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RISK FACTORS OF DENTAL CARIES IN PRIMARY SCHOOL CHILDREN: A SYSTEMATIC LITERATURE REVIEW

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ABSTRACT
Dental caries is a chronic infectious disease with a high prevalence in elementary school-aged children (6–12 years) globally. This condition is influenced by the complex interaction of various determinants of health. This study aims to identify and synthesize the dominant risk factors for the occurrence of dental caries in elementary school-age children based on the latest scientific evidence. Systematic review was conducted following the PRISMA 2020 guidelines. A comprehensive literature search was conducted on the Scopus and PubMed databases for English-language articles published in the time range November 2022 to November 2025. Inclusion criteria include cross-sectional, cohort, case-control studies that analyze caries risk factors in elementary school-aged children of 6–12 years. Of the 1,422 articles identified from three databases, 11 studies met the eligibility criteria and were included in the final analysis. The main risk factors are categorized into behavioral and lifestyle aspects, socio-demographic, and socioeconomic. The findings suggest that high-sugar diet behaviors (sugary snacks and soft drinks) and poor oral hygiene (rarely brushing and not using dental floss) were the dominant factors. Socio-demographically, low parental education levels, low socioeconomic status, and male gender have a significant association with an increased risk of caries. In addition, the presence of dental plaque and tooth morphology (deep gaps) are important biological determinants. Dental caries in elementary school children is multifactorial, but lifestyle factors related to diet and oral hygiene, as well as family socioeconomic background are the main determinants. Effective prevention strategies require a holistic approach that focuses on modifying children's behavior and improving parental education.

Keywords: dental caries; oral hygiene; primary school children; risk factors; socioeconomic status

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INTRODUCTION

Dental caries is a chronic infectious disease characterized by demineralization of the hard tissues of the teeth due to the activity of bacteria in plaque that ferment carbohydrates, especially sugar(Jurakova et al., 2023; World Health Organization, 2022). In the context of this study, the focus was limited to elementary school-age children, because this group was in the transition phase of the first to permanent teeth and began to have independence in personal hygiene including oral health(Peres et al., 2019). The causes of caries are multifactorial, including poor toothbrushing behavior, high-sugar food consumption patterns, inadequate fluoride exposure, and low access to dental health services(Kassebaum et al., 2015; Manton, 2018; Tomczyk et al., 2025).

Epidemiologically, the burden of caries is still high globally with prevalence reported to reach 89.55% in China, 58% in Saudi Arabia, and varies in other countries depending on the social determinants and behavior of the child(Farsi, 2024; T. Li et al., 2025). Similar findings were reported in Indonesia, where infrequent brushing behavior and sweet snacking habits were the

dominant factors in the occurrence of caries in elementary school children(Theresia et al., 2025). Pathophysiologically, dental caries occurs through the interaction between cariogenic bacteria such as Streptococcus mutans, sugar substrates, hosts, and time, resulting in the formation of an acidic environment that causes enamel demineralization(Conrads & About, 2018; Fejerskov, O., Nyvad, B., & Kidd, 2015; Jurakova et al., 2023; Spatafora et al., 2024).

A number of studies in the past decade have found a significant association between sugar consumption frequency, diet quality, and oral hygiene behaviors to an increase in DMFT/DMFT scores in children(Farsi, 2024; Wang et al., 2023). A longitudinal study in Brazil also showed that low parental education increases the risk of caries by 9% in children(Nazário et al., 2024). In a regional context, the consumption pattern of sugary foods such as biscuits, sweetened drinks, and easily accessible snacks in the school environment is a trigger for an increase in the incidence of caries in children(Theresia et al., 2025). In addition, the lack of fluoride use and lack of visits to dental health facilities are still a common phenomenon among elementary school-age children(De Sousa et al., 2019; Ha, Spencer, et al., 2021).

However, there are variations in findings regarding caries risk factors in children between countries and populations, especially related to the contribution of social, biological, behavioral, and environmental factors to the incidence of caries(Nazário et al., 2024; Nsabimana et al., 2023). This shows that there is a knowledge gap related to the most dominant risk factors in elementary school-age children based on the latest evidence. Therefore, this systematic review was conducted to identify and synthesize the main risk factors for caries in primary school children.

