Climate Health, Volume 1, Issue 2, Spring 2026: 116-124

Original Article

Global Research Trends in Health-Related Wildfire Preparedness and Community Resilience: A Bibliometric Analysis

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Article info:
Received: 03 February 2026
Revised: 02 March 2026
Accepted: 17 March 2026

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ABSTRACT

Background: Wildfires have become an increasingly important environmental health concern due to climate change and rising human exposure. This study aimed to explore the intellectual structure and temporal evolution of research on wildfire-related health, emergency preparedness, and community resilience.

Methods: A bibliometric analysis of 371 publications from 1980 to 2026 was performed using VOSviewer. MeSH term co-occurrence and organizational co-authorship networks were analyzed, and overlay visualization was used to examine temporal trends.

Results: Five major thematic clusters were identified, covering wildfire smoke exposure, disaster preparedness, mental health consequences, ecological risk assessment, and public health communication. The most influential terms were Humans, Wildfires, and Disaster Planning. Temporal analysis demonstrated a shift from early research focused on emergency response and post-traumatic stress disorders toward recent themes related to climate change, environmental exposure, and wildfire smoke. Organizational collaboration remained limited, although recent partnerships increasingly involved institutions focusing on sustainability, climate change, and global health.

Conclusions: Research on wildfire and human health has evolved toward an interdisciplinary framework integrating environmental, psychological, and public health dimensions. Expanding international collaborations may improve preparedness and mitigate the health impacts of climate-driven wildfire events.

Keywords: Wildfires; Human Health; Bibliometric Analysis; Climate Change; Environmental Exposure

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Citation: Zaheri K, Bahrami A, Shahmansouri M, Naraki M. Global Research Trends in Health-Related Wildfire Preparedness and Community Resilience: A Bibliometric Analysis. Climate Health. 2026;1(2):116-124.

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Introduction

Wildfires are becoming an increasingly serious global challenge[1]. In recent decades, their frequency, intensity, and geographic spread have increased. This rise is driven by a combination of climate change, prolonged droughts, and expanding human activity in fire-prone areas [2]. The consequences extend far beyond burned landscapes. Wildfires can damage ecosystems, reduce biodiversity, disrupt local economies, and threaten human health and safety [3, 4]. They also place growing pressure on communities and public systems that must cope with increasingly frequent and severe climate-related hazards [5]. As a result, wildfires are no longer viewed solely as environmental events. They are increasingly recognized as complex disasters with important ecological, social, and public health implications[4].

As wildfire impacts have intensified, greater attention has been directed toward preparedness[6]. Experience from recent wildfire disasters has shown that response efforts alone cannot sufficiently reduce losses when communities face rapidly evolving fire conditions [2]. Effective preparedness requires planning before disaster occurs[3]. Early warning systems, evacuation planning, risk communication, and coordinated emergency management are critical components of this process [2]. Technological advances have further strengthened preparedness capacities through improved monitoring, detection, and prediction of wildfire events[7]. However, important gaps remain. Facilities located in high-risk areas continue to demonstrate deficiencies in emergency preparedness despite their elevated exposure to wildfire threats [8]. Similar concerns have been reported across health and emergency response systems, highlighting the continuing need for preparedness-oriented strategies [9].

Preparedness alone, however, does not eliminate disaster impacts. Communities must also be able to adapt, recover, and function following disruption. This has led to growing interest in community resilience[10]. Evidence from the Australian bushfires demonstrated that preparedness, social support, and community engagement can strengthen resilience and reduce the long-term consequences of disaster exposure [11]. Likewise, stronger community connections and active information seeking have been associated with greater preparedness and helping behaviors following wildfire events [12].

These findings suggest that preparedness and resilience are complementary capacities that jointly shape how communities anticipate, respond to, and recover from wildfire disasters[13]. Over the past decade, research on wildfires, preparedness, and resilience has expanded across multiple disciplines, although their interconnections remain insufficiently explored. Most studies have addressed these topics in isolation, leaving gaps in understanding their co-evolution, research trends, and collaboration patterns[14]. To address this gap, this study applies a bibliometric approach to map the global research landscape, identify key trends, and highlight emerging themes in wildfire preparedness and community resilience research.

