

Second-Hand Smoke Exposure and Children's Health: A Bibliometric Analysis of Research Trends, 2015–2025

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Article Info	Abstract
Article History Received: 2026-04-28 Revised: 2026-09-01 Published: 2026-09-24 Keywords: children; child health; passive smoking; second- hand smoke; tobacco exposure	<i>This study aimed to analyze publication trends, research themes, influential publications, and international research patterns concerning second-hand smoke (SHS) exposure and children's health from 2015 to 2025. A quantitative bibliometric design was used. Records were identified from Scopus and Web of Science and screened according to predefined publication year, subject area, document type, language, and relevance criteria. A total of 228 articles were included in the final analysis. Bibliometric analysis examined publication trends, citations, productive countries, keyword co-occurrence, and research collaboration, with visualization using VOSviewer. The highest annual output was recorded in 2015 (34 articles). The United States contributed the largest number of publications (50 articles), followed by the United Kingdom (47 articles) and Australia (26 articles). The dominant research focus concerned second-hand smoke, children, and smoking, with respiratory outcomes such as asthma emerging as an important theme. Overlay visualization also indicates a shift toward topics involving children, pregnancy, and asthma in 2020–2021. These findings demonstrate that SHS exposure in children remains an important and evolving public health research area. The bibliometric map can support researchers and policymakers in prioritizing respiratory health, smoke-free environments, parental smoking cessation, and emerging passive exposure to alternative nicotine products.</i>
Artikel Info	Abstrak
Sejarah Artikel Diterima: 2026-04-28 Direvisi: 2026-09-01 Dipublikasi: 2026-09-24 Kata kunci: anak-anak; asap rokok pasif; kesehatan anak; merokok pasif; paparan tembakau;	Penelitian ini bertujuan menganalisis tren publikasi, tema penelitian, publikasi berpengaruh, dan pola penelitian internasional mengenai paparan asap rokok pasif (second-hand smoke/SHS) dan kesehatan anak selama 2015–2025. Penelitian menggunakan desain bibliometrik kuantitatif. Data diperoleh dari Scopus dan Web of Science dan disaring berdasarkan tahun publikasi, bidang subjek, jenis dokumen, bahasa, dan relevansi topik. Sebanyak 228 artikel dimasukkan dalam analisis akhir. Analisis bibliometrik mencakup tren publikasi, sitasi, negara paling produktif, kemunculan bersama kata kunci, dan jejaring kolaborasi, dengan visualisasi menggunakan VOSviewer. Jumlah publikasi tahunan tertinggi terjadi pada 2015 (34 artikel). Amerika Serikat menjadi negara dengan publikasi terbanyak (50 artikel), diikuti Inggris (47 artikel) dan Australia (26 artikel). Fokus penelitian yang paling dominan adalah second-hand smoke, children, dan smoking, sedangkan dampak respirasi seperti asma menjadi tema penting. Visualisasi overlay menunjukkan perkembangan perhatian terhadap topik children, pregnancy, dan asthma pada 2020–2021. Temuan ini menunjukkan bahwa paparan SHS pada anak tetap menjadi isu penelitian kesehatan masyarakat yang penting dan berkembang. Peta bibliometrik dapat menjadi dasar bagi peneliti dan pembuat kebijakan untuk memprioritaskan kesehatan respirasi, lingkungan bebas asap rokok, penghentian merokok pada orang tua, serta paparan pasif dari produk nikotin alternatif.

INTRODUCTION

Passive smoke exposure (*second-hand smoke/SHS*), also referred to as *environmental tobacco smoke (ETS)*, is a complex mixture of sidestream smoke

emitted from the burning end of tobacco products and mainstream smoke exhaled by smokers (Arfaeina et al., 2023). Recognized as one of the major indoor air pollutants, SHS contains thousands of chemical

compounds, including numerous toxic and carcinogenic substances (Wu et al., 2022).

