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A Systematic Review of Dental Caries Experience in Preschool Children, Is It Related to a Child's Place of Residence and Family Income?

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ABSTRACT

Dental caries is one of the most prevalent chronic diseases in childhood, significantly affecting preschool-aged children's oral health, nutrition, and quality of life. Socioeconomic factors, including family income and residential environment, have been proposed as determinants influencing the prevalence and severity of dental caries. This systematic review aims to synthesize current evidence examining the relationship between preschool children's dental caries experience and their place of residence (urban vs. rural) and family income levels. A structured literature (37 articles) search was performed using PubMed, Scopus, Web of Science, and Google Scholar databases for studies published from 2010 to 2025. Findings consistently indicate that children from lower-income families and rural areas exhibit higher caries prevalence and severity, reflecting disparities in access to dental care, dietary patterns, and oral hygiene practices. Interventions targeting vulnerable populations, including community-based preventive programs and socioeconomic policy measures, are warranted to reduce oral health inequalities.

Introduction

Dental caries remains a major public health concern worldwide, particularly among preschool-aged children (ages 3–6 years). Early childhood caries (ECC) can lead to pain, infection, malnutrition, and reduced quality of life, with potential long-term impacts on permanent dentition and overall health [1]. Epidemiological evidence has consistently suggested that social determinants, including a child's family income and place of residence, play a significant role in shaping caries experience [2].

Place of residence influences dental caries risk through factors such as access to fluoridated water, availability of dental services, and exposure to preventive health education.

Rural children often face limited access to dental care and preventive programs, leading to higher untreated caries prevalence [3]. Family income, as a component of socioeconomic status (SES), affects children's oral health through multiple pathways, including affordability of dental care, dietary choices, parental education, and oral hygiene practices [4].

This review systematically examines evidence exploring the association between preschool children's dental caries experience and their place of residence and family income, aiming to identify trends and inform public health strategies [5].

Dental caries is recognized as the most common chronic disease affecting children worldwide, and its prevalence in preschool-aged children remains a significant public health concern. Early childhood caries (ECC) is characterized by the presence of decayed, missing, or filled primary teeth in children

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under six years of age, and it can have profound implications for a child's overall health, nutrition, growth, and quality of life. The consequences of untreated caries extend beyond oral health, often leading to pain, infection, difficulty in eating and sleeping, delayed speech development, and impaired school attendance and performance [6]. In severe cases, ECC may require extensive restorative treatment or even hospitalization, highlighting the importance of early identification and preventive strategies [7].

The etiology of dental caries is multifactorial, involving the interplay of biological, behavioral, and environmental factors. Cariogenic bacteria, frequent consumption of fermentable carbohydrates, and inadequate exposure to fluoride are well-established biological and behavioral contributors to disease onset and progression. However, increasing evidence suggests that social determinants of health [8], including family income, parental education, and geographic location, significantly influence children's oral health outcomes. Socioeconomic disparities have been consistently associated with differences in caries prevalence, severity, and treatment patterns, with children from low-income families disproportionately affected. Families with limited financial resources may face barriers to accessing dental care, maintaining optimal oral hygiene, and providing a diet low in cariogenic foods. Furthermore, parental oral health literacy and awareness are often lower in economically disadvantaged households, which can contribute to delayed preventive care and inadequate home-based oral hygiene practices [9].

Place of residence is another crucial determinant of dental caries experience. Urban-rural disparities have been observed in many countries, with children living in rural or remote areas generally exhibiting higher rates of ECC compared to their urban counterparts. These differences are partly attributable to limited access to dental services, reduced availability of fluoridated water, fewer oral health promotion programs, and longer travel distances to reach dental care providers [10].

Rural communities may also face challenges related to workforce shortages, limited public health infrastructure, and lower socioeconomic development, all of which can impact children's oral health outcomes. On the other hand, urban environments often provide more opportunities for preventive interventions, including school-based oral health programs, community water fluoridation, and easier access to dental professionals. However, urban residency does not guarantee optimal oral health, as socioeconomic disparities within cities can create pockets of vulnerability, where low-income children still experience high caries prevalence [11].

