Review Paper

The Relationship Between Socioeconomic Status and Dental Caries Among Adults in India: A Scoping Review

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ABSTRACT

Background: It is well documented that India is an example of the unequal distribution of dental caries among different population groups, as higher prevalence and incidence have been reported among people with a low socioeconomic level. The objective of this review was to systematically map the scientific literature on the effect of socioeconomic status (SES) on dental caries among adults, identify the research gaps in this area, and propose recommendations for future research.

Methods: This scoping review was conducted based on the updated framework recommended by Joanna Briggs Institute. Relevant studies undertaken in India were identified by searching Medline/PubMed, EBSCO, and Google Scholar. The search strategy was limited to journal articles published between January 2012 and October 2022. Titles and abstracts were screened, and full texts were reviewed by two reviewers independently.

Results: The scoping review comprised 7 cross-sectional studies and 1 cohort study. Most reviewed studies used the Kuppuswamy scale or its modifications to assess the SES. Four studies determined the caries status regarding mean values according to SES and reported higher DMFT (decayed, missing, and filled teeth) among the middle and lower-class SES. Three studies employed regression analysis to determine the association, and all found that the DMFT score was significantly associated with socioeconomic status.

Conclusion: The findings of this review confirm the existence of inequalities in caries experience in adults from different socioeconomic backgrounds. More high-quality and follow-up studies are needed to establish the magnitude of the scientific evidence regarding the association between socioeconomic status and dental caries among adults in India.

Keywords: Dental caries, Adults, Socioeconomic status, India, Scoping review

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Introduction

Oral health is an integral part of general health and well-being. Poor oral health can have varying impacts on the quality of life, causing pain or discomfort, tooth loss, impaired oral functioning, and disfigurement, thus resulting in missing school time, loss of work hours, and death in the case of oral cancer or noma. Although improvements in oral health have been reported in the past few decades in several countries, oral disease has remained a public health problem in both developing and developed countries [1, 2]. Widening inequities in oral health exist among different social groupings between and within countries, indicating that social stratification and other social determinants of health are associated and may have similar adverse effects on oral and general health [3]. The landmark 2008 report of the World Health Organization's (WHO) Commission on Social Determinants of Health enunciated the call to address health disparities, emphasizing the pivotal role of the social determinants of health [4, 5].

Many oral diseases are associated with socioeconomic status, which connects to family income, educational and employment status, housing, and physical and mental health. Oral health disparities have a profound connection with the social determinants of health, as these are closely related to social, economic, and or environmental factors and, in some countries, to race, ethnicity, and education [6]. Oral health disparities adversely affect groups of people who systematically experience greater social and economic obstacles to health based on their racial or ethnic group, religion, gender, age, mental health, cognitive, sensory, or physical disability, sexual orientation, gender identity, geographic location, or other characteristics historically linked to discrimination or exclusion [3].

Disparities in oral health status exist in developing countries like India, specifically in urban and rural areas. Dental caries is prevalent among the rural population in India, with their prevalence being 46.2%, 36.9%, 43.2%, 39.2%, and 61.9% among the ages 5, 12, 15, 35-44, and 65-74 years, respectively [7]. As per the 2003 WHO oral health report, in India, the dental caries levels (decayed, missing, and filled teeth (DMFT)) of 12 years old and 35-44 years old people ranged from 1.2 to 2.6 and 5 to 8.9, respectively [8]. A national survey (2002–2003) was conducted to determine the prevalence of dental diseases in different states of India. It was found that the prevalence of dental caries was 40.0% to 80.0%, and provision for restorative treatment was inadequate in most parts of the country [9]. Moreover, it is well documented that India is a case of the unequal distribution of dental caries among different population groups, as higher prevalence and incidence have been reported among people with a low socioeconomic level.

In addition, although reviews have examined the association between social inequalities and oral health status in high-income countries, there is a lack of evidence among adults residing in different geographical areas of India. To the best of our knowledge, no recent studies have focused on the socioeconomic determinants of dental caries in India. Hence, this scoping review aimed to systematically map the scientific literature on the effect of socioeconomic status (SES) on dental caries among adults, identify the research gaps in this area, and propose recommendations for future research.

