ISSN 2548-6462 (online), ISSN 2088-8740 (print)

DOI: 10.30644/rik.v14i2.1022

The correlation between passive smoke exposure and childhood dental caries: evidence from recent studies

Mira Sri Gumilar[1*], Hendry Boy[1]
[1]Jurusan Kesehatan Gigi, Poltekkes Kemenkes Jambi, Indonesia
*Corresponding author's email: mirasrigumilar@poltekkesjambi.ac.id

Accepted: 25 March 2025; revision: 9 May 2025; published: 31 May 2025

Abstract

Background: Dental caries in children is a global health issue, particularly in lower-income countries. Exposure to tobacco smoke is one of the major risk factors. In Indonesia, where smoking is prevalent, children exposed to passive smoke face a higher risk of dental caries.
Method: A systematic review was conducted, focusing on studies published between 2019 and 2024. Literature was selected using specific keywords, with cross-sectional studies emphasizing the correlation between passive smoking and dental caries in children.
Results: Of the 11 selected studies, 9 demonstrated a significant correlation between passive smoking and dental caries, with P-values below 0.05. However, the two studies showed no significant relationship, potentially due to small sample sizes or other external factors like diet or hygiene.
Conclusion: Exposure to cigarette smoke significantly increases the risk of dental caries in children, necessitating public health interventions to reduce exposure and prevent oral health problems.

Keywords: Children's dental caries, passive smoking, secondhand smoke

INTRODUCTION

According to the latest WHO report on the global oral health status in 2022, dental caries in children remains a major health issue worldwide. Approximately 514 million children around the world suffer from dental caries in primary teeth. This issue is particularly evident in lower-middle-income countries, which face limited access to oral health services (1).

Nationally, the 2023 Indonesian Health Survey (SKI) report noted that the prevalence of dental caries among children in Indonesia has reached concerning levels. Based on the data, it was found that around 70-80% of children in Indonesia experience caries, with the highest distribution among elementary school-aged children (2). The main risk factor, such as dental caries in children, is excessive sugar consumption (3), lack of oral hygiene (4), and exposure to tobacco (5).

The short-term negative effects of children's dental caries are pain, systemic infection, and abscesses. Children's dental caries condition not only impacts dental health but can extend into systemic health conditions. Several studies have shown that children's dental caries can obstruct children's physical development, including height and weight gains, may cause loss of school days and increase days with restricted activities, and may diminish children's ability to learn (6). Furthermore, oral health problems can affect a child's speech development and self-esteem, impacting their social interactions and overall well-being. Maintaining healthy primary teeth is also essential for the proper eruption and alignment of permanent teeth (7).

Indonesia is one of the countries where smoking habits have become part of the culture and lifestyle of people across various social strata (8). The prevalence of smokers in Indonesia among men is 43.8%, while among women it is 0.7% (2). Parents who smoke have several negative impacts on their children, such as cognitive decline (9), stunting (10,11), respiration disorder (12), and dental caries (5).

Exposure to cigarette smoke is detrimental to children's health due to the presence of numerous toxic substances. These include carcinogens, such as polycyclic aromatic hydrocarbons (PAHs), and other harmful compounds like nicotine, carbon monoxide, and heavy metals (13). Exposure to these toxins can alter the composition of saliva, reducing its protective capacity and promoting the growth of cariogenic bacteria. Additionally, smoke exposure may compromise the integrity of the oral mucosa, further increasing the risk of caries development (14)

The significant incidence of dental caries among children in Indonesia, worsened by the risks associated with exposure to cigarette smoke, which makes them passive smokers, necessitates the implementation of preventive strategies and early interventions. This systematic review research aims to examine the studies about the correlation between passive smoking and dental caries in children and to identify how significant the variation among the research studies is. The results of this study are expected to serve as a basis for policy-making, both in controlling smoking behavior among parents and in managing dental caries in children.

Furthermore, the findings of this systematic review are expected to provide insights and information for health education. The information can raise awareness among parents about the detrimental effects of smoking on children's oral health is crucial, especially in countries with high smoking prevalence like Indonesia. Highlighting the connection between passive smoke exposure and dental caries, it could drive policy changes to regulate smoking behaviors in areas where children are present, ultimately contributing to a smoke-free environment for future generations.