METHOD

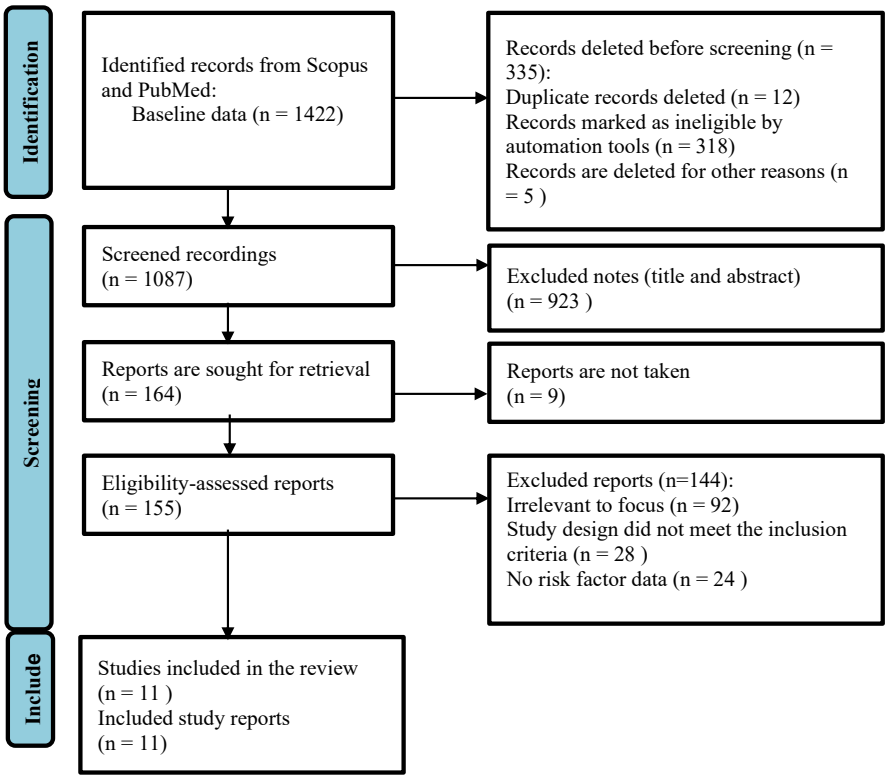
Article searches were conducted on two main databases, namely PubMed and Scopus, with a publication range of November 2022 to November 2025. The language of the publication is limited to English and only articles available in full text form are included in this review. Search keywords are compiled using a combination of Boolean operators (AND, OR) with the format: "dental caries" AND "children" OR "school-age children" AND "risk factors" OR "determinants" OR "predictors" AND "oral health". The selection of keywords was adjusted to MeSH terms and free terms relevant to pediatric dental caries research. The study focused on the population in children aged 6–12 years. Articles received include observational research designs, namely cross-sectional, cohort, and case-control, as well as randomized controlled trials (RCTs) if the study reports analyses related to risk factors for dental caries. The article should use standard methods in the assessment of caries, such as DMFT/dmft, deft, or ICDAS, and examine at least one risk factor related to caries. Articles must be published in English, available in full text, and within the 2022–2025 publication period. Study type: cross-sectional, cohort, case-control, RCT (if risk factor data are available)

The initial search process yielded a number of articles from both databases. The screening stage is carried out through an independent review of titles and abstracts by two reviewers. Articles identified as duplicates are removed in the initial stage, while irrelevant articles based on the content of the title and abstract are eliminated from the follow-up review. If there is a difference of opinion in the assessment of the feasibility of an article, the discussion is carried out until a mutual agreement is reached. Articles that are declared to meet the initial requirements are then analyzed at the full-text review stage to ensure their match with the focus of the study. Non-appropriate articles are excluded due to topic incompatibility, research methods, or limited access to the full manuscript. Articles that pass all stages of selection are then included as the main source in this systematic review. The article selection process is presented in the PRISMA 2020 flowchart(Page et al., 2021).