Methods

This review was conducted based on the updated framework recommended by Joanna Briggs Institute for scoping review [10]. The study protocol was developed and prepared from the inputs of public health research experts. This review was conducted using the following steps: Identifying the research question, identifying relevant studies, study selection, charting the data, and collecting, summarizing, and reporting the results.

Identifying research question

The present review examined the following research questions regarding socioeconomic inequalities in dental caries status in India.

Does socioeconomic status affect dental caries among adults?

What is the extent of association reported between socioeconomic status and dental caries, as measured by the DMFT index among adults in India?

Identifying relevant studies

Relevant studies were identified by searching electronic databases (MEDLINE via PubMed, Google Scholar, EBSCO) and using predefined search strategies, including a combination of medical subject headings and keyword search. The articles included in the referencing list of the selected studies and gray literature such as reports, dissertations, and conference abstracts were also checked via the internet to avoid missing any litera-

ture. The search strategy was limited to journal articles published between January 2012 and October 2022. The keywords "caries", "dental caries", "dental decay", "DMFT index", "decayed teeth", "socioeconomic factors", "socioeconomic level", "socioeconomic status", "social class", "income", "adult", and "India" were used as search terms in 'keywords', 'titles', and 'abstracts'. Boolean operators "AND" and "OR" were used, too.

Study selection

All the identified studies underwent two screening stages: Abstract and full-text. The first and second authors independently screened 'titles' and 'abstracts'. Full texts of potentially relevant literature were sorted and screened for inclusion criteria. Any conflicts regarding the selection of studies were resolved through discussion with a third reviewer. The inclusion criteria consisted of the following items: Any observational study design, such as cross-sectional, case-control, and cohort with subjects ≥18 years old conducted in India, and those studies investigating risk factors for dental caries and reporting socioeconomic indicators. Additionally, studies that did not address the results of the relationship between dental caries and socioeconomic status were also excluded.

Charting the data

Each article was evaluated, and relevant data were extracted independently by the same reviewers. All articles selected for the final review were analyzed and discussed by all three reviewers. The descriptive epidemiological data were charted: Author and publication year, aim, study design, study setting, sample characteristics (age range, eligibility criteria, sample sizes), DMFT/DMFS (decayed, missing, and filled surfaces) criteria used, socioeconomic status indicators used, and the association between caries outcome and SES.

Collecting, summarizing, and reporting the results

The extracted data were collated, and quantitative data were presented descriptively. The collated data were synthesized using descriptive statistics (frequencies and proportions). Microsoft Excel and SPSS software, version 16 were used to analyze the data. The results were presented using text, figures, and tables, and each research question was answered in the protocol for this scoping review.

Results

In total, 508 potentially relevant records were found. After removing duplicates, the remaining articles' titles and abstracts were screened, applying the inclusion and exclusion criteria. Of these, 495 articles were excluded, and 13 were selected for full-text analysis. After reviewing the full texts of these articles, 8 articles were identified for the final analysis (Figure 1).

Study characteristics

The scoping review comprised 7 cross-sectional studies [11-17], and 1 cohort study [18]. All of the studies were published between 2012 and 2022. The studies involved populations in age groups above 18 years. Three studies included people aged 60 years above [11-13], and only one study included participants aged 18-25 years [17]. However, two studies were conducted among adults aged 35-44 years, the standard monitoring group for health conditions of adults recommended by WHO [14, 15]. The research publications were conducted in different regions of India, including the rural and urban areas of North and South India. Two studies were carried out in outpatient departments and outreach centers of dental colleges [12, 16], two in industrial settings [18, 13], one in an educational institution [17] and the remaining studies in urban and rural settlement [11, 14, 15].

Measures of dental caries

Different dental caries measure indices were identified, with the analysis unit for teeth and surfaces such as DMFT and DMFS. A few articles reported the original DMFT criteria of Klein, Palmer, and Knutson (1938) [19]. In contrast, most articles reported the oral health status and treatment needs using the modified WHO format [20, 21].

The following parameters were used for the assessment of dental caries:

- DMFT and its components (decay teeth (DT), missing teeth (MT), and filled teeth (FT)) to indicate experience of dental caries,

- Caries prevalence

- Mean of the DMFT index and or separate components.