METHOD

The criteria for the research results selected for this review were study type, exposure type, outcome type, and respondent age. The type of study was research with a cross-sectional study design that assessed the relationship between passive smoking and dental caries in children, or research that evaluated risk factors for the occurrence of dental caries, including passive smoking as one of the analyzed variables. In the exposure type, what was reviewed was passive smoking through the assessment of caregivers who smoke, whether the father, mother, or guardian of the child. The type of outcome measured is the dental caries in children, that are determined based on the results of an oral cavity examination. The age of respondents was limited to 0-14 years old children.

Electronic searches for literature were conducted through the Google Scholar search engine. The keywords used were "tobacco smoking" and "dental caries in children", "Passive smoker ECC", and "Passive smoker dental caries in Children". The literature screening process was conducted using the PRISMA Flow Diagram 2009 method.

The literature screening process is first conducted by limiting the studies based on time, specifically literature with research from 2019 to 2024. Literature must be written in the English language. Additionally, the initial screening is also based on themes relevant to the research, specifically regarding passive smoking and dental caries.

The second screening is by selecting research results that have appropriate variables, namely, passive smoking in children and dental caries, with respondents being children. After ensuring that the variables and respondents are appropriate, the literature is reviewed, and duplicate literature is excluded. Each piece of literature is reviewed by three reviewers

to determine whether the study results can be included in the systematic review or not.

The third screening involves selecting studies that use cross-sectional research methods to assess the relationship between passive smoking and dental caries in children, or studies that evaluate risk factors for dental caries and include passive smoking as one of the variables being investigated.

RESULTS

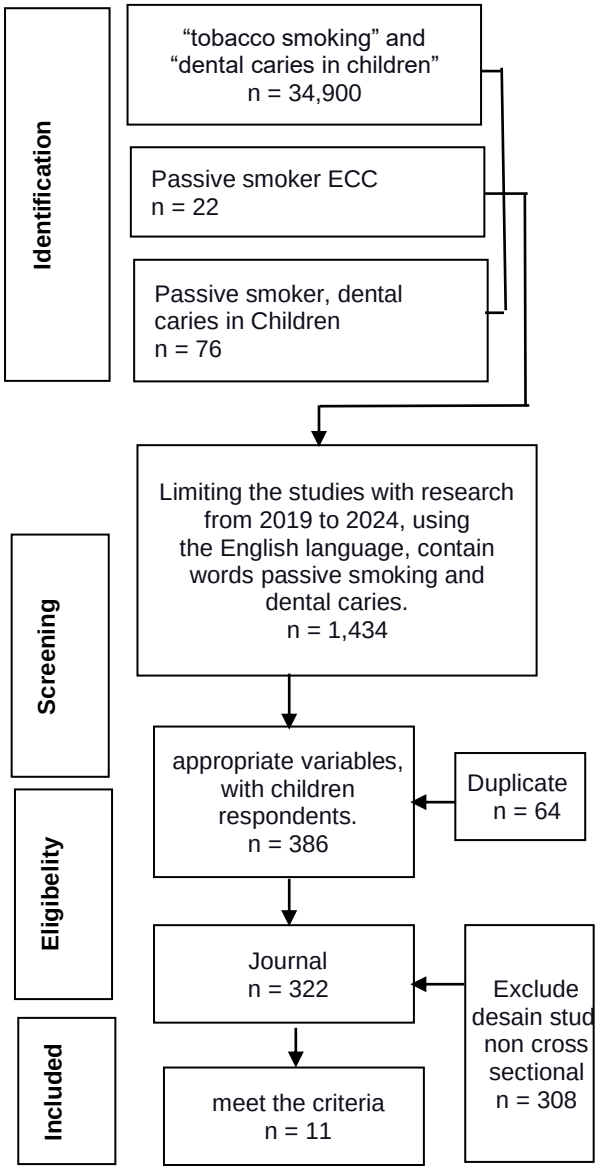

Figure 1. Literature Search Flow based on the PRISMA 2009 Flow Diagram

This process began with the initial identification of a large number of studies, which were then filtered to obtain relevant studies that met certain criteria. This diagram explains each stage from identification and screening to the studies that are ultimately included in the final analysis.

