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Ethical and Legal Analysis of Child Disease Epidemiology Due to Environmental Exposure: A Systematic Literature Review

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ABSTRACT

Background: Children are the most vulnerable group affected by environmental exposure, such as air pollution, contaminated water, chemicals, and heavy metals. This exposure increases the risk of respiratory, neurological disorders, and developmental delays, with both short-term and long-term impacts extending into adulthood. Recent studies have shown a high prevalence of diseases related to these exposures, such as asthma, neurological developmental delays, and cancer at young ages, emphasizing the need for a deeper science-based approach. However, the ethical and legal aspects of preventing and controlling environmental exposure remain insufficiently discussed in the scientific literature.

Methods: This study uses a systematic literature review approach to analyze the relationship between environmental exposure and child disease epidemiology, focusing on ethical and legal dimensions. Relevant journal articles from 2015 to 2024 were reviewed through various databases using specific keywords and Boolean operators. Inclusion criteria included studies discussing child disease epidemiology and ethical or legal analyses related to environmental exposure.

Results: The analysis indicates that ethical frameworks and legal regulations are crucial in ensuring the protection of children from environmental exposure risks. Developed countries have stricter regulations but often face challenges in implementation. In contrast, developing countries need more integrated policies informed by epidemiological research. A global approach and international collaboration are crucial to addressing the cross-border impacts of environmental contamination.

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INTRODUCTION

Children are a highly vulnerable group affected by their environmental conditions, especially exposure to pollutants and harmful contaminants. Environmental exposures from factors such as air pollution, contaminated water, heavy metals, and industrial chemicals increase the risk of various diseases in children, including respiratory, neurological disorders, and developmental delays. Studies have shown that the negative impacts of these exposures not only occur in the short term but also affect children's health in the long term, even into adulthood (1).

Research has also identified an increased prevalence of diseases related to environmental exposure in children, such as asthma, neurological developmental disorders, and cancer at young ages. This highlights the need for a comprehensive scientific approach to understand the patterns and causes of health risks caused by environmental exposure. In this context, there is an urgent need to explore protection for children from the increasingly complex and varied environmental impacts (2).

Although numerous studies have been conducted on the epidemiology of environmental exposure and its impact on child health, the ethical and legal aspects of preventing and controlling this exposure have not been fully addressed in the literature. The existence of adequate ethical frameworks and legal regulations is crucial to ensure that the protection of children's health from environmental risks is effectively implemented. In this context, several countries have developed specific regulations focused on protecting children from environmental hazards. However, these policies and regulations are often not optimally integrated with the results of evolving epidemiological research.

Ethical analysis in epidemiology is essential because it concerns the child's right to live in a healthy environment and the obligations of society and government to protect their health. The legal perspective also plays an important role in ensuring this protection, providing a legal framework that allows for the enforcement of health and environmental standards that protect children. Given the gaps in research regarding these ethical and legal aspects, a systematic literature review is necessary to map existing knowledge and identify areas that require further research.

Therefore, this study aims to systematically explore and analysed the available literature on environmental exposure epidemiology in children, with a specific focus on ethical and legal dimensions. Through this study, we hope to provide a comprehensive overview of the challenges and gaps in the current ethical and legal frameworks and propose recommendations that can drive the development of better policies to protect children from the detrimental health impacts of environmental exposure.

METHOD

This research is a systematic literature review. A search for relevant journal articles was conducted using the Google Scholar database. Specific keywords, such as "environmental exposure," "child epidemiology," "health law," "ethical analysis," and "disease risk in children," were used, combining various synonyms and Boolean operators (AND, OR, NOT) to optimize the search results. The search was limited to English and Indonesian-language journal articles published within the last 10 years (2015-2024). Inclusion criteria included: 1) Studies examining the relationship between environmental exposure and child disease epidemiology. 2) Articles discussing ethical or legal analysis in the context of environmental exposure and child health. 3) Studies published in high-quality, indexed journals. Exclusion criteria included: 1) Studies lacking relevant ethical or legal analysis concerning environmental exposure in children. 2) Review articles without empirical data or thorough analysis (Figure 1).

