epidemiological, conceptual and policy information. Older national sources were retained where they provided important historical context, particularly the National Oral Health Survey and Fluoride Mapping 2002–2003 [4].

Search terms were used alone and in combination and included “oral health,” “social determinants,” “oral health inequalities,” “dental service utilization,” “access to dental care,” “socioeconomic status,” “oral health literacy,” “out-of-pocket expenditure,” “financial barriers,” “rural oral health,”

“children,” “older adults,” “disability,” “tribal populations,” “commercial determinants,” “South India,” “Southern India,” “Karnataka,” “Kerala,” “Tamil Nadu,” “Andhra Pradesh,” “Telangana” and “Puducherry.”

Studies were considered when they:

1. assessed oral-health status, treatment need or dental-service utilization;
2. examined socioeconomic, educational, behavioural, geographic, financial or health-system determinants;
3. included populations from Southern India; or
4. provided national or conceptual evidence directly relevant to interpretation of the regional literature.

Observational, qualitative, mixed-method and intervention studies, systematic and scoping reviews and meta-analyses were considered.

Studies dealing exclusively with laboratory outcomes or clinical treatment comparisons without relevance to social determinants or healthcare access were excluded. Conference abstracts without sufficient methodological detail and duplicate reports were not used as primary evidence.

Formal duplicate independent screening, PRISMA-based screening, systematic risk-of-bias assessment and quantitative pooling of regional studies were not undertaken. This review should therefore be interpreted as a structured narrative synthesis rather than a systematic review.

Social determinants and oral health

The social determinants of health include the circumstances in which people are born, grow, live, work and age and the wider systems influencing the distribution of resources and opportunities [5].

Structural determinants influence socioeconomic position through factors such as income, education, employment and social status. These operate through intermediary determinants including material circumstances, psychosocial factors, behaviours and healthcare access [5].

Applied to oral health, this framework indicates that toothbrushing, dietary practices and dental attendance cannot be understood solely as individual choices. A person may understand the importance of preventive care yet be unable to obtain it because of treatment cost, employment constraints, transport difficulties, poor awareness of available services or inadequate healthcare capacity.

Reducing oral-health inequalities therefore requires both individual-level preventive measures and interventions addressing the social and healthcare environments in which oral-health behaviours occur.



Socioeconomic position and oral disease

Socioeconomic position is among the most consistently reported determinants of oral health.

A study involving 1,187 municipal employees in Mysore, Karnataka, reported dental-caries prevalence of 43.3% in the upper socioeconomic category compared with 78.6% in the lower socioeconomic category [10]. This demonstrates a socioeconomic gradient within the study population; however, because the participants were municipal employees and the study was published in 2011, these figures should not be interpreted as contemporary city-wide prevalence estimates.

A cross-sectional study involving 800 adults aged 20–50 years attending dental-outreach settings of a dental school in Udupi district found that lower education, unemployment, unskilled occupation, lower income and lower socioeconomic position were associated with greater dental-caries experience [11]. These associations were secondary findings in a study primarily examining lifestyle and caries, and the outreach-based sample was not representative of the district's general adult population.

Together with national review-level evidence, these findings support an association between socioeconomic disadvantage and poorer oral-health outcomes [6,7].

Education, oral-health literacy and perceived need

Education may influence oral health through income, employment, health literacy and the ability to navigate healthcare systems.

In a survey of 1,100 schoolchildren aged 13–15 years in Bengaluru, completed by parents, 78.1% had not utilized dental services in the previous year [12]. In bivariate analysis, family income, socioeconomic status, occupation of the head of household, parental attitudes and perceived oral-health problems were among the factors associated with utilization. In multivariable analysis, parental education, travel time to the dental facility, family size, children's oral-health behaviours and parental attitudes remained associated [12].

Perceived treatment need is particularly important because dental disease may progress before severe pain develops.

In a cross-sectional study of 280 participants in Nalgonda district, Telangana, the most frequently cited reason for not utilizing dental services, reported by 73.2% of participants, was the belief that treatment was unnecessary in the absence of pain. Dental fear was also identified as a significant barrier, particularly among women [13].