The first stage was the identification stage, where researchers conducted a literature search using the keywords "tobacco smoking" and "dental caries in children," resulting in 34,900 studies. From these results, further screening was carried out using more specific keywords such as "Passive smoker ECC," which yielded 22 studies, and "Passive smoker, dental caries in children," which yielded 76 studies.

At the screening stage, the identified studies were further filtered by limiting them to studies published between 2019 and 2024, using English, and including relevant terms such as "passive smoking" and "dental caries." After this screening, 1,434 studies were obtained. From this number, studies with variables relevant to child respondents were selected, resulting in 386 studies. However, 64 duplicate studies were found and subsequently removed from the selected literature. At the eligibility stage, out of the remaining 386 studies, a selection was made based on whether the studies were published in journal form, leaving 322 studies. At this stage, another criterion was also applied, which was to exclude studies that used designs other than cross-sectional studies, leaving 11 studies that met the final criteria.

Finally, the 11 studies that met all the inclusion criteria were thoroughly reviewed and analyzed for quality and relevance to the research question. These studies were evaluated based on their methodologies, sample sizes, and the consistency of their findings regarding the correlation between passive smoking and dental caries in children. The final analysis focused on extracting key data, comparing results

across studies, and synthesizing the evidence to draw meaningful conclusions. This rigorous selection process ensures that the findings of this systematic review are based on high-quality, relevant studies, providing a comprehensive understanding of the relationship between passive smoking and childhood dental caries.

Table 1. Significance of Relationships between Passive Smokers and Dental Caries

No.	Author	Respondent's Age (years)	Sample Size	Year	P-Value
1.	Ebru Hazar Bodrumlu, Esra Şahin , Hanife Can (15)	1-12	900	2024	0.0001
2.	Menon, Ipseeta; Bhat, Nagesh (16)	5-10	80	2019	0.001
3.	Shahram Mosharrafian, Shayan Lohoni, Saeedeh Mokhtari (17)	3-9	75		0.001
4.	Ammar Yaser Mohammed, Nibal Mohammed Hoobi (18)	5	60	2019	0.0001
5.	Yuko Goto, Keiko Wada, Kie Konishi, Takahiro Uji, Sachi Koda, Fumi Mizuta, Michiyo Yamakawa, Kaori Watanabe, Kyoko Ando, Jun Ueyama, Takaaki Kondo & Chisato Nagata (19)	3-6	405	2019	0.001
6.	Munther, Shahba'a; Awn, Baydaa Hussain; Yassin, Hiba N (20)	5	120	2023	0.935
7.	Piotr Sobiech, Dorota Olczak-Kowalczyk Dorota Olczak-Kowalczyk, Karolina Spodzieja, Dariusz Gozdowski (21)	0-4	907	2023	0.212
8.	Ghalia Misrabi, Mawia Karkoutly & Nada Bshara (22)	10-13	284	2023	0.212
9.	Abla Arafa (23)	5-7	210	2023	0.0001
10.	Fatemeh Hamidifarid, Roza Haghgo, Ferial Taleghani (24)	6-14	800	2019	0.0001
11.	Ebru Hazar Bodrumlu , Esra Şahin , Hanife Can (25)	1-12	900	2024	0.0001

The study in the final stage that included in this systematic review where only 11 studies. These results showed that although there are many early studies related to this topic, only a small fraction truly meet all the stringent selection criteria, including child respondent variables, appropriate study design, and topic relevance. The final results will be used to evaluate the relationship between passive smoking and dental caries in children. The results of the systematic review of the eligible research studies are presented in Table 1.