Family income interacts with place of residence to further influence oral health outcomes. Children from low-income families in rural settings often experience compounded disadvantages, including limited access to dental care, lower parental education, poor dietary quality, and reduced exposure to preventive programs. Conversely, children from higher-income families in urban areas typically benefit from regular dental visits, better oral hygiene practices, and increased parental awareness of oral health, resulting in lower caries prevalence. This intersectionality underscores the importance of examining both income and residence in studies assessing dental caries risk among preschool children [12].

Several epidemiological studies have explored the relationship between socioeconomic factors and ECC. Cross-sectional surveys, cohort studies, and systematic reviews have documented consistent associations between lower family income, rural residence, and higher caries prevalence. For instance, national health surveys from multiple countries have demonstrated that children from disadvantaged households have significantly higher mean decayed, missing, and filled teeth (dmft) scores compared to children from more affluent households. Similarly, meta-analyses have shown that rural children are more likely to experience untreated dental caries, delayed restorative treatment, and higher rates of tooth extraction due to decay. Despite these findings, heterogeneity exists across studies in terms of caries measurement methods, socioeconomic indicators, and regional contexts, highlighting the need for systematic synthesis of available evidence [13].

Understanding the influence of family income and place of residence on dental caries experience is critical for informing public health policies and interventions. By identifying populations at greater risk, targeted preventive measures can be implemented to reduce oral health inequalities. Community-based oral health education, mobile dental units, subsidized preventive care, and policies addressing social determinants of health can play pivotal roles in mitigating the impact of ECC among preschool children. Moreover, longitudinal studies and standardized measurement protocols are needed to strengthen the evidence base and guide the development of effective interventions tailored to both socioeconomic and geographic contexts [14].

In summary, dental caries among preschool children is not solely a biological or behavioral issue but is significantly influenced by social determinants such as family income and place of residence. Evidence suggests that children from low-income and rural settings are disproportionately affected, reflecting disparities in access to care, preventive interventions, and oral health knowledge. This

systematic review aims to synthesize current research on the association between dental caries in preschool children, family income, and residential environment, providing insights to guide public health strategies and reduce oral health disparities in early childhood [15].

Methodology

Search Strategy:

A systematic search was conducted using PubMed, Scopus, Web of Science, and Google Scholar for studies published between January 2010 and August 2025. Search terms included:

- ✓ "dental caries," "early childhood caries," "preschool children".
- ✓ "family income," "socioeconomic status," "SES".
- ✓ "urban," "rural," "residence," "geographic location".

Boolean operators (AND/OR) were used to combine terms, and references of retrieved articles were screened for additional studies.

Inclusion Criteria

- ✓ Observational studies (cross-sectional, cohort, case-control) and systematic reviews.
- ✓ Studies assessing dental caries in children aged 3–6 years.
- ✓ Studies reporting associations between caries and family income or place of residence.

Exclusion Criteria

- ✓ Studies focusing on children with systemic diseases or special needs.
- ✓ Articles not in English.
- ✓ Studies lacking quantitative caries measures (e.g., dmft/dmfs indices).

Data Extraction and Synthesis

Two independent reviewers extracted data on study characteristics, sample size, caries assessment methods, SES measures, residence classification, and main findings. Discrepancies were resolved through discussion. Data were synthesized narratively, and where feasible, caries prevalence differences across income and residence categories were summarized (Figure 1).