The health impacts of SHS exposure in children are multifaceted and well documented. Respiratory morbidity is among the most strongly established outcomes, with consistent evidence linking SHS exposure to an increased risk of asthma, lower respiratory tract infections, wheezing, and impaired lung function (Ali et al., 2015). Recent meta-analyses published between 2021 and 2024 confirm that children exposed to SHS have a significantly higher likelihood of experiencing asthma exacerbations and hospitalizations due to respiratory infections compared with children who are not exposed (Asfaw et al., 2024). In addition to respiratory outcomes, SHS exposure has also been associated with growth disturbances, including stunting and reduced height-for-age indices, suggesting a dose-response relationship between exposure duration and developmental deficits (Cao et al., 2022).

Beyond physical morbidity, increasing attention has been directed toward the neurodevelopmental and psychosocial consequences of SHS exposure (Mahabee-Gittens et al., 2021). Recent cohort studies indicate that early-life exposure to SHS is associated with behavioral disorders, including attention-deficit/hyperactivity disorder (ADHD), conduct disorders, and impaired executive functioning (Elbeeh, 2023). Neurobiological research suggests that toxic components of SHS may affect neurotransmitter systems and neurodevelopmental processes involved in

behavioral regulation and cognitive control (Chu et al., 2023). Furthermore, epidemiological studies published after 2021 have reported correlations between SHS exposure and increased symptoms of anxiety, depression, and psychological distress among school-aged children, particularly among populations with lower socioeconomic status (Kisby & Raber, 2025). These findings reinforce concerns that SHS contributes not only to somatic health disorders but also to long-term neurocognitive and mental health challenges.

The biological plausibility of these associations is supported by evidence that SHS exposure can induce oxidative stress, systemic inflammation, and other biological disturbances during critical developmental periods (Caliri et al., 2021). Biomarker-based studies using cotinine levels as an objective indicator of exposure have strengthened causal inference and reduced reliance on self-reported data (Oh et al., 2022).

As epidemiological evidence continues to expand, the research landscape on SHS has also undergone significant changes. Recent bibliometric analyses indicate a substantial increase in publications focusing on children's health outcomes, with the United States, the United Kingdom, and China emerging as major contributors in this field (Shaw et al., 2024). In particular, research topics have begun to shift toward the health implications of alternative nicotine delivery systems, such as electronic cigarettes and heated tobacco products, which produce passive aerosols that may

pose new risks to children (Fearon et al., 2024). This shift reflects changes in global tobacco consumption patterns and highlights the need to reconsider the traditional SHS paradigm in the context of emerging tobacco products.

Policy-oriented research has also gained increasing prominence. Evidence from natural experiments indicates that the implementation of comprehensive smoke-free legislation significantly reduces pediatric hospital admissions related to asthma and respiratory infections (Faber et al., 2016). Interventions targeting parental smoking cessation particularly those combining behavioral counseling with nicotine replacement therapy have proven to be cost-effective in reducing SHS exposure within households (M. Y. Li et al., 2025). Nevertheless, disparities remain, as children from lower socioeconomic backgrounds continue to be more vulnerable to SHS exposure, highlighting gaps in the reach and implementation of tobacco control policies (Hebbar et al., 2022).

Despite substantial progress, several important research gaps remain. First, more longitudinal and multinational cohort studies are needed to clarify long-term causal pathways and to distinguish between prenatal and postnatal exposure effects (Canova & Cantarutti, 2020). Second, further research is required to evaluate the health impacts of passive aerosol exposure from alternative tobacco and nicotine products. Third, interdisciplinary research integrating public health, environmental science, neuroscience, and social policy is

essential to better understand the complex dynamics of SHS exposure and the inequalities associated with it (H. Lu et al., 2025).