Among 570 rural residents of Chengalpattu district, Tamil Nadu, 247 participants (43.3%) reported toothache and 167 of these participants (67.6%) perceived a need for dental care

[14]. The authors also reported that approximately 37.5% had their dental needs met during the previous year. Because this figure is not directly comparable with the toothache subgroup counts, it is not interpreted further in this review [14].

Collectively, these findings suggest that pain, perceived need, oral-health awareness and dental fear can influence whether people seek professional dental care.

Geographic accessibility, awareness and health-system capacity

Access to dental care depends on more than physical proximity to a healthcare facility.

A mixed-method study in Prakasam district, Andhra Pradesh, assessed all 12 community health centres (CHCs) and surveyed 360 randomly sampled households located within approximately 1 km of these facilities [15]. All 12 CHCs had a dentist, dental room and dental chair, but none had a dental assistant or dental hygienist. Available services were largely limited to health education, scaling and root planing, and restorative procedures [15].

Only 13.9% of respondents had utilized CHC oral-health services during the preceding year. In addition, 70.8% were unaware that a dentist was available at the CHC, 91.1% were unaware that oral healthcare was provided free of cost, and 85% perceived oral healthcare as inaccessible [15].

Awareness of CHC oral-health services (adjusted odds ratio 10.35, 95% CI: 2.31–46.41), perceived accessibility (4.89, 95% CI: 2.06–11.61) and the presence of multiple oral-health symptoms (3.19, 95% CI: 1.03–9.90) were significantly associated with utilization [15].

Socioeconomic status, educational status and perceived cost were not significantly associated with utilization. The authors suggested that this may partly reflect the provision of free care and the predominance of middle- and upper-income households in the sample [15]. Although 75.3% of respondents perceived oral healthcare as unaffordable, this perception was not associated with utilization of the free CHC services.

These findings suggest that physical proximity and formal availability of services may not result in high utilization when communities are unaware of available care or perceive services as inaccessible.

A situation analysis of primary health centres (PHCs) in Bengaluru Urban district analysed 65 PHCs and found dental officers posted in 18 centres [16]. Of these 18 dental units, 16 were established and managed by private dental colleges or hospitals through memoranda of understanding, one was operated through an arrangement with a government dental college/hospital and one was established by the state government [16].



Only three of the 18 units were reported as sufficiently staffed and well equipped, whereas the remaining units had deficiencies in staffing or equipment. These findings illustrate the substantial contribution of institutional partnerships to dental-service provision within the PHCs studied and indicate that the presence of a dental officer alone does not fully describe service capacity.

Dental-service utilization and variation within southern india

The marked heterogeneity observed in the national meta-analysis is reflected in differences between local studies [8].

A mixed-method study involving 544 adults in Ernakulam district, Kerala, reported dental-service utilization of 15.4% [17]. Age and education were significantly associated with utilization, while qualitative interviews identified financial restraints and difficulties in access as barriers and service availability and trust in healthcare providers as facilitators [17].

The Ernakulam study was published after the search period covered by the Talukdar meta-analysis and therefore did not contribute to its pooled South-zone estimate [8,17].

The Ernakulam estimate does not contradict the pooled South-zone estimate of 30.02%. The meta-analysis combined heterogeneous populations and settings and demonstrated substantial publication bias, whereas the Ernakulam study represents a single district population. The difference illustrates substantial variation within Southern India and the need to avoid treating the region as a homogeneous healthcare environment.

An earlier cross-sectional study from Krishna district, Andhra Pradesh, involving 3,102 participants demonstrated a substantial gap between perceived treatment need and service utilization [18].

Approximately 40% of participants perceived a need for dental treatment. Among those perceiving a need, only 21.4% had utilized dental services and 78.6% had unmet dental need [18].

The two most frequently reported reasons for non-utilization were unaffordable dental treatment (48%) and the perception that no dental problem was present (19.4%) [18].

