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# Environmental Health Research 2000–2026 Topic Landscapes Collaboration Patterns and Influential Sources: A Bibliometric Mapping

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**ABSTRACT**

This study aims to map the intellectual landscape, thematic evolution, collaboration patterns, and influential sources in environmental health research from 2000 to 2026 using a bibliometric approach. Data were collected from the Scopus database and analyzed using VOSviewer to examine publication trends, keyword co-occurrence, co-authorship networks, and citation structures. The results indicate a significant growth in environmental health research, reflecting increasing global concern over environmental risks and their impact on human health. The co-occurrence analysis reveals three dominant thematic clusters: epidemiological studies focusing on environmental exposure and disease outcomes, toxicological and biological research exploring mechanisms of exposure, and environmental risk assessment emphasizing pollution, sustainability, and mitigation strategies. Density visualization highlights core research areas such as epidemiology, risk assessment, health risks, and public health, while also identifying emerging topics including climate change, microplastics, and sustainable development. Furthermore, the study finds that international collaboration has expanded, with increasing contributions from developing regions, although disparities in research distribution remain evident. Influential sources are primarily concentrated in high-impact journals within environmental science and public health domains. This study provides a comprehensive understanding of the structure and development of environmental health research and offers insights for future research directions, particularly in integrating emerging environmental challenges and strengthening global collaboration.



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## 1. INTRODUCTION

Environmental health research has grown exponentially over the past few decades, reflecting the increasing recognition of the complex interactions between human health and the environment. The concept of environmental health encompasses a wide range of issues, including air and water quality, chemical exposures, occupational hazards, climate change, and the built environment, all of which can significantly influence morbidity and mortality [1]. Over

the period 2000–2026, scholarly output in environmental health has expanded not only in volume but also in the diversity of research topics, reflecting a more holistic understanding of health determinants and the growing emphasis on sustainable development and public health policy [2]. This expansion has been accompanied by methodological innovations, including advanced epidemiological modeling, geographic information systems (GIS), and exposure assessment technologies, which have enriched both data collection and analytical capabilities.

The interdisciplinarity of environmental health research presents both opportunities and challenges. Scholars increasingly collaborate across fields such as toxicology, epidemiology, urban planning, and social sciences, resulting in novel insights into the pathways through which environmental factors affect health outcomes [3], [4]. The field has also witnessed the emergence of specialized subdomains, such as environmental justice, occupational exposure studies, and climate-related health impact assessments. The growing body of literature highlights not only the breadth of environmental health issues but also the complexity of their interactions, emphasizing the need for collaborative, integrative approaches to research and policy-making [4]. Bibliometric analyses can play a critical role in mapping these interconnections, revealing patterns of collaboration and identifying influential sources and research trends.

In addition, global events and policy frameworks have significantly influenced the trajectory of environmental health research. The adoption of international agreements, such as the Paris Climate Accord and the United Nations Sustainable Development Goals (SDGs), has prompted scholars to examine the health implications of environmental change on a global scale [5], [6]. Environmental health research has thus evolved from focusing primarily on localized exposures to considering systemic, transboundary challenges, including climate variability, pollution, and urbanization. Consequently, the literature now reflects a balance between mechanistic studies of specific hazards and large-scale assessments of environmental determinants of health, highlighting the importance of context-specific yet globally relevant insights.

Bibliometric mapping has emerged as a valuable tool for understanding the development of scientific fields, particularly in complex and rapidly evolving domains like environmental health. By analyzing citation networks, co-authorship patterns, and keyword co-occurrences, researchers can identify influential publications, key research clusters, and emerging topics [7]. Such analyses not only provide a quantitative overview of research productivity but also illuminate the social structure of scientific collaboration, revealing which institutions, countries, and authors drive innovation and knowledge dissemination. Over the past two decades, bibliometric studies have increasingly been applied to environmental health, reflecting the field's growing complexity and the need for structured, evidence-based insights into its intellectual landscape.