RESULT

Literature search listed in Figure 1. A Flow Chart diagram showing the results of the two databases yields 1422 articles. After the removal of duplicates and articles that did not meet the initial requirements (335 articles in total), a total of 1087 articles entered the screening stage. At the title and abstract screening stage, 923 articles were excluded because they were not relevant to the focus of the research. A total of 164 articles were then searched further to obtain the complete manuscript, but 9 of them were inaccessible. A total of 155 full-text articles were evaluated to assess the suitability of topics, research design, and completeness of caries risk factor data. At this stage, 144 articles were excluded, mainly because the topic was not appropriate (92 articles), the research design did not meet the criteria (28 articles), or did not provide adequate risk factor data (24 articles).

The final result was 11 articles that were included in the further review. Table 1 shows that based on their geographical distribution, the studies represent populations from three different continents, namely Asia, Europe, and Africa. The majority of research was conducted in Asia (36.4%), followed by Europe (27.3%), and Africa (9.1%). Specifically, studies in Asia included China (two studies), Vietnam, and Iran. Studies in Europe were conducted in the southern and eastern states, namely Spain, Italy, and Romania. Meanwhile, representation from the African continent comes from Somaliland. Most studies (n=10) used a cross-sectional design to evaluate the prevalence and risk factors of caries, with one study applying a cohort approach to predict risk factors.



Picture 1. Flowchart Diagram

Table 1.
Chart Table

No	Author, year	Country	Study design	Age of Population & Sample	Caries measurement	Risk factors analyzed	Key findings
1.	(Nazário et al., 2024)	Brazil	Longitudinal (Cohort)	6–10 years, (n=168 children)	WHO (dmf-t/DMFT)	Sociodemographics: 1. Father's education 2. Gender	1. Children with a low-educated father (≤8 yrs) had a 9% higher risk of caries (RR=1.09). 2. Girls had a 10% higher risk (RR=1.10).
2.	(Theresia et al., 2025)	Indonesia (Jakarta)	Cross-section	9–12 years, (n=421 children)	WHO (DMFT)	Behavior & Diet: 1. Brushing your teeth 2. Consumption of Biscuits & Fruit	1. Rarely brushing teeth is significantly associated with caries (<0.05). 2. Consumption of biscuits (>1x/day) and never eating fruit increases the risk of caries (p<0.05).
3.	(T. Li et al., 2025)	Chinese	Cross-section	8–12 years, (n=1,024 children)	WHO (DMFT/DMFT)	Demographics & Behavior: 1. Ethnicity (Tibet) 2. Age of starting brushing your teeth 3. Sugar intake	1. Starting a toothbrush late (age 4-5 years) increases the risk of caries by 2.2x (OR=2,295). 2. The frequency of sugar consumption is positively related to caries.
4.	(Farsi, 2024)	Saudi Arabia	Cross-section	Primary school age, (n=300 children)	WHO (DMFT/DMFT)	Lifestyle: 1. Diet Quality (KIDMED) 2. Physical Activity (PA) 3. BMI	1. Poor diet quality was significantly associated with higher caries scores (p=0.012). 2. There is no significant association between Physical Activity (PA) and caries.
5.	(Nsabimana et al., 2023)	Rwanda	Cross-section	11–12 years, (n=400 children)	WHO (DMFT)	Clinical/Biology: 1. Deep holes and crevices 2. Dental plaque	1. Deep teeth increased risk by 2.4x (OR=2.4; p<0.001). 2. The presence of dental plaque increases the risk by 2.2x (OR=2.2; p=0.01).
6.	(Alshayeb & Dashash, 2025)	Syria	Cross-section	8–12 years, (n=1,052 children)	WHO (DMFT/DMFT)	Socioeconomic (SES): 1. Family size 2. Parent education 3. School Type	1. Large family size, low SES, and low parental education were significantly associated with caries (p<0.05). 2. Infrequent *flossing* & irregular visits to the dentist increase the risk.
7.	(Pizzo et al., 2023)	Italy (Palermo)	Cross-section	Age 6-7 years (n=995 children)	ICDAS II (Preliminary & Extensive)	District location, family characteristics (mother's knowledge, father's knowledge, father's education level, parents' occupation) and diet, and visits to the	In this study, all the factors mentioned had a p value of <0.05. The most significant <0.001 and <0.002 are the 5th district location factors, the 7th district location associated with intial caries. Meanwhile, factors related to moderate