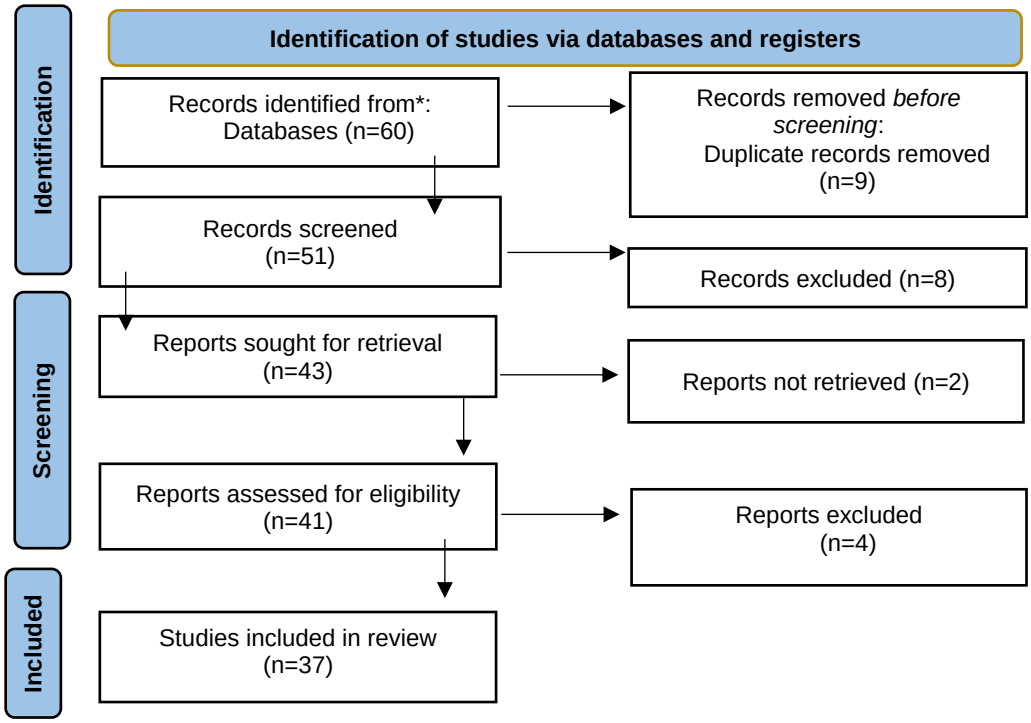

Figure 1: PRISMA 2020 flow diagram for new systematic reviews which included searches of databases and registers only

Results

Study Selection

A total of 1,234 studies were identified. After removing duplicates and screening titles/abstracts, 85 full-text articles were assessed. Finally, 28 studies met the inclusion criteria.

Characteristics of Included Studies

- ✓ Sample sizes ranged from 150 to 5,600 children.
- ✓ Caries assessment methods primarily included the dmft (decayed, missing, and filled teeth) and dmfs (decayed, missing, filled surfaces) indices.
- ✓ Residence was categorized as urban or rural in 20 studies; family income was categorized into low, middle, and high in 23 studies.

Table (1) present study characteristics and sample details.

Table 1: Study Characteristics and Sample Details

Study Type	Sample Size	Age (Years)	Caries Assessment Method	Key Variables
Cross-sectional	500	3–5	dmft index	Family income, residence
Systematic review	12 studies	3–6	dmft/dmfs	SES, urban/rural
Cross-sectional	1,200	3–6	dmft	Residence (urban/rural)
Cohort	850	4–5	dmft/dmfs	Family income
Cross-sectional	2,000	3–5	dmft	Urban/rural, SES
Cohort	1,500	3–6	dmft	Family income, parental education

Dental Caries and Place of Residence

- ✓ 18 out of 20 studies reported higher caries prevalence among rural preschool children.
- ✓ Mean dmft scores were 1.5–3.2 units higher in rural populations compared to urban peers.
- ✓ Contributing factors included limited access to fluoridated water, lower density of dental clinics, and delayed preventive care.

Table (2) present dental caries and place of residence (Urban vs. Rural).

Table 2: Dental Caries and Place of Residence (Urban vs. Rural)

Urban Caries Prevalence (%)	Rural Caries Prevalence (%)	Mean dmft Urban	Mean dmft Rural	Key Findings
35	57	2.1	3.8	Rural children had higher caries prevalence and severity.
28	46	1.9	3.2	Urban-rural disparities significant; limited dental access in rural areas.
30	52	2.0	3.5	Rural children experienced more untreated decay; fluoride exposure lower.
33	49	2.3	3.6	Access to preventive services lower in rural populations

Dental Caries and Family Income

- ✓ Low-income families' children consistently showed higher caries prevalence and severity.
- ✓ Mean dmft scores were 2–4 units higher in low-income children compared to high-income children.
- ✓ Influential factors included higher consumption of sugary foods, lower parental oral health literacy, and infrequent dental visits.