However, these research developments have generated a broad and increasingly diverse body of literature, making it difficult to identify the overall structure, evolution, and emerging directions of research on SHS exposure and children's health from individual studies alone. Existing research has largely focused on specific health outcomes, exposure patterns, biological mechanisms, or tobacco-control interventions, while less attention has been given to systematically mapping publication trends, influential contributions, geographical patterns, and relationships among research themes. This gap highlights the need for a bibliometric analysis to provide a comprehensive overview of how research in this field has developed, identify dominant and emerging topics, and reveal areas that remain relatively underexplored.

The 2015–2025 publication period was selected to capture recent developments in SHS research over an eleven-year period while providing sufficient temporal coverage to examine changes in publication trends and research themes. This period encompasses the continued development of research on children's health outcomes, objective exposure assessment, tobacco-control interventions, smoke-free policies, and emerging nicotine-delivery products. Including publications through 2025 also allows the analysis to reflect the most

recent direction of research within the defined study period. Therefore, the 2015–2025 period provides an appropriate timeframe for.

METHODS

This study employed a quantitative approach with a bibliometric study design aimed at analyzing the development and direction of research on second-hand smoke exposure and its impact on children's health disorders. The research process followed several stages, including identification, screening, eligibility, and inclusion of articles, based on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flow framework.

The data sources were obtained from international scientific databases, namely Scopus and Web of Science. The initial search yielded a total of 573 records from the databases. Data collection was conducted through a systematic search using combinations of keywords such as "secondhand smoke," "passive smoking," "environmental tobacco smoke," "children," and "child health," combined with Boolean operators AND and OR. To improve search reproducibility, the search strategy used the TITLE-ABS-KEY field in Scopus and the Topic (TS) field in Web of Science. The search terms included variations of second-hand smoke exposure, such as "secondhand smoke," "second-hand smoke," "passive smoking," "environmental tobacco smoke," and "secondhand tobacco smoke," combined with terms related to children and child health.

Subsequently, limitations were applied according to the study criteria, including a publication year range from 2015 to 2025, limitation to the subject areas of Medicine and Nursing, restriction to document types Article and Review, and limitation to English-language publications. The publication period of 2015–2025 was selected to capture the most recent decade of research on second-hand smoke exposure and its impact on children's health while providing a sufficiently broad period to identify publication trends, emerging research topics, citation patterns, and developments in the field. The year 2025 was selected as the endpoint because it represented the most recent complete publication year available at the time of data collection.

After applying these restrictions, 345 records were excluded, leaving 228 records for the screening stage. The individual numbers associated with each database filter were not summed because the exclusion criteria could overlap, meaning that a single record could meet more than one exclusion criterion. A total of 228 articles were screened based on titles and abstracts, and all were subsequently assessed for full-text retrieval. No reports were unavailable for retrieval (reports not retrieved = 0). Furthermore, all 228 articles underwent full-text eligibility assessment, and no articles were excluded at this stage (reports excluded = 0). Therefore, the final number of articles included in the analysis was 228 (Figure 1).

Data analysis was performed quantitatively using bibliometric analysis

with VOSviewer version 1.6.20. The analysis included the distribution of publications by year to identify research trends, identification of the most productive authors, institutions, and countries, citation analysis to determine the most influential articles and journals, and keyword co-occurrence analysis to map research theme clusters. In addition, collaboration network analysis among authors and countries was conducted to illustrate patterns of research collaboration. The results were visualized using VOSviewer version 1.6.20 to generate network maps and thematic clusters, which were then interpreted descriptively to explain the development and direction of research on second-hand smoke exposure and its effects on children's health disorders