No	Author, year	Country	Study design	Age of Population & Sample	Caries measurement	Risk factors analyzed	Key findings
						dentist twice a year were associated with caries severity. Initial caries lesions are mostly found in the first permanent molar.	lesions were dental visits >2x/year, and the location of the 7th district. In addition, the most significant factors with extensive lesions are dental visits, the level of education of fathers below high school and high school and fathers who do not work.
8.	(Dahroug et al., 2024)	Somaliland (Hargeisa)	Cross-section	Age 12 years (n = 405)	WHO Criteria (DMFT)	Type of school (public schools have a higher prevalence than private ones). Behavioral factors such as oral hygiene were also evaluated as determinants.	The overall prevalence of dental caries was found to be 62.7%, with an average DMFT of 1.7 and a SiC score of 3.7. Non-public school students showed significantly higher prevalence of dental caries and average DMFT compared to their peers in public schools (68.5% vs. 58.6%) and (1.91 vs. 1.48), respectively. Only 14.7% of participants used dental care services in the previous year.
9.	(Masaebi et al., 2024)	Iran	Cross-section	Children aged 6 and 12 years (n=1305)	DMFT / Caries Index	Factors related to DMF in children are 1. Gender factors 2. factors of dental visits, 3. consumption of sweet foods, Mother's education level.	Children's gender was associated with a p-value of 0.034, dental visits (p=0.011), consumption of sugary foods once a day and more than one in a day had a p-value=0.007 and high and medium maternal education levels were associated with DMF scores with p-value=0.002.
10.	(H. Li et al., 2024)	China (Jinzhou)	Cross-section	Age 7-9 years (n=1603)	Carytic lesions with WHO standard criteria	The related factors are: 1. Gender 2. Age 3. Mother's education level 4. Frequency of toothbrushing 5. Long toothbrush 6. Flossing 7. Consumption of soft drinks 8. Consumption of sweet foods Consumption desert	Gender (higher prevalence in males [77.1%] than females) p=0.036 value, age in the category 7-9 years (p value = 0.000), mother's education level is mostly low whose child has caries lesions (p-value = 0.000), tooth hygiene behavior in the form of brushing teeth, the duration of brushing 2-3 min, and the use of dental floss and diet (diet) are related to dental caries lesions.
11.	(Hoa et al., 2025)	Vietnam (Northern Region)	Cross-section	Primary school children (n= 545 children)	DMFT	Factors related to *decay in primary teeth* are: 1. Candy consumption 2. Consumption of soft drinks Age	The overall prevalence of dental caries was 91.4%, with 57.4% of children affected by caries in permanent teeth and 82.2% in baby teeth. Older age increases the risk of primary caries and dmft scores. Frequent consumption of candy/snacks and sodas is associated with higher primary caries, while poor

No	Author, year	Country	Study design	Age of Population & Sample	Caries measurement	Risk factors analyzed	Key findings
							toothbrushing habits and visits to the dentist only when symptoms are present are associated with a worse caries index.

DISCUSSION

According to published evidence, dental caries has a detrimental impact on children's quality of life, growth and academic achievement(Masaebi et al., 2024). This literature review is about the factors of dental caries in children aged 6-12 years which includes socio-demographic factors, behavioral and lifestyle factors to maintain children's dental and oral hygiene, and socio-economic. The details of the findings are summarized in the table above.

Socio-demographic factors

The results of the literature review show that gender is a factor in caries risk in line with previous research showing that dental caries affects 39.60% of women and 60.40% of men (N. Naveenaa, 2025). This is supported by another study assessing the prevalence and risk of associations with sex, that boys have a higher prevalence of cavities. In addition, they have a higher risk of association with cavities (Sathiyakumar et al., 2021). The male population has a higher prevalence of those who do not receive dental care as well as a greater association risk of not getting dental care.