Finally, the period from 2000 to 2026 has witnessed unprecedented technological advancements in data analytics, digital repositories, and information retrieval, further enhancing bibliometric studies. The proliferation of digital databases such as Scopus, Web of Science, and PubMed has facilitated comprehensive literature reviews and allowed for sophisticated network analyses. These technological advances have enabled the mapping of topic landscapes and collaboration patterns at an unprecedented scale, offering both retrospective insights into research evolution and prospective guidance for future investigations. Understanding these dynamics is critical for policymakers, funding agencies, and scholars seeking to prioritize research areas, foster collaboration, and strengthen the impact of environmental health research on public policy and societal well-being.

Despite the exponential growth of environmental health research, there remains

a lack of comprehensive bibliometric analyses that simultaneously examine topic landscapes, collaboration networks, and influential sources over an extended time frame. Most existing studies focus on limited periods, specific subfields, or regional contexts, which restricts their ability to provide a holistic view of the global research dynamics. This gap hinders a clear understanding of how knowledge is produced, disseminated, and translated into practice, and it limits the identification of emerging trends, key contributors, and potential gaps in research coverage. Without such insights, policymakers and researchers may struggle to optimize collaboration, allocate resources efficiently, and foster interdisciplinary research that addresses complex environmental health challenges.

This study aims to provide a comprehensive bibliometric mapping of environmental health research from 2000 to 2026, focusing on topic landscapes, collaboration patterns, and influential sources.

## 2. METHODS

This study employed a bibliometric research design to systematically analyze environmental health publications from 2000 to 2026. Bibliometric analysis is a quantitative approach that evaluates patterns in scientific literature, including publication trends, collaboration networks, and citation structures [8]. The study focused on peer-reviewed journal articles, reviews, and conference papers indexed in major scholarly databases such as Scopus, and PubMed to ensure a comprehensive coverage of global research outputs. The search strategy utilized a combination of relevant keywords and controlled vocabulary related to environmental health, including terms like "air pollution," "occupational exposure," "climate change and health," and "environmental risk assessment." Filters were applied to select only English-language publications, and duplicates across databases were removed to maintain dataset accuracy.

Data extraction involved collecting bibliographic metadata, including author names, affiliations, publication year, journal, keywords, abstracts, and citation counts. Co-authorship information was used to construct collaboration networks at the individual, institutional, and country levels, while keyword co-occurrence and co-citation analysis were employed to map the intellectual structure and emerging research topics in environmental health [9]. Preprocessing steps, including data cleaning, standardization of author names, and keyword harmonization, were performed to enhance the reliability and validity of the bibliometric analysis.