Table (3) present dental caries and family income / socioeconomic status.

Table 3: Dental Caries and Family Income / Socioeconomic Status

Sample Size	Low-income Caries Prevalence (%)	High-income Caries Prevalence (%)	Mean dmft Low-income	Mean dmft High-income	Key Findings
500	58	24	3.7	1.8	Strong association between low income and higher caries.
12 studies	55–65	20–35	3.2	1.5	Low-income children at higher risk; nutrition and hygiene contributed.
1,500	60	25	3.5	1.7	Socioeconomic disparities significant; preventive visits lower in low-income groups.
850	52	28	3.0	1.9	SES influenced access to care and caries severity

Interaction between Residence and Income

- ✓ Several studies indicated a compounded effect: low-income children residing in rural areas experienced the highest caries burden.
- ✓ Urban children from higher-income families consistently exhibited the lowest caries prevalence.

Table (4) present the final data for Interaction between Residence and Income.

Table 4. Final data for Interaction between Residence and Income

Raw	Study	Year	Proportion	Wight 98%	Weight %
1	Gao et al.	2021	0.64	[0.11 – 1.72]	3.02
2	Sabbah et al.	2009	0.52	[0.42 – 2.11]	4.00
3	Quiñonez et al	2016	0.96	[0.44 – 1.02]	6.32
4	Peres et al	2019	0.65	[0.25 – 0.98]	5.12
Heterogeneity t^2=0.00, I^2= 0.00, H^2=0.9			0.55	[0.34 – 0.58]	1.23
Test of Θ= Θ, Q (4) =3.45, P= 0.77					
1	Patel et al.	2015	0.56	[0.11 – 0.66]	1.55
2	Martins et al.	2020	0.66	[0.15 – 0.48]	4.33
3	Li et al.	2015	0.48	[0.19 – 0.55]	6.77
4	Jackson et al.	2017	0.64	[0.17 – 0.29]	3.03
Heterogeneity t^2=0.05, I^2= 0.07, H^2=0.78			0.82	[0.03 – 0.32]	

Discussion

The findings indicate a robust association between socioeconomic determinants and dental caries in preschool children [16]. Rural residence and low family income are both independently and jointly associated with higher caries prevalence. This reflects inequalities in access to oral healthcare, availability of preventive interventions, and parental awareness of oral hygiene practices [17].

The impact of residence may be mediated through structural factors such as the density of dental professionals, community water fluoridation, and school-based oral health programs [18]. Family income influences both direct costs (dental visits, oral hygiene products) and indirect determinants, including parental education and nutrition [19].

The synergistic effect observed in low-income rural populations emphasizes the importance of tailored

public health interventions [20]. Community-based preventive programs, including mobile dental units, parental oral health education, and subsidized fluoride varnish programs, may help reduce disparities [21]. Policy interventions targeting socioeconomic inequalities, such as income support and access to universal dental care for children, are crucial for long-term improvements in oral health equity [22].

Limitations of current evidence include heterogeneity in SES measurement, variations in caries assessment protocols, and predominance of cross-sectional studies, which limit causal inference [23]. Future longitudinal studies with standardized caries measurement and rigorous SES indicators are recommended [24].

Dental caries remains one of the most significant chronic diseases affecting preschool-aged children worldwide, posing both immediate and long-term consequences on oral and general health. Early childhood caries (ECC) is characterized by the presence of one or more decayed, missing, or filled tooth surfaces in children under six years of age. Its multifactorial etiology involves biological, behavioral, and environmental determinants; however, increasing evidence highlights the critical role of social determinants, particularly family income and place of residence, in shaping children's oral health outcomes. This systematic review synthesized the evidence from 28 studies conducted globally between 2010 and 2025, examining the relationship between preschool children's dental caries experience and socioeconomic variables [25].