A study suggests that the consequences of belonging to an ethnic minority can emerge early in life and are associated with dental caries (Rodriguez-Alvarez et al., 2022). Similar inequalities have been reported in the Amsterdam(van Ligten et al., 2025), Sweden (Julihn et al., 2021), and Canada (Dahlan et al., 2024) , where children from migrant/ethnic minority backgrounds continue to show a higher caries risk even after accounting for socioeconomic factors and caries-related behaviors. Therefore, from the earliest years of life, ethnic/migrant background can be considered an important determinant of oral health.

In one study, the highest prevalence of cavities in children was in the age group of 6-11 years. The 6-11 year age group has the highest associative risk of cavities (Sathiyakumar et al., 2021). This trend of lack of dental care from an early age is interesting to observe as a possible path to a high prevalence of dental caries in children aged 6-11 years. The prevalence of caries is also seen higher in rural areas than in urban areas. (Ha, Crocombe, et al., 2021). High consumption of sugary drinks was associated with a higher experience of primary and permanent dental caries in rural areas compared to urban areas. Dental access is also associated with differences between rural and urban.

The majority of studies show a higher prevalence of dental caries in children in public schools compared to private schools (Freire et al., 2010; Hoffmann et al., 2004; Sukhabogi et al., 2014; Taani, 2002). In general, the prevalence of oral diseases, including poor oral hygiene status, was found to be lower in private school children. Despite contradictory findings that show the prevalence of caries is lower in public school students than in private schools (Cheng et al., 2019)23. Public schools typically serve a higher proportion of low-income and low-educated families compared to private schools (Almubark et al., 2019)(Murnane & Reardon, 2018). Public schools are state-funded institutions that provide no-cost education to families, which is why many low- to middle-income families choose these schools for their children. This economic factor is important, as several factors contribute to the differences observed in the prevalence of dental caries between students in public and private schools (Sengupta et al., 2023; Soofi et al., 2020).

Behavioral and Lifestyle Factors for Maintaining Dental and Oral Hygiene in Children

The publication evidence in this article explains that behavioral and lifestyle factors maintain dental and oral hygiene in children. In general, children's behavior in consuming foods that are at risk of damaging teeth is widely discussed as one of the dominant factors(Masaebi et al., 2024),(Pizzo et al., 2023),(H. Li et al., 2024),(Hoa et al., 2025). Dental caries is a multifactorial problem caused by the interaction of certain bacteria in the mouth, vulnerable tooth surfaces, or a high-sugar diet(Masaebi et al., 2024). The trend in China explains that there is an increase in people's purchasing power due to China's economic growth, which has led to a large increase in sugar consumption without an increase in demand for oral health care(Hu et al., 2015),(Liu et al., 2016).

In addition, a study by Hong et al. in the UK showed strong evidence regarding a significant link between the consumption of sugary foods and permanent tooth decay in children(Hong et al., 2018). For sugar-sweetened beverages, each additional serving of SSB (Sugar-sweetened beverage) consumed daily increased the experience of caries by 22 percent(Wilder et al., 2016). In addition to sugary foods, snack consumption explained in a previous study showed that eating fried high-carb foods between regular meals can increase the presence of dentobacterial plaques(Escoffié-Ramirez et al., 2017).

Another aspect described in oral hygiene can trigger this dental caries. However, due to differences in culture, diet, and other factors in different countries as well as within each country, people's daily life habits and lifestyles are different, so oral behavior, caries incidence and related government policies are also different(Kazeminia et al., 2020; Tilton et al., 2021). The evidence of this publication explains that children's daily behavior in the form of frequency of brushing, the length of brushing their teeth, and the use of dental floss are related to the incidence of dental caries(H. Li et al., 2024),(Dahroug et al., 2024).

Several studies have shown that the use of dental floss or flossing can prevent the onset of caries lesions in the proximal area(de Oliveira et al., 2017; Kim et al., 2022). This may be due to the fact that dental floss can remove food debris that is tucked near the teeth and physically interfere with the adhesion of bacteria in the plaque biofilm, thereby reducing the number of caries-causing bacteria and thus also the prevalence of caries(Kim et al., 2022). The more frequent the brushing and the longer the duration of brushing, the lower the prevalence of caries, which is consistent with most studies(Abbass et al., 2019; Alhabdan et al., 2018; Peters et al., 2022).