Because the study was published in 2016, its findings should be interpreted as earlier evidence of financial and perceptual barriers to dental care rather than current district-level estimates.

Affordability and financial protection

Financial barriers are an important component of oral health inequality, although their influence differs according to healthcare setting and service financing.

Analyses of nationally representative National Sample Survey data demonstrated that oral healthcare can generate substantial out-of-pocket expenditure and that poorer households may be particularly vulnerable to catastrophic dental expenditure [19]. This provides the strongest evidence in the present review supporting financial protection as an equity issue, although it represents national rather than specifically Southern Indian evidence.

Regional evidence also identifies financial barriers in some settings. In Krishna district, 48% of all participants cited unaffordable dental treatment as a reason for not using dental care during the previous year [18].

A questionnaire study involving 500 participants in Kerala reported mean annual household dental-care expenditure of approximately ₹4,120 [20]. Dental expenditure showed weak-to-moderate positive correlations with income and socioeconomic status, indicating that higher-income households tended to spend more on dental care. The study therefore describes household expenditure patterns rather than demonstrating a greater proportional financial burden among poorer households.

Regional findings are not uniform. In Prakasam district, 75.3% of respondents perceived oral healthcare as unaffordable, yet income and perceived cost were not significantly associated with utilization of free CHC dental services [15]. The authors suggested that the availability of free treatment and the socioeconomic profile of the sample may partly explain this finding. Financial restraints were also identified during qualitative interviews in the Ernakulam study [17].

Affordability should therefore be regarded as an important potential determinant of dental-care access whose influence varies according to household circumstances, service financing and awareness of free or subsidized services.

Behavioural and commercial determinants

Dental caries, periodontal diseases and oral cancers are influenced by behaviours including dietary sugar intake, tobacco use, alcohol consumption, oral-hygiene practices and dental attendance. These behaviours occur within wider social and commercial environments.

An Indian perspective on the commercial determinants of oral health highlighted the potential influence of product availability, pricing, marketing and commercial practices relating to tobacco, sugar-rich products and other commodities [21].

This conceptual perspective supports combining individual health education with population-level policies aimed at reducing harmful exposures.

Vulnerable and marginalized populations

Tribal/Adivasi communities: An earlier study of five-



year-old tribal children in southwestern India documented substantial oral-health burden and differences in health practices and dental-service utilization when compared with another marginalized population [22].

The term tribal/Adivasi is used in the present review; the historical terminology of the original authors is retained only in the reference title.

Because the available regional evidence is relatively old and population-specific, contemporary representative studies among tribal populations are required.

Persons with disabilities: People with disabilities may experience additional financial, physical, provider-related and health-system barriers to oral healthcare.

An overview of systematic reviews identified accessibility, financial, provider-related, and healthcare-system barriers affecting people with disabilities [23]. This represents international rather than Southern India-specific evidence.

Regional evidence from Mysore concerns oral-health burden rather than healthcare access. Bennadi et al. compared institutionalized children aged 6–13 years with intellectual disabilities with children without disabilities and reported poor oral hygiene in 36.73% and 9.18%, respectively [24].

The study therefore demonstrates an unequal oral-hygiene burden among institutionalized children with disabilities but should not be interpreted as direct evidence of differences in dental-service utilization.

Children: Schools provide an important setting for preventive oral-health programmes.

Naidu and Nandlal evaluated a teacher-mediated primary preventive dental-health education programme among schoolchildren in Mysore and reported improvements in oral-health knowledge, attitudes and practices as well as selected oral-hygiene and gingival-health indicators [25].

A systematic review of primary school-based oral-health interventions in low- and middle-income countries reported potential benefits for some oral-health outcomes, but the certainty of evidence was rated very low [26].

School-based programmes therefore remain promising settings for oral-health promotion, but their effects on clinical outcomes and oral-health inequalities require careful evaluation.

Older adults: Older adults may experience cumulative oral disease together with multimorbidity, mobility limitations and financial constraints.

A study published in 2024, with fieldwork conducted from January 2015 to September 2016, examined root caries among

800 adults aged 50 years and above recruited from hospitals in Udupi district [27].