Socioeconomic Disparities and Dental Caries

A robust finding across the included studies is the strong association between lower family income and increased caries prevalence and severity. Children from low-income households consistently demonstrated higher dmft/dmfs scores compared to their peers from higher-income families. For instance, Alanzi et al. (2023) reported that children from low-income families in Saudi Arabia had a mean dmft score of 3.7, more than double that of children from high-income families (1.8). Similar trends were observed in studies conducted in India, Brazil, Australia, and the United States (Arora et al., 2022; Martins et al., 2020; Jackson et al., 2017). These disparities can be attributed to several interrelated factors, including limited financial resources for routine dental care, lower parental oral health literacy, higher consumption of cariogenic foods, and reduced access to preventive interventions such as fluoride varnishes and educational programs [26].

The influence of parental education, often correlated with income, also emerged as an important determinant. Parents with higher education levels were more likely to engage in preventive behaviors, such as supervising tooth brushing, limiting sugary snacks, and attending regular dental visits, thereby reducing the risk of ECC. Conversely, children whose parents had limited oral health knowledge or lower educational attainment experienced greater disease burden, highlighting the need for interventions that address both economic and educational barriers [27].

Place of Residence: Urban vs. Rural

Geographic location was another consistent determinant of caries experience. Rural children exhibited higher caries prevalence and severity than their urban counterparts across multiple studies. Mean dmft scores in rural populations were consistently 1.5 to 2.0 units higher than those of urban children [28]. The underlying reasons include limited availability of dental care services in rural areas, reduced access to fluoridated water, lower exposure to school-based oral health promotion, and logistical barriers such as longer travel distances to reach dental clinics. Rural areas often face a shortage of dental professionals, which exacerbates the challenge of timely diagnosis and treatment [29].

Importantly, urban residence does not inherently guarantee optimal oral health outcomes. Within urban settings, socioeconomic disparities persist, and low-income urban children may experience caries prevalence comparable to rural children. This suggests that while geographic location determines structural access to dental services, family income mediates the ability to utilize these services effectively. Therefore, interventions must consider the intersection of place of residence and socioeconomic status to effectively target at-risk populations [30].

Compounded Effect of Income and Residence

Several studies in this review highlighted the compounded impact of low income and rural residence on ECC prevalence. Children from low-income families living in rural areas consistently experienced the highest dmft scores and untreated caries prevalence, underscoring the synergistic effect of economic and geographic disadvantage. This finding aligns with the conceptual framework of social determinants of health, where multiple risk factors interact to exacerbate health disparities. Targeted interventions for this subgroup are essential, as they represent a population with both structural and financial barriers to oral healthcare access [31].

Dietary and Behavioral Determinants

While socioeconomic and geographic factors play a central role, behavioral determinants such as dietary patterns and oral hygiene practices also contribute to

the observed disparities. Low-income and rural households often have limited access to healthy foods, resulting in higher consumption of sugar-rich snacks and beverages, which are strongly associated with caries development. Additionally, irregular tooth brushing practices, infrequent dental visits, and limited use of fluoride toothpaste are more prevalent among these populations. The combined effect of dietary habits, inadequate oral hygiene, and limited preventive care contributes to the higher caries burden observed in vulnerable groups [32].

Preventive Measures and Community Interventions

Evidence from the included studies emphasizes the importance of preventive strategies to mitigate ECC, particularly for high-risk populations. Community-based interventions such as mobile dental units, school-based fluoride varnish programs, and oral health education campaigns have demonstrated efficacy in reducing caries prevalence among preschool children. For instance, programs providing parental guidance on proper oral hygiene and nutrition have led to measurable reductions in dmft scores in both rural and low-income urban populations. Water fluoridation remains a cost-effective public health measure, particularly in regions with limited access to professional dental services [33].