The above factors increase plaque if not done properly. Dental caries involves demineralization and damage to the tooth structure, which leads to the formation of cavities or holes in the enamel, dentin, and eventually reaching the tooth pulp. Plaque, deep holes and crevices, dental lesions indicate a relationship with the incidence of dental caries (Dahroug et al., 2024). Similarly, research In China, a large cross-sectional study of 6–7-year-olds found that caries was already present in newly erupted first permanent molars, highlighting the need for prevention from the onset of eruption (Zhao et al., 2024).

The physical activity in this publication's evidence suggests that there is no association with dental caries. Dental caries is based on the biological fact that caries is a locally infectious disease triggered by specific interactions between bacteria, sugar, and oral hygiene, the mechanisms of which are separate from the body's energy metabolism system or muscle movement(Masaebi et al., 2024). Physical activity does not have a direct pathway to remove plaque or neutralize acid on the surface of the teeth, so a person's fitness level does not become a determining factor or protector against cavities if it is not accompanied by proper dietary control and brushing habits.

Plaque factors can be controlled with either of them with a visit to the dentist(Masaebi et al., 2024),(Pizzo et al., 2023). Through regular check-ups, dentists can clean accumulated plaque and

tartar that are difficult for toothbrushes to reach, providing additional protection in the form of fluoride or fluoride applications. *Tooth Sealant*, as well as detect early signs of enamel damage to be treated immediately before it develops into severe cavities. However, these visits include essential levels of care including pediatric dental visits, but parents in underprivileged settings often don't realize that they can access free oral health care for their children(Saber et al., 2018).

Socio-Economic Factors

Many socioeconomic determinants, including health inequalities, income, ability to pay for services, and physical and geographic access to dental care services, directly or indirectly correlate with dental health disparities(Bastani et al., 2021). Children from low-income households show a higher prevalence of caries than children from high-income households, and are more likely to experience untreated dental caries (Campus et al., 2020). Socioeconomic status (SES) is measured by a series of indicators. Taking into account the socioeconomic status of children, family income, employment status, and education level of parents are some of the most important indicators of SES (Campus et al., 2022).

Measuring socioeconomic inequality in health is a useful tool for assessing the scale of inequality between population groups and within populations (Harper et al., 2008)·(Keppel et al., 2005). This index is sensitive to the order of their social groups and health gradients, which means that a negative score indicates an increase in disease outcomes as socioeconomic losses increase(Harper et al., 2008). This gradient in health runs from the top to the bottom of the socioeconomic range which indicates the existence of a social gradient(Arrica et al., 2017).

Direct education to children aged 6-12 years should focus on simplifying the concept of caries causation, which is the interaction between sugary food residues and bacteria that produce tooth-damaging acids(Pitts et al., 2017). In the age In this school, the formation of disciplined behavior and lifestyle is the main key, so children need to be taught correct brushing techniques with a frequency twice a day (morning after breakfast and night before bed) and are accustomed to gargling water after eating school snacks. This approach aims to build children's independence in maintaining oral hygiene as an integral daily routine, while reducing the risk due to a diet high in sugar that is common at that age.

Meanwhile, education for parents must highlight the influence of socio-demographic and economic factors so that they do not become obstacles in maintaining children's dental health(Schwendicke et al., 2015). Parents need to be given an understanding that caries prevention through routine brushing and the use of first-level health facilities (such as Phc) is a much more cost-effective investment than curative treatment when the tooth is already severely damaged. By increasing parental literacy regarding the selection of economical but healthy snacks and the importance of parental supervision of children's oral hygiene at home, socioeconomic status gaps are no longer the main reason for the high incidence of caries in children. The limitation of this study is that there are articles that cannot be accessed Full text, Limited in language differences, in this article the literature search is in English, making it difficult to synthesize data.

CONCLUSION

In general, dental caries occurs because Factors of dental caries in children aged 6-12 years which include socio-demographic factors, behavioral and lifestyle factors to maintain children's dental and oral hygiene, and socio-economic. The most dominant are the direct factors, namely children's lifestyle and parental knowledge.

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