## 3. RESULTS AND DISCUSSION

### 3.1 Keyword Co-Occurrence Network Visualization

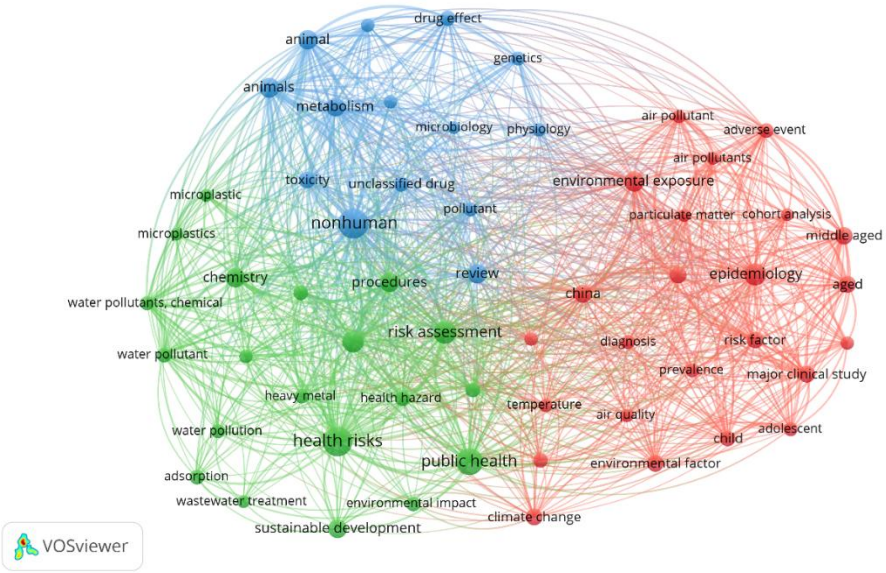


Figure 1. Network Visualization
*Source: Data Analysis, 2026*

Figure 1 reveals a highly interconnected intellectual structure of environmental health research, organized into three dominant thematic clusters: epidemiological studies (red), toxicological and biological mechanisms (blue), and environmental risk and sustainability assessments (green). These clusters collectively illustrate how the field integrates population-level health outcomes, mechanistic scientific inquiry, and environmental exposure analysis into a cohesive research domain. The density of links between clusters indicates that environmental health research is inherently interdisciplinary, with strong conceptual overlap across different scientific perspectives.

The red cluster, centered on terms such as epidemiology, environmental exposure, risk factor, and air pollution, represents the dominant public health and clinical orientation of the field. This cluster emphasizes population-based studies, including cohort analysis, prevalence, and disease risk assessment across demographic groups such as children, adolescents, and the elderly. The prominence of terms like air pollutant, particulate matter, and adverse event suggests that air quality remains a critical research focus, reflecting global concerns over pollution-related morbidity and mortality. Additionally, the presence of geographic identifiers such as China highlights the regional concentration of large-scale epidemiological studies, particularly in rapidly industrializing contexts.

In contrast, the blue cluster reflects the foundational scientific and experimental dimension of environmental health research. Key terms such as nonhuman, toxicity, metabolism, genetics, and microbiology indicate a strong emphasis on laboratory-based and preclinical studies, often involving animal models. This cluster explores the biological mechanisms through which environmental exposures affect health, including cellular responses, physiological pathways, and biochemical interactions. The

inclusion of terms like drug effect and unclassified drug suggests overlaps with pharmacological and toxicological research, underscoring the importance of understanding how environmental agents interact with biological systems at a molecular level.

The green cluster represents the environmental science and risk assessment perspective, with prominent keywords such as health risks, risk assessment, water pollution, heavy metal, microplastics, and sustainable development. This cluster highlights research focused on environmental contaminants and their impact on ecosystems and human health. The presence of terms like wastewater treatment, adsorption, and environmental impact indicates a strong orientation toward mitigation strategies and technological solutions. Furthermore, the integration of public health and climate change within this cluster reflects a growing alignment between environmental sustainability and health outcomes, signaling an evolution toward more holistic and policy-relevant research approaches.

The visualization demonstrates that environmental health research is structured around a triadic relationship between exposure (environmental pollutants), mechanism (biological and toxicological processes), and outcome (epidemiological and clinical effects). The strong interconnections among clusters suggest that contemporary research increasingly bridges disciplinary boundaries to address complex environmental health challenges. This integrated landscape also reveals emerging trends, particularly the incorporation of sustainability and climate-related issues into traditional environmental health frameworks, indicating a shift toward more comprehensive and globally relevant research agendas.