Methods

This study used a bibliometric approach to analyze the global research landscape on wildfires, emergency preparedness, and community resilience. The aim was to identify publication trends, research hotspots, collaboration networks, and emerging themes in the field.

Study design

This bibliometric study was conducted to map the scientific landscape of health-related research on wildfires, emergency preparedness, and community resilience. The analysis focused on identifying major research themes, publication trends, and institutional collaboration patterns.

Data source and search strategy

The literature was retrieved exclusively from PubMed. This database was selected because of its comprehensive coverage of biomedical and public health research and its standardized indexing using Medical Subject Headings (MeSH). The study focused on the health dimensions of wildfires rather than the broader environmental literature.

An initial exploratory search was performed to identify relevant keywords, synonyms, and MeSH terms. Based on this process, a refined search strategy combining MeSH terms and free-text keywords was developed:

("Wildfires"[Mesh] OR wildfire*[tiab] OR "forest fire*"[tiab] OR bushfire*[tiab] OR "wildland fire*"[tiab]) AND (preparedness[tiab] OR "disaster preparedness"[tiab] OR "emergency preparedness"[tiab] OR "emergency management"[tiab] OR evacuation[tiab] OR "community resilience"[tiab])

The final search was conducted without time restrictions and was limited to English-language original articles and review articles. A total of 371 publications met the eligibility criteria and were included in the analysis.

Eligibility criteria

Original research articles and review articles indexed in PubMed were eligible for inclusion. Editorials, letters, conference abstracts, commentaries, and non-English publications were excluded.

Data extraction and preprocessing

The final dataset was exported from PubMed in XML format and imported into VOSviewer (version 1.6.20). Bibliographic information, including publication year, author affiliations, titles, abstracts, and MeSH terms, was extracted.

The dataset was manually screened before analysis. Duplicate records were removed when necessary, and institutional names and MeSH terms were standardized to improve the consistency and accuracy of the bibliometric networks.

Bibliometric analysis

Bibliometric analyses were performed using VOSviewer (version 1.6.20). MeSH term co-occurrence analysis was conducted to identify the principal thematic structure of the literature. Organizational co-authorship analysis was performed to evaluate institutional collaboration networks. A full counting approach was applied for network construction, and minimum occurrence thresholds were defined to improve network interpretability.

Temporal visualization

Overlay visualization was used to examine temporal changes in research topics and institutional collaboration. The average publication year of nodes was used to illustrate the evolution of MeSH terms and organizational collaboration patterns over time. Network visualization maps were generated to display relationships among MeSH terms and collaborating institutions.

Results

MeSH Term Co-occurrence Analysis

A MeSH term co-occurrence analysis was performed to identify the main thematic structure of wildfire-related health research. Using a threshold of ≥5 occurrences, 76 MeSH terms were included in the final network and grouped into five interconnected clusters (Figure 1). The most dominant terms were Humans (TLS = 1094, n = 217), Wildfires (TLS = 599, n = 116), Disaster Planning (TLS = 401, n = 81), Fires (TLS = 405, n = 77), and Disasters (TLS = 379, n = 72), indicating a strong convergence of environmental hazards, population health, and disaster preparedness.