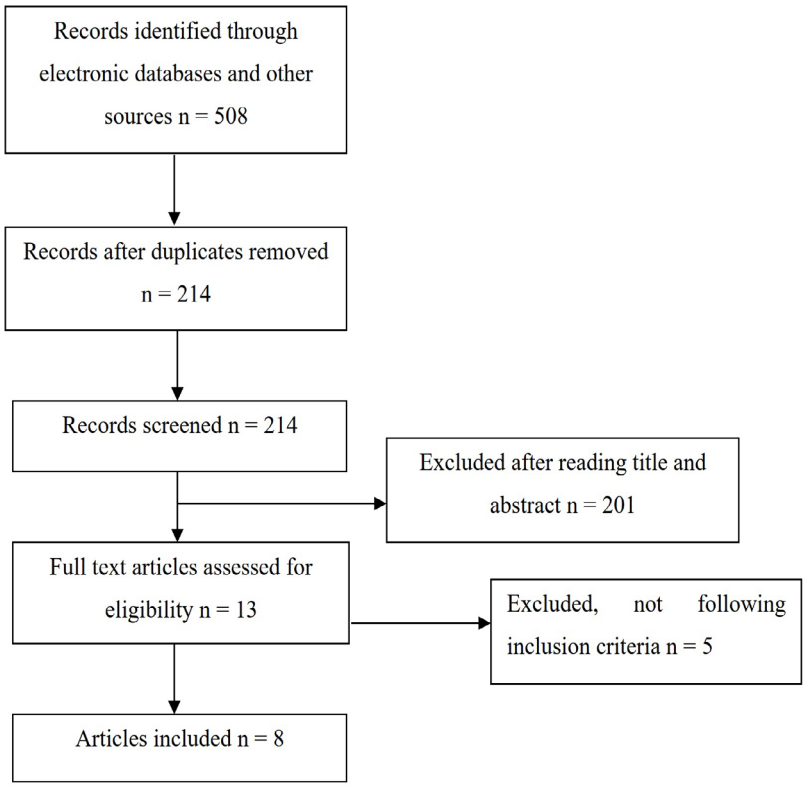

Figure 1. Flowchart of study selection process

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Assessment of socioeconomic status (SES)

Different socioeconomic status scales were considered in the selected studies. Most reviewed studies used the Kuppuswamy scale or its modifications, which included three broad domains of SES: Occupation, total family income, and education. However, the assessment of socioeconomic status was not mentioned explicitly in one study, where the participants were categorized as upper, upper middle, lower middle, upper lower, and lower [12].

Statistical analysis of associations between dental caries and socioeconomic status

Seven of the eight studies employed bivariate statistical analyses [11-17], whereas only one used structural equation modeling (SEM), a powerful multivariate analysis [18]. Three studies presented the results of regression analyses for the seven studies that employed bivariate analyses. Only one study applied negative binomial regression to calculate the adjusted odds ratio and the association between the dependent (DMFT-count data) and independent variables (age, gender, location, occupation, education, income, socioeconomic status, religion, frequency of dental visits, frequency of brushing, and overall lifestyles) [11, 16, 17]. Table 1 displays the characteristics of the studies included and the results of the analysis between socioeconomic status and the associations with the number of decayed teeth. The evaluation also considered the results of the DMFT, DMFS, or other parameters used to determine dental caries.

Four studies determined the caries status regarding mean values according to socioeconomic status and reported higher DMFT among the middle and lower classes of SES [12-15]. Of these, two studies categorized the DMFT value based on the cutoff value of 2.9 to analyze the association between socioeconomic status and caries experience. Both studies reported a mean DMFT value of less than 2.9 in the upper class compared to the middle and lower classes [12, 14]. Only one study analyzed the mean number of missing and filled teeth in different socioeconomic strata apart from decayed teeth and reported higher values of mean MT (0.62±1.19) and FT (0.54±0.85) among the lower-middle and upper-middle classes of SES, respectively [13]. Moreover, 2 out of the 4 studies found higher mean DT components among upper-lower and lower classes of SES [13, 15]. Among these, one study reported that caries prevalence was higher in a lower-middle class of SES [13].