Based on the data presented in Table 1 it shows that the respondents are in the age range of 0-14 years. Out of the eleven studies displayed in the table, nine of them show a highly significant relationship between exposure to passive cigarette smoke and an increased risk of dental caries in children, as evidenced by the very small p-value (below 0.05). This indicates that the majority of the studies provide strong evidence that the cigarette smoke inhaled by passive smoking significantly contributes to the occurrence of dental caries in children. The literature showing the significance of the relationship between passive smoking and dental caries consists of: a study by Ebru Hazar Bodrumlu, Esra Şahin, Hanife Can in 2024, with a large sample of 900 respondents (children aged 1-12 years), showing a p-value of 0.0001, indicating a highly significant relationship between exposure to cigarette smoke and dental caries. Similar results are seen in many other studies that include narrower age

groups, such as the research by Menon, Ipseeta, Bhat, Nagesh on children aged 5-10 years, which also shows a P-value of 0.0001.

Although most studies show a significant relationship, there are notable differences in some studies that do not find a significant correlation. For example, a study by Munther, Shabha'a; Awn, Baydaa Hussain; Yassin, Hiba N in 2023 involving 120 respondents aged 5 years, showed a p-value of 0.935. This indicates that there is no significant relationship between exposure to passive cigarette smoke and dental caries in this age group in the study. Furthermore, research by Piotr Sobiech and Dorota Olczak-Kowalczyk on infants aged 0-4 years with a sufficiently large sample (907 respondents) also did not find a significant relationship, with a P-value of 0.212.

Research with larger sample sizes tends to yield more consistent and significant results, as seen in studies with large samples by Ebru Hazar Bodrumlu (900 respondents) or Yuko Goto (405 respondents), both of which showed significant relationships. However, some studies with smaller samples, such as those by Shahram Moshafarrian (75 respondents) or Ammar Yaser Mohammed (60 respondents), also showed significant results despite the smaller sample sizes. This shows that the effect of passive cigarette smoke exposure on children's dental caries remains evident despite variations in sample size, although studies with small samples may require caution in interpreting the results.

DISCUSSION

From the overall findings, it can be seen that exposure to passive cigarette smoke is a significant risk factor contributing to the occurrence of dental caries in children. The statistically significant research results indicate that children exposed to passive cigarette smoke have a higher risk of developing dental caries compared to those who are not exposed. Tooth decay is one of the most common oral diseases in children, and this finding provides additional evidence that environmental factors, such as exposure to secondhand smoke, can worsen children's dental health.

Although most studies show a significant relationship, there are two studies (numbers 6 and 7 in the table) that did not find a significant relationship between passive smoking exposure and dental caries. Studies by Munther, Shabha'a, and colleagues, involving 5-year-old children, as well as research by Piotr Sobiech and Dorota Olczak-Kowalczyk involving infants aged 0-4 years, show that exposure to passive cigarette smoke does not always result in an increased risk of dental caries in all age groups. This indicates that there may be other factors at play in the occurrence of dental caries, such as differences in diet, oral hygiene, or genetic factors that may not have been detected in this study.

The clinical implications of these findings are very important, especially for parents, caregivers, and healthcare professionals working with children. The results of this study highlight the importance of reducing passive cigarette smoke exposure in children's environments to prevent dental health issues such as tooth decay. This could also serve as a basis for public health policies to tighten regulations on smoking in public areas, especially around children, to protect their oral health.

Cotinine, as the primary biomarker of passive cigarette smoke exposure, has been proven to play a significant role in increasing the risk of dental caries in children. When children are exposed to cigarette smoke, the levels of cotinine in their blood, urine, or saliva increase. Several studies have shown a positive correlation between high cotinine levels and an increased incidence of dental caries. One of the mechanisms is the harmful effect of nicotine and other chemicals on saliva production, which can disrupt saliva's ability to combat cavity-causing bacteria (26).

Moreover, longitudinal studies show that children exposed to cigarette smoke and with high cotinine levels tend to have more dental damage compared to children who are not exposed. High cotinine levels are also associated with changes in the oral environment, such as a decrease in saliva pH, which increases susceptibility to cariogenic bacteria like *Streptococcus mutans*. Chronic

exposure to cigarette smoke worsens oral health, and caries prevention should include efforts to reduce passive cigarette smoke exposure in children's homes or environments (26).