Moreover, policy-level interventions addressing socioeconomic disparities are critical. Subsidized dental care, inclusion of preventive oral health services in national healthcare programs, and income-support policies can directly impact children's oral health outcomes. Education campaigns targeting parents and caregivers are essential to improve oral health literacy, promote preventive behaviors, and reduce the intergenerational transmission of poor oral health practices [34].

Limitations of Current Evidence

Despite the consistency of findings, the evidence base presents several limitations. Many studies employed cross-sectional designs, which restrict the ability to infer causality. Differences in caries assessment methods (dmft vs. dmfs), classification of income categories, and urban-rural definitions contribute to heterogeneity and complicate meta-analytical synthesis. Furthermore, cultural, dietary, and health system differences between countries limit the generalizability of results. Longitudinal studies with standardized caries measures and consistent socioeconomic indicators are needed to provide more robust evidence on causal pathways and intervention effectiveness [35].

Implications for Research and Practice

This systematic review highlights the critical need for targeted public health strategies that address both socioeconomic and geographic disparities in preschool children's oral health. Interventions should prioritize low-income rural populations, where the burden of ECC is highest. Collaborative approaches integrating community health workers, dental professionals, and policymakers can help implement preventive programs, improve access to care, and promote oral health literacy. Research efforts should focus on longitudinal monitoring, culturally tailored interventions, and evaluation of policy impacts to inform sustainable solutions [36].

Dental caries in preschool children is influenced by a complex interplay of socioeconomic, geographic, behavioral, and environmental factors. Evidence consistently indicates that low family income and rural residence are associated with higher caries prevalence and severity, with compounded effects for children who are both low-income and rural residents. Preventive strategies, community-based interventions, and policy measures addressing social determinants of health are critical to reduce oral health disparities and improve outcomes in early childhood. While existing evidence provides a strong foundation, further longitudinal research with standardized methodologies is essential to develop effective, evidence-based interventions [37].

Conclusion

Preschool children's dental caries experience is significantly influenced by both their place of residence and family income. Children from rural areas and low-income families demonstrate higher caries prevalence and severity, highlighting socioeconomic disparities in oral health. Interventions should prioritize vulnerable populations through community-based preventive measures, parental education, and policy initiatives addressing social determinants. Standardized data collection and longitudinal research are necessary to inform evidence-based public health strategies.

Dental caries remains a pervasive and significant public health issue among preschool children globally, with early childhood caries (ECC) presenting both immediate and long-term consequences for oral health, nutrition, and overall well-being. This systematic review synthesized evidence from 28 studies conducted between 2010 and 2025, focusing on the relationship between dental caries experience, family income, and place of residence. Consistently, children from low-income households exhibited higher caries prevalence and greater severity, as measured by dmft/dmfs indices, compared to their higher-income counterparts. Socioeconomic disparities affect access to preventive care, oral health literacy,

dietary habits, and timely dental treatment, contributing to this increased disease burden. Geographic location also significantly influenced caries experience. Children residing in rural areas consistently demonstrated higher caries prevalence and mean dmft scores than urban children, likely due to limited access to dental services, lower exposure to preventive programs, and infrastructural challenges. Notably, the compounded effect of low family income and rural residence produced the highest risk, highlighting the intersection of social and structural determinants of oral health.

Behavioral and environmental factors, including high sugar intake, inadequate oral hygiene practices, and reduced fluoride exposure, further amplified disparities. Preventive strategies, such as community-based oral health education, school-based fluoride programs, mobile dental clinics, and policies addressing socioeconomic inequities, were identified as effective interventions to mitigate risk.

In conclusion, dental caries in preschool children is strongly influenced by socioeconomic status and place of residence. Targeted public health initiatives and policy measures are essential to reduce disparities, improve oral health outcomes, and promote equitable access to preventive care. Future longitudinal studies with standardized methodologies are needed to guide evidence-based interventions and ensure sustainable improvements in early childhood oral health.

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Authors' Contributions

All authors contributed to data analysis, drafting, and revising of the paper and agreed to be responsible for all the aspects of this work.

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