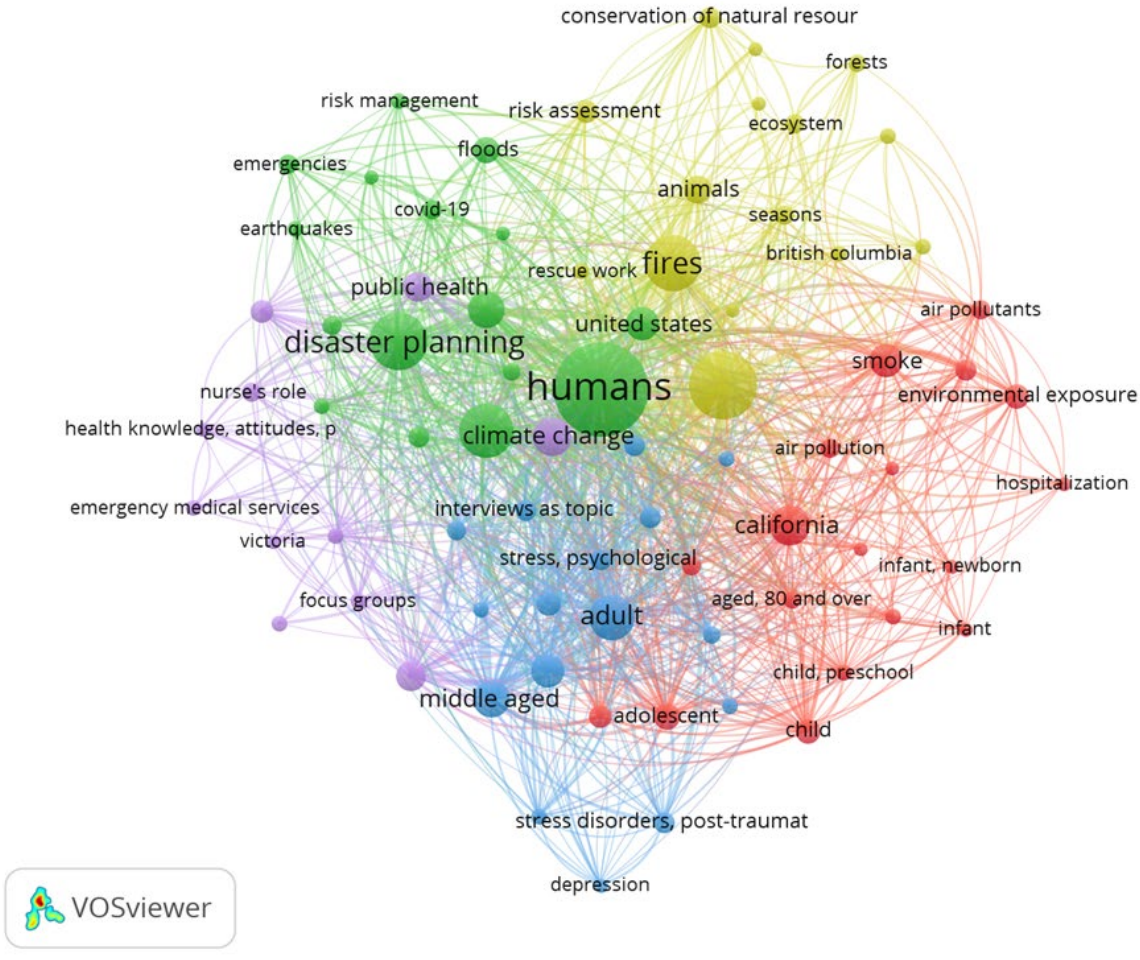

Figure 1: Network visualization of MeSH term co-occurrence in wildfire exposure and human health research (1980–2026).

The first cluster focused on wildfire smoke exposure and health outcomes, particularly in vulnerable populations, including children and adolescents. The second cluster represented disaster preparedness and health system response, emphasizing risk management and emergency planning across different geographical contexts. The third cluster highlighted the mental health consequences of wildfire exposure, including depression, psychological stress, and post-traumatic stress disorders. The fourth cluster reflected the ecological and environmental dimension of wildfires, focusing on forests, ecosystems, risk assessment, and conservation. The fifth cluster captured public health communication and preparedness, emphasizing climate change, health knowledge, communication strategies, and emergency medical services.

Overall, the co-occurrence network demonstrates the inherently interdisciplinary nature of wildfire-health research, integrating environmental science, public health, mental health, and disaster risk management.