CONCLUSIONS

Based on the results of this systematic review, it was found that exposure to cigarette smoke in children significantly increases the risk of dental caries, as indicated by the majority of studies with a p-value below 0.05. Most studies with large samples show a strong relationship between exposure to cigarette smoke and an increased risk of dental caries in children. However, some studies with smaller samples or specific age groups do not show a significant relationship, which may be due to other factors such as diet or oral hygiene. This finding emphasizes the importance of reducing exposure to cigarette smoke in children's environments to prevent dental health issues. A quantitative study needs to be conducted with a meta-analysis on the relationship between children as passive smokers and the incidence of dental caries.

While this systematic review provides valuable insights into the correlation between passive smoke exposure and childhood dental caries, several limitations need to be acknowledged, as they may affect the overall findings. The limitation of this study is about the differences in sample Size. The studies included in the review varied greatly in terms of sample size, with some studies involving large populations (e.g., 900 respondents) while others had much smaller sample sizes (e.g., 60 respondents). Smaller sample sizes may have limited statistical power, leading to inconclusive or inconsistent results. Larger studies tend to provide more reliable data, but smaller studies may be valuable in identifying potential risk factors that larger studies might overlook.

Except for the sample variation of size, the limitation of this study is the limitation in the Control of Confounding Variables. Many studies controlled for some confounding variables, such as diet and oral hygiene, but there could still be other unmeasured factors affecting the results. For instance, genetic predispositions to dental caries, environmental factors unrelated to smoking, or socioeconomic status might influence the occurrence of dental caries, and the lack of control for these variables could lead to an overestimation or underestimation of the true effect of passive smoke exposure.

The review highlighted variations in results based on age group. Further research should focus on understanding how passive smoke exposure affects different age groups, particularly infants and toddlers, who are at a more vulnerable stage of development. Investigating age-specific mechanisms could provide more targeted recommendations for preventive strategies.

ACKNOWLEDGEMENTS

We extend our deepest gratitude to all parties who have contributed to this research, especially to those who assisted in reviewing the journals that will be included in this study. Without their contributions and support, this research would not have been possible.

REFERENCES

1. World Health Organization. Global oral health status report: Towards universal health coverage for oral health by 2030. Geneva: World Health Organization; 2022. 29–52 p.
2. Kementerian Kesehatan. Survey Kesehatan Indonesia (SKI) dalam Angka. Jakarta; 2023.
3. Dewi AMPDP, Pamungkasari EP, Murti B. The Impact of Sugar Intake, Household Income, and Maternal Education on the Occurrence of Dental Caries in Children: A Meta-Analysis. Journal of Epidemiology and Public Health. 2024 Apr 16;9(2):227–42.
4. Butera A, Maiorani C, Morandini A, Simonini M, Morittu S, Trombini J, et al. Evaluation of Children Caries Risk Factors: A Narrative Review of Nutritional Aspects, Oral Hygiene Habits, and Bacterial Alterations. Children. 2022 Feb 15;9(2):262.
5. Mosharrafian S, Lohoni S, Mokhtari S. Association between Dental Caries and