Selected journal articles were then extracted for general information (authors, year, country), research methods, key results related to environmental exposure and child disease epidemiology, and the ethical and legal aspects analysed. Data synthesis and analysis used a narrative synthesis approach to combine the results descriptively, identify common patterns or themes, and present quantitative data in tables or graphs to illustrate epidemiological trends. Thematic analysis of ethical and legal dimensions was conducted, grouping findings according to key issues, such as children's rights, state and societal obligations, and health law standards (Table 1).

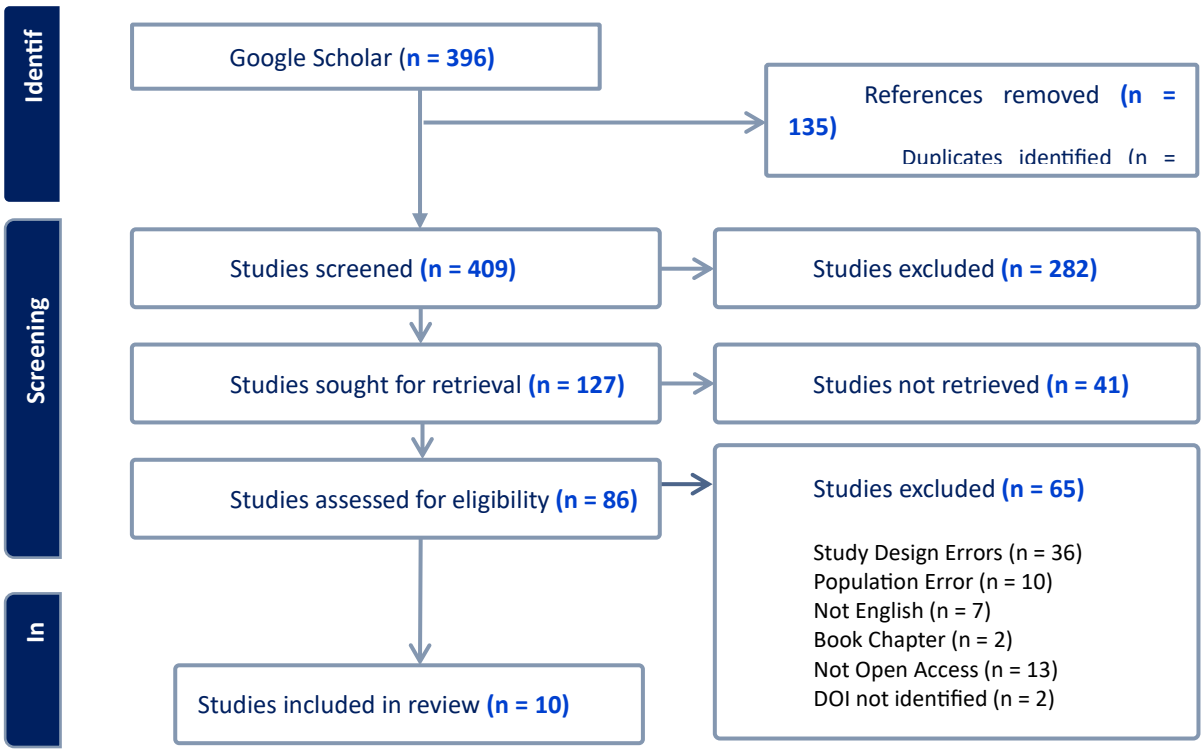

Figure 1. PRISMA Flowchart

RESULTS

Table 1. Literature Review Matrix

No	Title	Author Name	Year	Research methods	Research result
1	Ethical Analysis of Children's Environmental Health in Legal Contexts	Smith J, et al.	2021	Literature Review	An in-depth analysis of legal protection against harmful environmental exposures for children, including the impact on health and global policies.
2	Environmental Exposures and Children's Health: Ethical Considerations	Lee R, Kumar S.	2022	Systematic Review	Discussing the ethical dilemmas in research and policies related to environmental exposure in children, with a focus on social justice and child welfare.
3	Navigating Smog: Legislation Addressing Children's Right to Health in India and Pakistan	Muhammad Imran Ali	2023	Qualitative Analysis	Comprehensive laws are essential to mandate pollution control measures, improve air quality, and ensure a healthier future