Representation of Community Resilience in the Thematic Structure

Community resilience was included in the search strategy. However, it did not emerge as a distinct dominant cluster in the MeSH co-occurrence network. Resilience-related concepts were mainly reflected in themes related to disaster preparedness, public health communication, emergency management, and community responses. The preparedness cluster highlighted risk management and emergency planning. The public health communication cluster emphasized health knowledge, communication strategies, and emergency medical services. These themes represent important components of community capacity to prepare for and respond to wildfire events. The temporal analysis also showed a shift from emergency response toward preparedness, climate change, and environmental exposure. This pattern suggests that resilience is increasingly integrated into broader wildfire preparedness and public health research rather than being studied as a separate thematic domain.

Temporal Evolution of MeSH Terms

Overlay analysis revealed a clear temporal shift in research focus from environmental and disaster-centric topics toward more health- and climate-oriented perspectives (Figure 2).

Earlier studies (approximately 2015–2018) were dominated by terms such as Fires, Emergency Medical Services, Risk Assessment, Post-Traumatic Stress

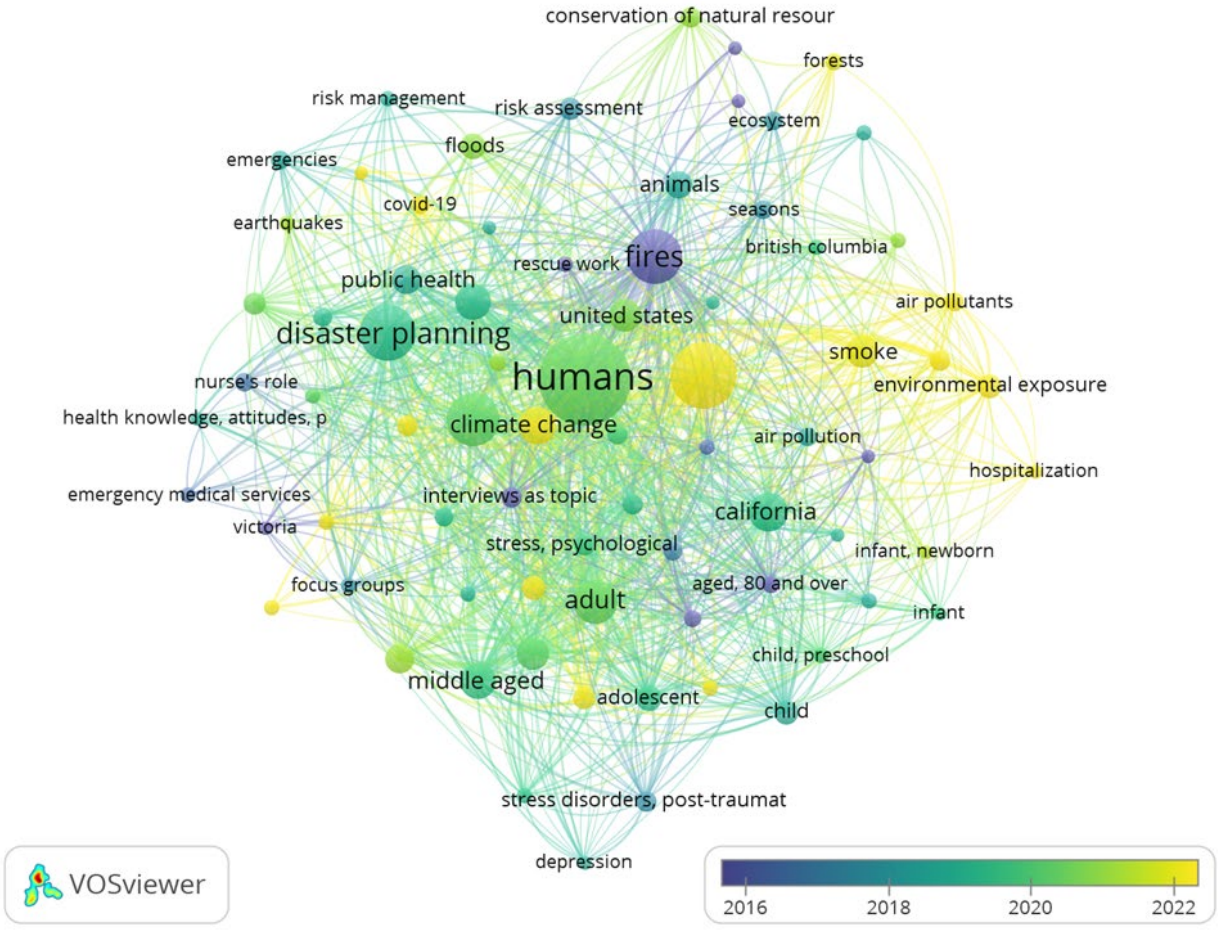

Figure 2: Overlay visualization of MeSH term co-occurrence in wildfire exposure and human health research (1980–2026).

Disorders, and Ecosystem, reflecting a focus on disaster response and immediate health and environmental consequences. In the intermediate period (2019–2021), research increasingly incorporated human-centered and public health dimensions, with rising prominence of Humans, Disasters, Adult, Mental Health, and Surveys and Questionnaires. More recent studies (2022–2023) were characterized by the emergence of Wildfires, Climate Change, Smoke, and Environmental Exposure, indicating a shift toward climate-driven wildfire risk and air pollution related health impacts.

This evolution also reflects a conceptual transition from general fire-related research toward a more specialized focus on wildfires as climate-sensitive public health hazards.

Organizational Collaboration Network

An organizational co-authorship analysis was conducted using VOSviewer with a minimum threshold of two documents per organization. A total of 17 organizations were identified, forming two main collaboration clusters (Figure 3).