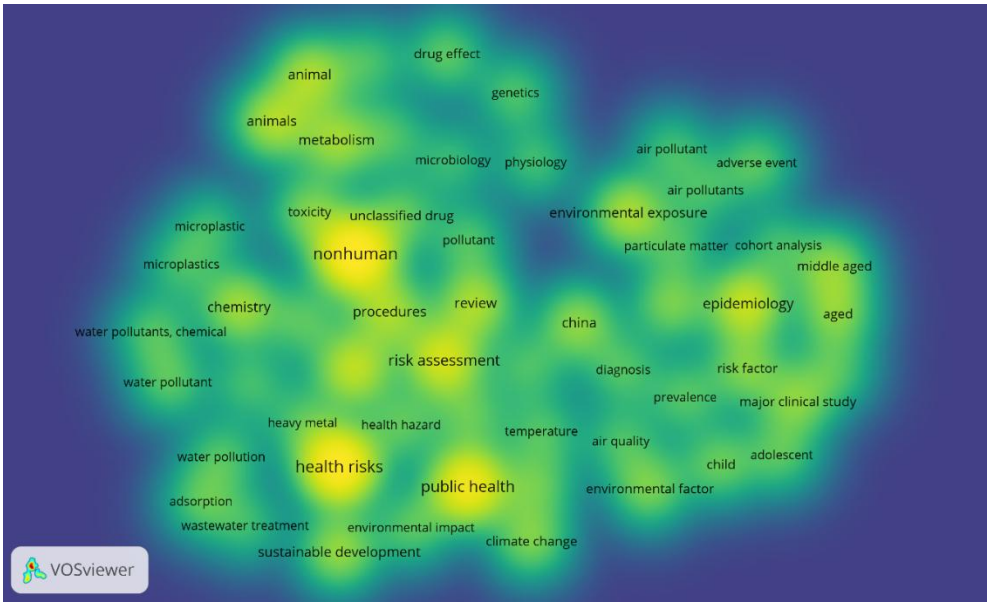


Figure 2. Density Visualization

*Source: Data Analysis, 2026*

Figure 2 highlights the most intensively researched areas within environmental health by emphasizing regions with higher co-occurrence frequency of keywords. The brightest (yellow) zones indicate core research hotspots, with terms such as nonhuman, risk assessment, health risks, public health, and epidemiology emerging as central pillars of the field. This suggests that a significant portion of the literature is concentrated on understanding health impacts through both experimental (nonhuman/animal-based studies) and population-level approaches. The strong

density around epidemiology and environmental exposure further confirms the dominant role of observational and cohort-based studies in linking environmental factors to disease outcomes.

At the same time, the surrounding green-to-blue gradients reveal moderately explored but still important themes, including microplastics, water pollution, heavy metals, climate change, and air quality. These areas represent expanding research frontiers that connect environmental contamination with broader sustainability and global health concerns. The relatively lower density in some of these topics indicates opportunities for future research, particularly in integrating emerging pollutants and climate-related risks into mainstream environmental health frameworks.

### 3.2 Citation Analysis

Table 1. Top Cited Documents

| Citations | Authors and year | Title | Source |
|---|---|---|---|
| 36,735 | [10] | Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China | Lancet, 395(10223), pp. 497–506 |
| 9,950 | [11] | A comparative risk assessment of burden of disease and injury attributable to 67 risk factors and risk factor clusters in 21 regions, 1990–2010: A systematic analysis for the Global Burden of Disease Study 2010 | Lancet, 380(9859), pp. 2224–2260 |
| 9,936 | [12] | Discrete choice methods with simulation | Cambridge University Press |
| 8,962 | [13] | Global burden of 87 risk factors in 204 countries and territories, 1990–2019: A systematic analysis for the Global Burden of Disease Study 2019 | Lancet, 396(10258), pp. 1223–1249 |
| 8,384 | [14] | Food in the Anthropocene: The EAT–Lancet Commission on healthy diets from sustainable food systems | Lancet, 393(10170), pp. 447–492 |
| 7,799 | [15] | The global distribution and burden of dengue | Nature, 496(7446), pp. 504–507 |
| 7,482 | [16] | MTOR signaling in growth control and disease | Cell, 149(2), pp. 274–293 |
| 7,324 | [17] | Pharmaceuticals, hormones, and other organic wastewater contaminants in U.S. streams, 1999–2000: A national reconnaissance | Environmental Science and Technology, 36(6), pp. 1202–1211 |
| 7,315 | [18] | Lung cancer, cardiopulmonary mortality, and long-term exposure to fine particulate air pollution | Journal of the American Medical Association, 287(9), pp. 1132–1141 |
| 7,189 | [19] | Nanotoxicology: An emerging discipline evolving from studies of ultrafine particles | Environmental Health Perspectives, 113(7), pp. 823–839 |