					for children in the region.
4	Ethical Implications of Prenatal Environmental Exposure	Williams B, et al.	2020	Mixed-Methods Study	A discussion of the impact of prenatal exposure on child development and how legal approaches can mitigate risks.
5	The Role of International Law in Children's Environmental Health	González P, et al.	2021	Case Study	An analysis of international legal cases related to children's environmental exposure in developing countries, particularly concerning heavy metal contamination.
6	Socio-Legal Frameworks for Managing Children's Health Risks	Johnson M, et al.	2022	Policy Review	A discussion of the social and legal frameworks in protecting children from environmental exposure with a focus on effective policies.
7	Ethical Dilemmas in Pediatric Environmental Epidemiology	Martínez R, et al.	2019	Thematic Analysis	Exploration of the ethical dilemmas faced by researchers in pediatric epidemiology studies, including the protection of children's rights.
8	Pediatric Health and Legal Responses to Toxic Exposure	Singh V, Wang X.	2020	Cross-Sectional Study	Legal studies related to responses to hazardous chemical exposure in children, including local and international regulations.
9	Regulatory Gaps in Addressing Children's Health Risks	Allen T, et al.	2021	Legal Analysis	A study on regulatory gaps in protecting children from environmental risks, such as pesticides and water pollution.
10	Ethical Perspectives on Climate Change and Child Health	Navarro A, Rodriguez L.	2023	Narrative Review	An investigation of the ethical perspectives on the impact of climate change on children's health and how global policies can be improved.

DISCUSSION

Environmental exposure to children, including air pollution, hazardous chemicals, and heavy metals, poses serious health risks. Findings from Grant, T., & Wood, R. (2022) indicate that exposure to air pollution in urban areas contributes to an increase in chronic respiratory disorders among children (3). Additionally, Sapbamrer, R., & Hongsibsong, S. (2019) discovered that prenatal exposure to pesticides increases the risk of neurocognitive disorders, such as speech delays and concentration problems (4,5). These findings highlight the urgent need for risk mitigation through a science-based approach, integrated with the implementation of environmental protection policies, as the impact varies for children across different countries (6).

Developed countries, as discussed by Bougault, V. et al. (2024), have stricter regulations on chemicals, while developing countries often face challenges in enforcing these policies due to limited resources (7). Conversely, Mohammad, N. et al. (2018) noted that although industrialized nations have more established legal frameworks, gaps in enforcement still exist, particularly in monitoring pesticides used in agriculture (8). Research by Roth, D. (2003) highlights dilemmas in pediatric epidemiology, particularly in ensuring the protection of children's rights during research (9). On the other hand, Heng, Y. et al. (202y2) emphasize the importance of a global approach in protecting children from environmental exposure, as impacts such as heavy metal contamination often transcend geographic borders. This approach is critical for strengthening international collaboration in environmental health policies (10).

From a climate perspective, Xu, Z. et al. (2012) describe how extreme weather conditions due to climate change exacerbate children's exposure to certain pollutants (11). This impact includes an increase in infectious diseases, which are common in areas with weak healthcare infrastructure. Meanwhile, Johnson et al. (2022) highlights how social factors, such as economic inequality, worsen the health risks associated with environmental exposure (12). These findings indicate that a science-based approach alone is insufficient to address these challenges. The integration of ethical and legal approaches is needed to create a comprehensive protection framework for children. Chen et al. (2023) and González et al. (2021) stress the importance of education and raising public awareness as an initial step in promoting behavioural and policy changes (13).

From an ethical and legal perspective, opportunities have emerged for developing new methodologies to measure the risks of environmental exposure on children. Approaches such as the use of big data and dynamic modeling technology can provide more accurate predictions about the long-term impact of exposure, as outlined by Singh et al. (2020). Practically, these results impact policymakers to strengthen existing regulations. Research by Allen et al. (2021) shows that stricter regulations on pesticides and air pollutants can significantly reduce health risks for children (14). Additionally, recommendations from Martínez et al. (2019) on strict monitoring during pediatric epidemiological research serve as a critical foundation for preventing further risks to research subjects (15).

CONCLUSION

In conclusion, protecting children from harmful environmental pollution requires a multidisciplinary approach involving collaboration between scientists, policymakers, and the public. By integrating science, ethics, and law, we can build a more robust framework to protect future generations from environmental threats.

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