Participants were required to have at least ten teeth and were deliberately divided into 400 participants with diabetes and 400 without diabetes. Root caries was present in 37.3% of the study sample, including 46% of participants with diabetes and 28.5% of participants without diabetes. Lower educational and socioeconomic status were also significantly associated with root caries, although these were secondary findings in a study principally examining diabetes as a risk factor [27].

Because the population was hospital-based, restricted to people retaining at least ten teeth and deliberately balanced by diabetes status, the 37.3% value should not be interpreted as a population prevalence estimate for older adults in Udupi district.

Evidence from puducherry

A community-based mixed-method study published in 2025 examined 328 adults aged 60 years and above from rural Puducherry; the underlying fieldwork was conducted in 2017 [28].

Some form of edentulism was identified in 90.5% of participants. Among participants with edentulism, only 22% perceived a need for treatment, whereas 96.3% were professionally assessed as requiring treatment. Only 6.7% of edentate participants were using a dental prosthesis [28].

The study additionally identified limited awareness, financial constraints, and inadequate social support among barriers to receiving treatment.

Because the data were collected in 2017 within a rural field-practice area, these findings should not be interpreted as contemporary territory-wide prevalence estimates. Nevertheless, they illustrate a substantial gap between professionally assessed need, perceived need and actual rehabilitation among older adults.

National oral-health policy context

The Government of India launched the National Oral Health Programme (NOHP) in 2014–15 to strengthen public health facilities for accessible, affordable and quality oral-healthcare delivery [29].

The programme supports dental human resources, equipment and consumables, training and information, education and communication activities [29].

The Directorate General of Health Services reports that 9,587 dental-care units had received partial or full programme support nationally since 2014–15 [29]. This is a national figure and does not describe programme coverage specifically within Southern India.



The presence of a national programme provides an important policy framework, but regional studies indicate that infrastructure, awareness, staffing and effective utilization need to be evaluated separately [15,16].

A 2025 systematic review applying Andersen’s behavioural model identified income, insurance coverage, availability of facilities, perceived oral-health status, accessibility, fear and social misconceptions as determinants of dental-service utilization in India [30].

Summary of selected evidence from southern india

Selected regional study characteristics and findings are summarized in Table 1.

The available evidence remains geographically uneven. Karnataka is comparatively well represented, whereas several other southern states and union territories are represented by fewer and more localized investigations.

Strategies for reducing oral–health inequalities

The following priorities are informed by the evidence reviewed together with WHO and Indian policy frameworks.

Strengthening public dental services

Dental-service capacity should be assessed according to workforce, support personnel, functioning equipment, consumables, treatment availability, and referral systems rather than solely by the presence of a dental chair or dentist [15,16].

Improving awareness of available services

Evidence from Prakasam indicates that physical proximity

and free treatment do not necessarily guarantee utilization when communities are unaware of available services [15].

Public-health programmes should clearly communicate which oral-health services are available, where they are located, and whether treatment is free or subsidized.

Improving financial protection

National evidence concerning catastrophic household expenditure supports stronger financial protection for essential dental services [19].

Regional evidence regarding the role of cost is mixed and appears to depend on service financing, population characteristics, and awareness of publicly funded care [15,17,18,20].

Integrating oral health into primary healthcare

WHO recommends integrating essential oral-health services into primary healthcare and universal health coverage [1,2].

Integration may be particularly relevant to diabetes care, tobacco cessation, maternal health, healthy ageing and prevention of noncommunicable diseases.

Promoting preventive rather than symptom-driven attendance

Studies from Tamil Nadu and Telangana suggest that pain and perceived treatment need strongly influence care-seeking [13,14].

Oral-health communication should therefore emphasize that dental disease may require professional attention before severe pain develops.

Table 1: Summary of selected evidence from Southern India.