The collaboration network was relatively concentrated, with limited inter-organizational connectivity. The largest cluster primarily included institutions from the United States, Australia, Sweden, Norway, and Poland, with a strong focus on emergency medicine and disaster preparedness research. Harvard Medical School (TLS = 23, n = 3) represented the most central institution in the network, followed by Griffith University, Gold Coast Health, Beth Israel Deaconess Medical Center, and the University of Gothenburg (TLS = 22 each).

The second cluster consisted of institutions with a stronger orientation toward climate change, sustainability, and global health, including Florida International University, University College London, Harvard University, and the Mercator Research Institute on Global Commons and Climate Change.

Overall, the findings indicate that organizational collaboration in this field remains relatively concentrated within a limited number of leading academic and clinical institutions.

Temporal Evolution of Organizational Collaboration

Overlay analysis demonstrated a temporal shift in institutional collaboration patterns between 2021 and 2024 (Figure 4). Early collaborations were dominated by emergency medicine and disaster response institutions, including Harvard Medical School, Griffith University, Gold Coast Health, Beth Israel Deaconess Medical Center, and Swedish emergency medicine research groups.

More recent collaborations have increasingly involved institutions engaged in climate change, sustainability, and interdisciplinary environmental health research, such as Florida International University, University College London, Harvard University, and the Mercator Research Institute. This shift indicates a transition from a disaster-response–oriented collaboration structure toward a multidisciplinary climate and environmental health research network.

Discussion

This bibliometric study provides a comprehensive overview of the evolving landscape of health-related wildfire preparedness and community resilience research. The findings revealed that the field has developed into a highly interdisciplinary area integrating public health, disaster management, environmental sciences, and mental health. Temporal analyses demonstrated a shift from traditional disaster-response perspectives toward climate-sensitive and health-oriented approaches. Organizational collaboration patterns also indicated an increasing involvement of institutions working in climate change and environmental health. Overall, the results suggest that wildfire research is undergoing a conceptual transition from reactive disaster management to preparedness, resilience, and climate-health frameworks.