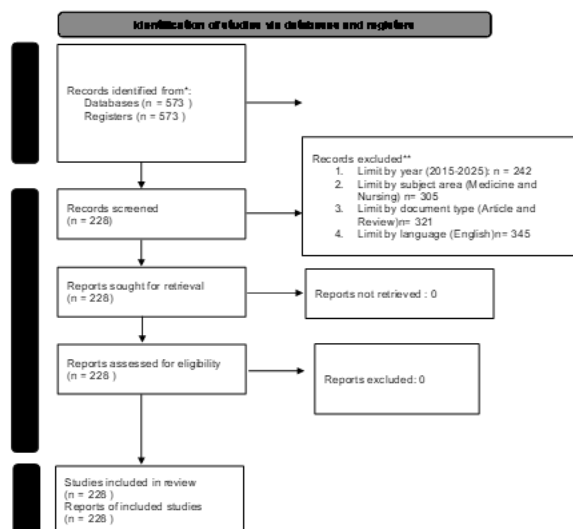


Figure 1. Prisma

RESULTS AND DISCUSSION

The analysis results show the most frequently cited articles and provide an overview of research trends second-hand smoke exposure and its impact on children's health disorders.

Table 1. Most Cited Articles

No	Document Title	Authors/ Year	Source	Cited by	Quartile
1	Tobacco use and second-hand smoke exposure in young adolescents aged 12-15 years: data from 68 low-income and middle-income countries	Xi, Bo., Liang, Yajun., Liu, Yunxia., Yan, Yinkun., Zhao, Min., Ma, Chuanwei., Bovet, Pascal. // 2016	The Lancet Global Health	178	Q1
2	Burden of disease attributable to second-hand smoke exposure: A systematic review	Carreras, Giulia., et al. // 2019	Preventive Medicine	123	Q1
3	Exposure to Second-Hand Smoke and the Risk of Tuberculosis in Children and Adults: A Systematic Review and Meta-Analysis of 18 Observational Studies	Patra, Jayadeep., Bhatia, Mehak., Suraweera, Wilson., Morris, Shaun K., Patra, Cyril., Gupta, Prakash C., Jha, Prabhat. // 2015	PLoS Medicine	119	Q1
4	Reducing tobacco smoking and smoke exposure to prevent preterm birth and its complications	Wagijo, Mary-ann., Sheikh, Aziz., Duijts, Liesbeth., Been, Jasper V. // 2017	Paediatric Respiratory Reviews	65	Q1
5	Recent trends in children's exposure to second-hand smoke in England: Cotinine evidence from the Health Survey for England	Jarvis, Martin J., Feyerabend, Colin. // 2015	Addiction	65	Q1

Table 1 presents the most frequently cited articles on SHS exposure and its impact on children's health. Xi et al. (2016)

received the highest number of citations, with 178 citations, followed by Carreras et al. (2019), which received 123 citations, and Patra et al. (2015), which received 119 citations. These highly cited studies indicate that epidemiological research and systematic reviews addressing tobacco exposure and its health burden have played an important role in shaping the development of this research field.

Table 2. Characteristics of the Included Articles on Second-Hand Smoke Exposure and Children's Health Disorders

No	Characteristics	Description
1	Number of included articles	228 articles
2	Publication period	2015-2025
3	Data sources	Scopus and Web of Science
4	Document types	Articles and Reviews
5	Publication language	English
6	Subject areas	Medicine and Nursing
7	Most productive country	United State, with 50 documents
8	Second most productive country	United Kingdom, with 47 documents
9	Third most productive country	Australia, with 26 documents
10	Most cited article	Xi et al. (2016), with 178 citations
11	Second most cited article	Carreras et al. (2019), with 123 citations
12	Third Most cited article	Patra et al. (2015), with 119 citations
13.	Most frequent keywords	Second-hand smoke, children, and smoking
14.	Main research focus	Second-hand smoke exposure and children's health disorders, particularly respiratory disorders

The characteristics of the included articles show that the dataset consisted of 228 English-language articles and reviews published between 2015 and 2025, with Medicine and Nursing representing the main subject areas. The United States was the most productive country, followed by

the United Kingdom and Australia. The most frequently occurring keywords were "second-hand smoke," "children," and "smoking," indicating that the relationship between second-hand smoke exposure and children's health disorders was the central focus of the literature.