Passive Smoking and Its Related Factors in Children Aged 3-9 Years Old. Int J Clin Pediatr Dent. 2021 Mar 31;13(6):600–5.
6. Mireya Catalina León Abad, Michelle Bridget Guerrero Andrade, Tutora Fernanda de Lourdes Cárdenas Vidal. Early childhood caries and its impact on general health: Narrative review. World Journal of Advanced Research and Reviews. 2024 May 30;22(2):083–92.
7. American Academy of Pediatric Dentistry. Perinatal and Infant Oral Health Care. In: The Reference Manual of Pediatric Dentistry. Chicago: American Academy of Pediatric Dentistry; 2024. p. 318–22.
8. SATRIAWAN D. GAMBARAN KEBIASAAN MEROKOK PENDUDUK DI INDONESIA. Jurnal Litbang Sukowati : Media Penelitian dan Pengembangan. 2022 May 23;5(2):51–8.
9. Srivastava P, Trinh TA. The effect of parental smoking on children's cognitive and non-cognitive skills. Econ Hum Biol. 2021 May;41:100978.
10. Rahmiwati A, Karlinda, Hasyim H, Febriyansyah. Passive Smoking and Its Correlation with Stunting in Children: A Systematic Review. Kesmas National Public Health Journal. 2024 Jul 31;19(5).
11. Dartanto T, Moeis FR, Nurhasana R, Satrya A, Thabrany H. Parental Smoking Behavior and its Impact on Stunting, Cognitive, and Poverty: Empirical Evidence from the IFLS Panel Data. Jakarta; 2018 Oct.
12. Zhuge Y, Qian H, Zheng X, Huang C, Zhang Y, Li B, et al. Effects of parental smoking and indoor tobacco smoke exposure on respiratory outcomes in children. Sci Rep. 2020 Mar 9;10(1):4311.
13. Centers for Disease Control and Prevention (US). The Health Consequences of Smoking—50 Years of Progress. Atlanta; 2014.
14. Saho H, Taniguchi-Tabata A, Ekuni D, Yokoi A, Kataoka K, Fukuhara D, et al. Association between Household Exposure to Secondhand Smoke and Dental Caries among Japanese Young Adults: A Cross-Sectional Study. Int J Environ Res Public Health. 2020 Nov 20;17(22):8623.
15. Hazar Bodrumlu E, Şahin E, Can H. The Relationship between Passive Smoking and Caries Experience in Children Aged 1-12 Years and Influencing Factors. Balıkesır Health Sciences Journal. 2024 Mar 6;13(2):310–6.
16. Menon I, Bhat N. Association of passive smoking with dental caries and salivary biomarkers among 5–10 years old children of Muradnagar, Ghaziabad. J Family Med Prim Care. 2019 Aug;8(8):2633–9.
17. Mosharrafian S, Lohoni S, Mokhtari S. Association between Dental Caries and Passive Smoking and Its Related Factors in Children Aged 3–9 Years Old. Int J Clin Pediatr Dent. 2021 Mar 31;13(6):600–5.
18. Mohammed AY, Hoobi NM. Dental Caries Experience and Salivary Total Protein among 5 Years Passive Smokers in Tikrit City, Iraq. Indian J Public Health Res Dev. 2019;10(11):1773.
19. Goto Y, Wada K, Konishi K, Uji T, Koda S, Mizuta F, et al. Association between exposure to household smoking and dental caries in preschool children: a cross-sectional study. Environ Health Prev Med. 2019 Dec 26;24(1):9.
20. Munther S, Awn BH, Yassin HN. The Impact of Passive Smoking on Salivary Glutathione Peroxidase and Selenium in Relation to Dental Caries Severity among Five Years Old Children. Indian Journal of Dental Research. 2023 Jul;34(3):270–3.
21. Sobiech P, Olczak-Kowalczyk D, Spodzieja K, Gozdowski D. The association of maternal smoking and other sociobehavioral factors with dental caries in toddlers: A cross-sectional study. Front Pediatr. 2023 Apr 3;11.
22. Misrabi G, Karkoutly M, Bshara N. The effect of secondhand smoke exposure on dental caries and gingival health

among schoolchildren in Damascus, Syria: a cross-sectional study. BMC Oral Health. 2023 Oct 11;23(1):745.
23. Arafa A. Household smoking impact on the oral health of 5- to 7-years-old children. BMC Oral Health. 2023 Dec 19;23(1):1028.
24. Hamidifarid F, Haghgoo R, Taleghani F. Parental Smoking and Dental Caries in Children Aged 6-14 Years. Journal of Iranian Medical Council. 2019 Apr 7;2(3):20–5.
25. Hazar Bodrumlu E, Şahin E, Can H. The Relationship between Passive Smoking and Caries Experience in Children Aged 1-12 Years and Influencing Factors. Balıkesır Health Sciences Journal. 2024 Mar 6;
26. Uthayakumar T, Bennett JX, Cartas HL, Brunet M, Vo KL, Kroon J. Passive Smoking and Oral Health of Infants, Preschoolers, and Children: A Systematic Review. Nicotine and Tobacco Research. 2023 Aug 23;25(10):1625–32.