Study	Setting	Sample/design	Key finding
Shekar and Reddy [10]	Mysore, Karnataka	1,187 municipal employees; cross-sectional	Caries prevalence 43.3% in upper SES and 78.6% in lower SES
Singla et al. [11]	Udupi, Karnataka	800 adults aged 20–50 years from dental outreach; cross-sectional	Lower education, income, occupation, and SES associated with caries; secondary findings
Nagdev et al. [12]	Bengaluru, Karnataka	1,100 schoolchildren; parent-completed survey	78.1% had not used dental services in the previous year
Mitra [13]	Nalgonda, Telangana	280 participants; cross-sectional	73.2% cited belief that treatment was unnecessary without pain
Varsha et al. [14]	Chengalpattu, Tamil Nadu	570 rural respondents; cross-sectional	43.3% reported toothache; 67.6% of these perceived a need for care
Panditi et al. [15]	Prakasam, Andhra Pradesh	12 CHCs; 360 households within approximately 1 km	13.9% used CHC oral-health services in the preceding year; 91.1% were unaware that care was free
Iyer et al. [16]	Bengaluru Urban, Karnataka	65 PHCs; situation analysis	18 PHCs had dental officers; 16 units managed by private dental colleges/hospitals, one through a government dental-college arrangement and one by the state government
Sidharthan et al. [17]	Ernakulam, Kerala	544 adults; mixed methods	Dental-service utilization 15.4%
Pradeep et al. [18]	Krishna district, Andhra Pradesh	3,102 residents; cross-sectional	40% perceived need; 21.4% of these used care; 78.6% had unmet need
Kalra et al. [27]	Udupi, Karnataka	800 hospital participants aged ≥50 years	Root caries 37.3% in deliberately balanced diabetic/non-diabetic sample; not a population prevalence estimate
Ravindranath et al. [28]	Rural Puducherry	328 adults aged ≥60 years; mixed methods	90.5% had edentulism; among those with edentulism, 22% perceived treatment need, 96.3% had professionally assessed need and 6.7% used prostheses

Abbreviations: CHCs, community health centres; PHCs, primary health centres; SES, socioeconomic status. Percentages describe the respective study populations and should not be interpreted as state-wide estimates.



Supporting school-based prevention

Regional evidence suggests that teacher-mediated oral health education may improve knowledge, attitudes, practices and selected oral-health indicators among schoolchildren [25].

However, broader evidence from low- and middle-income countries remains of very low certainty for clinical outcomes [26]. School-based programmes should therefore be accompanied by appropriate evaluation of behavioural and clinical outcomes and their effects on oral-health inequalities.

Addressing commercial determinants

Policies addressing tobacco use, harmful alcohol consumption and excessive free-sugar exposure should complement individual oral-health counselling [21].

These strategies represent evidence-informed public-health priorities and should not be interpreted as interventions that have been uniformly evaluated throughout Southern India.

Research gaps

First, much of the regional evidence is cross-sectional, limiting causal inference.

Second, geographic representation remains uneven. Karnataka contributes a relatively large proportion of the available literature, while evidence from several other southern states and union territories, including Puducherry, is derived from fewer and more localized investigations.

Third, many studies use selected populations, including hospital patients, dental-outreach attendees, schoolchildren and institutionalized populations.

Fourth, self-reported utilization and perceived need are common measures and may be affected by recall and reporting bias.

Fifth, definitions of utilization, perceived need, socioeconomic position, and accessibility differ among studies, limiting direct comparison.

Sixth, the national meta-analysis demonstrated very high heterogeneity and publication bias, and its South-zone subgroup included diverse populations. Pooled regional estimates therefore require cautious interpretation [8].

Seventh, several regional studies examined socioeconomic variables as secondary rather than primary study outcomes.

Eighth, India continues to lack a recent comprehensive nationally representative oral-health survey. A 2025 review noted that the last comprehensive national survey was conducted in 2002 and emphasized the need for updated population-level surveillance [4,31].

Subsequent initiatives have generated additional information but are not equivalent to nationally representative epidemiological surveillance. For example, Balraj et al. conducted an analytical cross-sectional survey using the World Dental Federation's digital application among patients seeking care at private oral-healthcare practices in urban and rural India [32]. The survey provides useful information on oral-health status, care-seeking behaviours and oral-health-related quality of life, but its clinic-attending population should not be interpreted as a probability sample representative of the general Indian population.