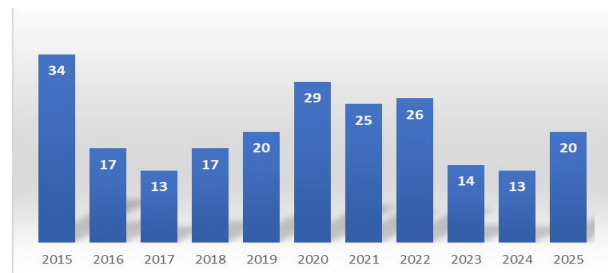


Figure 2. Publications by Year

Figure 2 shows that the highest number of publications was recorded in 2015, with 34 articles. This finding indicates substantial research interest in second-hand smoke exposure and children's health disorders during the selected period.

The research focus has subsequently expanded from exposure and respiratory disorders toward other aspects of children's health, including developmental, cognitive, behavioral, and mental health outcomes. This expansion suggests that the impact of SHS is increasingly being examined as a broader child-health problem rather than being limited to respiratory effects.

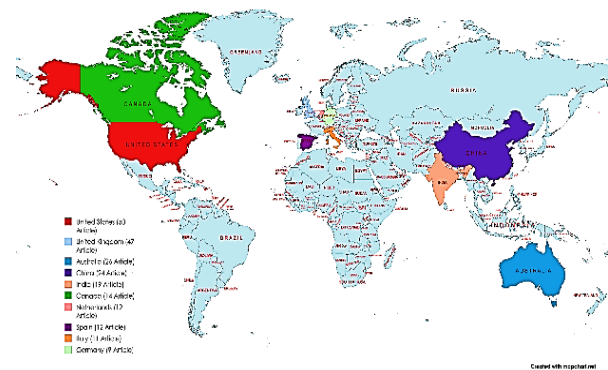


Figure 3. Publications by Country

Figure 3 shows the global distribution of publications related to second-hand smoke exposure and its impact on children's health disorders. The United States has the highest number of publications with 50 documents, followed by the United Kingdom with 47 documents, and Australia with 26 documents. The dominance of the United States and the United Kingdom may be attributed to their strong research infrastructure, established public health and tobacco-control research programs, availability of population-based health data, and extensive academic collaboration networks. Their established tobacco-control and smoke-free policies also provide opportunities to evaluate tobacco exposure and its effects on children's health.

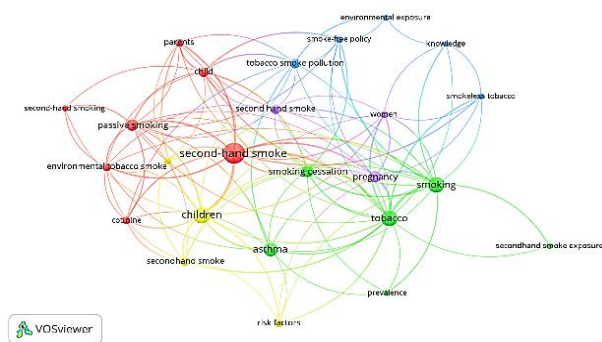


Figure 4. Network Visualization of Second-Hand Smoke Exposure and Children's Health Disorders

Figure 4 illustrates the relationships among research keywords related to SHS exposure and children's health. *Second-hand smoke*, *children*, and *smoking* appear as central keywords, indicating that they represent the core concepts of the research field. Their connections with health-related terms demonstrate that research has primarily focused on the relationship

between tobacco smoke exposure and children's health outcomes.

The network also shows connections between exposure-related terms, pregnancy, asthma, and other health outcomes. This pattern suggests that research has expanded from identifying SHS exposure to examining different exposure contexts and their potential consequences for children's health.