Table 1. Study characteristics and results reported from included studies

Author (y)	Study Design	Subject's Age (y)	Location	Sample Size	Dental Caries Index	Assessment of Socioeconomic Status	Association Between Dental Caries and Socioeconomic Status
Devishree et al. (2018) [12]	Cross-sectional study	25-74	Private dental college hospital in Chennai	250	Mean DMFT	Not mentioned	The mean DMFT score among males is >2.9 in the upper middle, lower middle, upper lower, and lower classes, and <2.9 in the upper class. The mean value of DMFT score among females is >2.9 in lower middle, upper, and lower classes and <2.9 in upper and upper middle classes.
Gupta et al. (2015) [18]	Cohort study	≥18	Automobile parts manufacturer unit in Faridabad, Haryana, India	495	Mean DMFT	SES (indicator variables: education, occupation, and income).	Individuals with a higher SES had fewer decayed and missing teeth and better OHQoL.
Vishwakarma et al. (2021) [17]	Cross-sectional study	18-25	Degree college students in Bangalore City	400	Mean DMFT	Modified Kuppuswamy scale	SES (B=-0.347) is significantly associated with dental caries experience with a moderate level of prediction (R=0.434) and explains 18.8 % (R^2=0.188) of the variability of dental caries experience (P<0.01).
Khare et al. (2018) [13]	Cross-sectional study	18-65	GEI industrial recruits of Bhopal city,	448	Mean DMFT Mean DT, Mean MT, Mean FT Caries prevalence	The Kuppuswamy scale	Mean DT (1.34±1.62) was higher among the upper-lower class of SES. The mean MT (0.62±1.19) was higher among the lower-middle class of SES. Mean FT (0.54±0.85) and DMFT (2.19±1.92) were higher among upper-middle SES (P=0.001). Dental caries prevalence more in lower-middle class of SES (P=0.177)
Soniya et al. (2020) [14]	Cross-sectional study	34–44years	Perambur, Chennai	200	Mean DMFT Caries prevalence	The Kuppuswamy scale (modified for the year 2015)	Mean DMFT is >2.9 in the upper middle and upper lower classes. The upper middle class was found to be more prone to dental caries (39%) than other classes.
Gijwani et al. (2020) [15]	Cross-sectional study	35 to 44	Sri Ganganagar City	995	Mean DMFT Mean DT, Mean MT, Mean FT	The Kuppuswamy scale	The mean DT component (5.50±1.91) was higher among lower SES (P=0.02). The mean DMFT score (6.99±3.21) was higher among upper-lower SES (P=0.01).
Singla et al. (2020) [16]	Cross-sectional study	20–50	Outreach dental setups of a dental school in India	800	Mean DMFT	The Kuppuswamy scale	Study subjects with lower socioeconomic status (RR=0.71) were more prone to have dental caries than their counterparts (P<0.001).
Srivastava et al. (2013) [11]	Community-based cross-sectional study	> 60	Urban resettlement colony in Delhi	448	Mean DMFT	Modified Kuppuswamy scale	The DMFT score was significantly associated with socioeconomic status in a simple regression analysis.

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Abbreviations: DMFT: Decayed, missing, filled teeth; SES: Socioeconomic status; DT: Decayed teeth; MT: Missing teeth; FT: Filled teeth.

Three studies employed regression analysis to determine the association, and all found that the DMFT score was significantly associated with socioeconomic status. One study found that study subjects with lower socioeconomic status (risk ratio=0.71) were more prone to have dental caries than their counterparts [16], and another study reported a significant inverse association of SES (B=-0.347) with dental caries experience with a moderate level of prediction (R=0.434) [17]. Only one study explored the relationship between environmental and individual factors and oral health outcomes, guided by a theoretical model and a robust SEM statistical technique. The Wilson and Cleary model and Brunner and Marmot model were used as the conceptual framework to guide SEM. The lagged structural equation modeling analysis identified a significant direct pathway from socioeconomic status to oral clinical status (decayed teeth, periodontal status) [18].