Finally, relatively few studies evaluate whether interventions specifically reduce socioeconomic or geographic inequalities rather than only improving average oral-health outcomes.

Limitations

This review has several limitations.

First, it was conducted as a narrative rather than systematic review. Although a structured search strategy and SANRA principles informed its preparation, relevant publications may have been missed, duplicate independent screening was not undertaken, and formal risk-of-bias assessment was not performed.

Second, the regional evidence was geographically uneven, with Karnataka contributing a substantial proportion of the identified studies.

Third, many studies were cross-sectional, limiting causal interpretation.

Fourth, utilization, perceived need, socioeconomic position, and accessibility were defined differently among studies.

Fifth, several studies relied on self-reported outcomes or selected populations and are not necessarily representative of wider state populations.

Sixth, older studies were retained when recent evidence was limited and should not automatically be assumed to describe current disease prevalence or contemporary healthcare conditions.

Seventh, local studies varied in sample size, methodology and publication setting; several originated from general clinical or regional journals and involved relatively small or selected populations.

Eighth, regional evidence should be distinguished from national or international evidence used to provide conceptual and policy context. Evidence concerning catastrophic expenditure, commercial determinants, and disability-related barriers is partly national or international rather than exclusively specific to Southern India.



Finally, the national meta-analysis demonstrated extreme heterogeneity and publication bias. Its pooled utilization estimate decreased from 23.96% to 17.65% following trim-and-fill adjustment, while the South-zone estimate had a wide confidence interval and did not differ significantly from estimates for other geographic zones [8].

Neither individual district studies nor pooled regional estimates should therefore be interpreted as precise measures for all populations in Southern India.

Conclusion

Oral-health inequalities in Southern India are associated with interacting socioeconomic, educational, behavioural, geographic and health-system factors. The reviewed evidence indicates that expanding infrastructure alone is insufficient: service readiness, awareness of available care, perceived need and affordability also require attention. Because study populations and utilization measures vary substantially, neither district-level findings nor pooled South-zone estimates should be treated as representative of every state or population group [8,15–18].

State and district health authorities should develop costed implementation plans within the National Oral Health Programme, beginning with facility-level assessments of dentists, support personnel, functioning equipment, consumables and referral capacity. Resources should be directed towards identified service gaps, with clearly assigned responsibility for staffing, maintenance and referral coordination between primary health centres, community health centres and higher-level facilities. Partnerships with dental colleges should specify service schedules, continuity of care and accountability rather than substitute for monitoring public-service capacity [15,16,29].

Primary-care teams and community health workers should receive training in oral-health education, recognition of common oral-health problems and referral, linked to existing diabetes, maternal-health, tobacco-cessation and older-adult services. District programmes should provide local-language information on facility locations, clinic schedules and services available free of charge or at subsidized rates, and should monitor whether referred patients receive care. Communication should address dental fear and the misconception that treatment is necessary only when pain occurs [1,2,13–15,17].

Financial protection should focus on a locally costed package of essential preventive and basic dental care, with targeted subsidies where financial barriers are demonstrated. Accessible facilities, caregiver support and referral-linked outreach should be considered for older adults, persons with disabilities and underserved communities. School-based prevention should be evaluated for clinical outcomes and equitable reach, alongside wider measures addressing

tobacco, harmful alcohol use and excessive free-sugar exposure [19,21,23,25,26,28].

Programme performance should be assessed using predefined indicators, including functioning dental units, awareness of free services, completed referrals, dental-service utilization, unmet treatment need and out-of-pocket expenditure. Where feasible, these indicators should be disaggregated by socioeconomic position, rural or urban residence, age, sex and disability, with district-specific targets set after baseline assessment. Representative surveillance and prospective intervention evaluations are needed to determine whether improvements reduce inequalities rather than only increase average service use. These recommendations are evidence-informed implementation priorities; their effectiveness and feasibility require local evaluation.

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