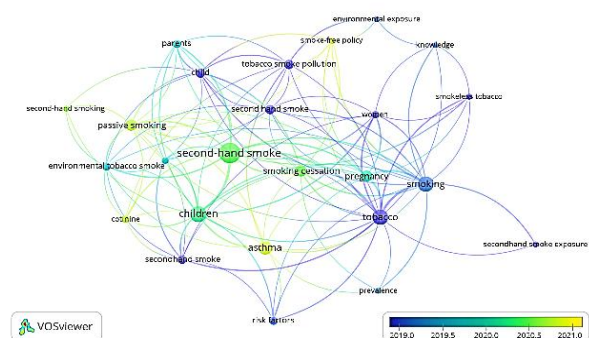


Figure 5. Overlay Visualization

Figure 5 shows the trends over time related to the topic of second-hand smoke exposure and children's health disorders. *Second-hand smoke*, *smoking*, and *tobacco* were the most frequently discussed keywords in 2019–2020. Meanwhile, *children*, *pregnancy*, and *asthma* were the most frequently discussed keywords in 2020–2021.

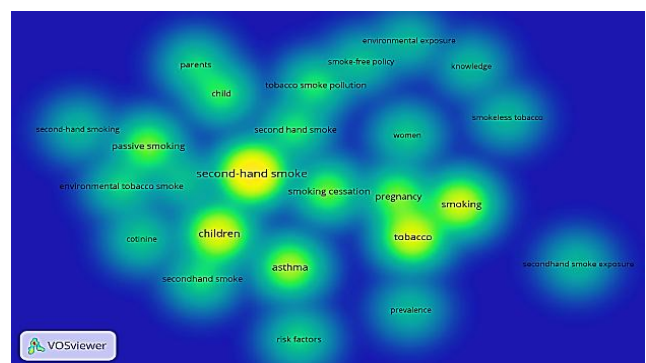


Figure 6. Research Agenda and Future Directions on Second-Hand Smoke Exposure and Children's Health Disorders.

Figure 6 shows the density of research topics related to second-hand smoke exposure and children's health disorders. The most frequently discussed keywords are *second-hand smoke*, *children*, and *smoking*.

Exposure to second-hand smoke (SHS) remains a major public health concern worldwide due to its significant impact on children's health (H. Lu et al., 2025). Children are particularly vulnerable to tobacco smoke exposure because their respiratory and immune systems are still developing (Flor et al., 2024). As a result, exposure to toxic substances in tobacco smoke can lead to a wide range of short- and long-term health problems. This study demonstrates that research on second-hand smoke exposure and children's health disorders continues to expand and has become a major focus of attention across many countries. These findings are supported by recent studies indicating that SHS exposure remains a major contributor to various child health problems globally, particularly in countries with high smoking prevalence (Reitsma et al., 2021).

The results of this study show that publications on this topic have increased and are distributed globally, with countries such as the United States and the United Kingdom being the largest contributors to research on second-hand smoke exposure in children (H. Lu et al., 2025). This finding is consistent with global studies showing that although tobacco control policies have been strengthened, children's exposure to second-hand smoke remains relatively high in many countries, particularly those with

high tobacco consumption and limited implementation of smoke-free home regulations (Fallavollita et al., 2021). A study analyzing global trends of tobacco smoke exposure among adolescents in 27 countries reported that such exposure remains widespread and has declined only in some countries (Lee et al., 2024). Other studies also indicate that household environmental factors and parental smoking behavior are the primary determinants of children's exposure to tobacco smoke across different countries (Myers et al., 2020).

The health effects of second-hand smoke exposure in children are primarily associated with respiratory disorders. Children exposed to tobacco smoke have a higher risk of developing asthma, lower respiratory tract infections, bronchitis, and reduced lung function (W. Lu et al., 2025). Recent studies indicate that children living in environments with active smokers have poorer lung function and lower physical fitness compared with children who are not exposed to tobacco smoke (Pavić et al., 2024). In addition, exposure to tobacco smoke is known to trigger more frequent and severe asthma attacks in children who already have a history of the disease (Ignasius Tamba et al., 2021). Recent studies have also shown that SHS exposure is associated with increased incidence of pneumonia, middle ear infections, and impaired lung function in early childhood (B. Li et al., 2025).