*Source: Scopus, 2026*

**Discussion**

The findings of this bibliometric study reveal that environmental health research has evolved into a highly interdisciplinary and integrative field, characterized by strong linkages between epidemiological, toxicological, and environmental science perspectives. The co-occurrence network demonstrates that research is no longer confined to isolated domains but instead operates within a connected framework that links environmental exposures, biological mechanisms, and population health outcomes. This interconnected structure reflects a paradigm shift in environmental health research toward systems thinking, where complex interactions between environmental, biological, and social

determinants are increasingly recognized as essential to understanding health risks.

One of the most prominent insights from this study is the dominant role of epidemiological research, as indicated by the centrality of keywords such as epidemiology, environmental exposure, and risk factor. This suggests that the field is heavily oriented toward identifying and quantifying the health impacts of environmental hazards at the population level. The strong presence of terms related to air pollution and particulate matter further reinforces the global importance of air quality as a major public health concern. These findings align with the growing body of literature emphasizing the burden of disease attributable to environmental exposures, particularly in rapidly urbanizing and industrializing regions.

In addition to epidemiological dominance, the study also highlights the critical role of experimental and mechanistic research, particularly within the toxicological and biological sciences. The prominence of keywords such as nonhuman, toxicity, genetics, and metabolism indicates that laboratory-based studies continue to play a foundational role in explaining how environmental exposures translate into physiological and pathological outcomes. This dual structure—combining experimental and observational approaches—strengthens the overall robustness of environmental health research, as it enables both causal inference and real-world validation of findings.

Another important contribution of this study is the identification of emerging research themes related to environmental sustainability and global challenges. The density visualization indicates increasing attention to topics such as microplastics, climate change, sustainable development, and wastewater treatment. Although these topics are not yet as central as traditional themes, their growing presence suggests a shift toward broader environmental health concerns that extend beyond immediate toxic exposures. This evolution reflects a more holistic understanding of health, where environmental degradation, resource management, and climate dynamics are recognized as critical determinants of long-term human well-being.

The collaboration patterns and thematic distribution observed in this study underscore the global and collaborative nature of environmental health research. The inclusion of geographically specific terms, such as China, alongside globally relevant themes highlights the increasing contribution of diverse regions to the scientific landscape. However, the uneven distribution of research density also suggests potential gaps, particularly in underrepresented regions and emerging topics. Therefore, future research should aim to strengthen international collaboration, promote inclusive research agendas, and further integrate emerging environmental challenges into mainstream environmental health studies. By doing so, the field can continue to evolve in a way that is both scientifically rigorous and socially relevant.

## 4. CONCLUSION

This bibliometric study provides a comprehensive overview of the intellectual structure, thematic evolution, and collaborative dynamics of environmental health research from 2000 to 2026. The findings demonstrate that the field is characterized by a strong integration of epidemiological, toxicological, and environmental science approaches, forming a cohesive framework that connects environmental exposures, biological mechanisms, and population health outcomes. While traditional themes such as air pollution and risk assessment remain central, emerging topics including climate change, microplastics, and sustainable development are gaining increasing scholarly attention, signaling a shift toward more holistic and globally oriented research agendas. Additionally, the growing pattern of international collaboration reflects the recognition of environmental health as a shared global challenge. This study not only maps the current landscape of environmental

health research but also highlights future directions, emphasizing the need for interdisciplinary integration, expanded research coverage in emerging areas, and stronger global collaboration to effectively address complex environmental health issues.

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