Discussion

Oral diseases disproportionately affect adults of lower socioeconomic position (SEP). It is widely accepted that a social gradient in oral health is determined by an individual's position on the social ladder. There is substantial evidence of social inequalities in adult oral health in developed countries. Moreover, a consistent association between SEP and adult oral health has been found regardless of the population, the method of social classification, and the measure of oral health outcome [22]. This scoping review was performed to identify the literature on the effect of SES on dental caries among adults in India. We have assumed that SES in adulthood reflects an individual's final socioeconomic position and is unlikely to change unless the social conditions change.

This scoping review shows some indications of inequalities in caries experience in adults from different socioeconomic backgrounds. Although many studies have investigated the effect of childhood SES on oral health behavior and dental health, only a few have evaluated oral health outcomes with clinically evaluated oral health data in adults. However, to expand the search and supplement the selection of dental caries studies in adults, the minimum age requirement in the inclusion criterion was decided as 18 years. We identified 8 studies reporting the results of the relationship between dental caries and socioeconomic status conducted in different regions of India.

The association between socioeconomic position and two health outcomes, representing general and oral health, has been well established [23]. Despite significant improvement in India's overall health indicators in the last few decades, inequalities across socioeconomic groups persist. The most frequently used measures of SES at the individual level are income, education attainment, and occupation. Numerous SES scales are designed to capture populations' and groups' social and economic status. The Kuppuswamy scale is widely used for urban populations and was proposed in 1976, including index parameters like education, occupation, and total income. The scale has been revised over the past years as the overall income of the family from all the sources scale loses its pertinence due to steady inflation in the value of the Indian rupee based on the change in the consumer price index while the occupation of the head of family and education of the head of the family has remained the same with time [24].

The findings from this review revealed socioeconomic inequality in caries experience/ DMFT scores among different populations in India, indicating SES as the primary contributor. Furthermore, the results of this review suggest that dental caries experience was greater among individuals from middle to low than high SES. Earlier studies have reported dental caries as a disease of modern civilization, and its severity increases as standards of living and nutrition improve [25]. The trend in caries experience has reversed since 1980, and caries has changed from a disease of affluence to a disease of deprivation that mainly affects those from the most disadvantaged groups [26]. A systematic review of the prevalence of oral diseases among the different SES in India has shown that the SES was inversely proportional to the oral diseases [27]. The unequal distribution of dental caries in the population indicates the existence of dental polarization and is usually related to socioeconomic deprivation [28]. Consistent with previous studies, the results of this review suggest that low SES can be considered a significant predictor or risk factor for the development of dental caries [29, 30].

The present review revealed additional gaps in the literature that could be interpreted as opportunities for future research. Very little research currently investigates the relationship between SES and dental caries among adults. Regarding the type of studies, most studies were cross-sectional and were not risk-predictive. The life-course concept is suitable for assessing the long-term effect of socioeconomic inequalities on oral health. In the context of dental caries, the life-course epidemiology approach would be ideal because it captures the impact of conditions where the individual was born, grew up, and lived on the onset and progression of disease [31].

This review has some limitations. One of the limitations was that most of the primary studies included in the review used only bivariate analyses, not accounting for confounding factors and mediators. Also, the quality of the included literature could not be assessed because of the diversity of the included articles. Another limitation of our review was that the methodological approach was unclear among the included articles except for a few studies. Therefore, it is recommended that future research on socioeconomic and dental caries in India should be directed with analytical approaches and with increased scientific rigor. In addition, more studies need to be conducted in the age group suggested by WHO for adults to fill the research gap. Such studies would help better understand the relationship between SES and dental caries among adults in India.

Conclusion

The findings of this review demonstrate differences in dental caries experience across different SES groups, confirming the existence of inequalities in caries experience in adults from various socioeconomic backgrounds. Although there is evidence of the association between SES and dental caries, further research is required to understand better the underlying mechanisms of dental caries risks that disproportionately affect low- SES individuals. More high-quality and follow-up studies are needed to establish the magnitude of the scientific evidence regarding the association between SES and dental caries among adults in India.

Ethical Considerations

Compliance with ethical guidelines

The instructions of the National Ethics Committee and the COPE (India) (The Committee on Publication Ethics) regulations have been considered in the article's writing.

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Authors' contributions

All authors equally contributed to preparing this article.

Conflict of interest

The authors declared no conflict of interest.

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