Beyond respiratory disorders, second-hand smoke exposure also affects various other aspects of children's health, including

growth, cognitive development, and mental health (Ling & Heffernan, 2016). A recent systematic review found that children exposed to tobacco smoke have a higher risk of behavioral disorders, reduced cognitive ability, and neuropsychological developmental problems (Salehi et al., 2024). Toxic substances present in tobacco smoke, such as nicotine and fine particulate matter, can affect the development of the central nervous system and trigger biological changes that may influence brain function in children (Hajdusianek et al., 2021). In addition, recent studies have reported that tobacco smoke exposure is associated with attention deficits and hyperactivity among school-aged children (Lee & Lee, 2023)

Other studies also show that tobacco smoke exposure in children is associated with an increased risk of behavioral problems and learning difficulties (Jorge et al., 2016). This occurs because chemical compounds in tobacco smoke can affect neurotransmitters involved in emotional regulation and cognitive function (Hammad et al., 2023). Chronic exposure to tobacco smoke may even trigger epigenetic changes that influence gene expression related to brain development (Kisby & Raber, 2025). Furthermore, recent studies indicate that children who experience long-term exposure to tobacco smoke are also at greater risk of mental health problems such as stress, depression, and anxiety (Park, 2020).

In addition to its effects on individual health, second-hand smoke exposure also has broader public health implications.

Recent systematic studies show that SHS exposure contributes to increased rates of chronic diseases, immune disorders, and growth delays in children (Asfaw et al., 2024). Furthermore, these studies emphasize that the implementation of smoke-free policies and parental smoking cessation programs can significantly reduce children's exposure to tobacco (Nawawi et al., 2025). Health policy research also demonstrates that comprehensive smoke-free regulations can reduce pediatric hospitalizations due to respiratory diseases by more than 10% in several countries (Been et al., 2015)

The bibliometric findings of this study also indicate that the most frequently occurring keywords in the literature are second-hand smoke, children, and smoking. This suggests that the main focus of research continues to center on the relationship between tobacco smoke exposure and children's health. However, recent studies have begun to expand their focus toward the impact of tobacco smoke exposure on mental health, neurological development, and the effects of aerosol exposure from alternative tobacco products such as electronic cigarettes (Farrell et al., 2022). Recent studies have shown that aerosols from electronic cigarettes also contain harmful chemicals that may affect children's health when inhaled passively (Tattan-Birch et al., 2024)

The development of these research topics indicates that the issue of second hand smoke exposure and children's health disorders is becoming increasingly complex and requires a multidisciplinary approach.

In addition to medical perspectives, future research should also consider social, economic, and public policy factors that influence the level of tobacco smoke exposure within households (Herawati et al., 2019). Children from families with lower socioeconomic status are known to have a higher risk of tobacco smoke exposure due to limited access to health information and living environments that may not support smoke-free policies (Muchlis et al., 2023). Future research should further investigate the long-term effects of second-hand smoke exposure on children's respiratory, cognitive, behavioral, and mental health outcomes through longitudinal studies. Further studies should also examine prenatal and early-life exposure, passive exposure to electronic cigarettes, and the effectiveness of smoke-free home interventions. In addition, research from low- and middle-income countries is needed to provide a more comprehensive understanding of the social and environmental factors influencing children's exposure to second-hand smoke.

CONCLUSION

This study demonstrates that research on second-hand smoke exposure and children's health disorders has developed into a global research area, with the United States and the United Kingdom as the leading contributors. The main research themes were centered on "second-hand smoke," "children," and "smoking," with respiratory disorders remaining a prominent focus.

Future research should further explore prenatal and early-life exposure, cognitive and mental health outcomes, electronic cigarette exposure, and underrepresented populations. These findings contribute to public health policy development by supporting evidence-based smoke-free policies, parental smoking cessation programs, and health education, while providing directions for future SHS research.

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