The present findings highlight the inherently interdisciplinary nature of health-related wildfire research. The identified thematic clusters encompassed environmental health, disaster preparedness, mental health, public health communication, and ecological dimensions, demonstrating the broad scope of this field. Similar observations have been reported in recent reviews, which emphasized that wildfire-related challenges extend beyond environmental concerns and require the integration of public health, epidemiology,



Figure 3: Network visualization of organizational co-authorship in wildfire exposure and human health research (1980–2026).

psychology, and disaster risk management perspectives [4]. Furthermore, community resilience has been recognized as a multidimensional concept shaped by social, institutional, and governance factors[10]. Together, these findings indicate that addressing the health impacts of wildfires requires coordinated and interdisciplinary approaches that bridge environmental sciences, health systems, and disaster management [4, 15].

The present findings provide further insight into community resilience in wildfire research. Community resilience did not emerge as a distinct thematic cluster. However, resilience-related concepts were reflected across several major research themes. These included disaster preparedness, public health communication, emergency management, and mental health. These themes are important components of community resilience in the context of wildfire risk [10]. Recent research also shows that wildfire resilience is shaped by social, economic, and environmental factors [16]. The temporal analysis showed a shift toward preparedness, climate change, and environmental exposure. This shift suggests a growing focus on resilience-oriented approaches. Overall, the findings indicate that community resilience is addressed through an integrated and multidisciplinary framework rather than as an independent research theme.

Overlay analysis revealed a gradual shift in research priorities from immediate disaster response toward preparedness- and resilience-oriented approaches. Earlier studies primarily focused on emergency response, risk assessment, and the acute consequences of wildfire exposure, whereas more recent research has increasingly emphasized preparedness, adaptation, and community resilience [2, 10, 17]. Similar trends have been reported in previous studies, which highlighted the growing importance of proactive risk reduction and community-based strategies in addressing escalating wildfire threats [10, 12]. Experiences from recent large-scale wildfire events have further reinforced the need to strengthen preparedness capacities and foster resilient communities capable of adapting to increasingly complex climate-related hazards [18]. Consequently, wildfire management is evolving from a reactive paradigm toward a more preventive and resilience-based framework [10, 19].

Another notable finding was the increasing prominence of mental health-related topics within the wildfire literature. The emergence of distinct clusters involving post-traumatic stress disorder, psychological stress, and depression suggests that the psychological consequences of wildfires have become a major focus of recent research. Previous studies have similarly demonstrated that wildfire exposure is associated with a wide range of adverse mental health outcomes, including anxiety, depression, post-traumatic stress symptoms, and prolonged emotional distress [20, 21]. Beyond the immediate impacts of disasters, growing attention has been directed toward the long-term psychological burden experienced by affected individuals and communities [22]. These findings underscore the importance of integrating mental health considerations into wildfire preparedness, response, and recovery strategies [20, 22].

The organizational collaboration patterns identified in this study indicate that the research network on wildfire preparedness and community resilience remains relatively centralized and structurally constrained. Despite an increasing number of contributing institutions, collaboration tends to cluster around a small group of highly productive organizations, while peripheral institutions maintain weak or indirect connections. Similar patterns have been reported in recent network-based studies, which show that disaster and climate-health research systems often exhibit hub-dominated structures with limited cross-cluster integration [23]. Such centralization may enhance short-term coordination but can reduce system robustness by increasing dependence on key nodes, thereby making the network more vulnerable to disruption [24]. Furthermore, evidence suggests that interdisciplinary and cross-sectoral collaboration between health, environmental, and emergency management institutions remains insufficiently developed, leading to fragmented knowledge exchange across domains[25]. Overall, these findings highlight that although scientific collaboration in this field is expanding, it is still characterized by uneven participation and limited structural integration, which may constrain the development of truly global and resilient research networks [23, 26].

Climate change has emerged as a dominant driver reshaping the epidemiology and spatial distribution of

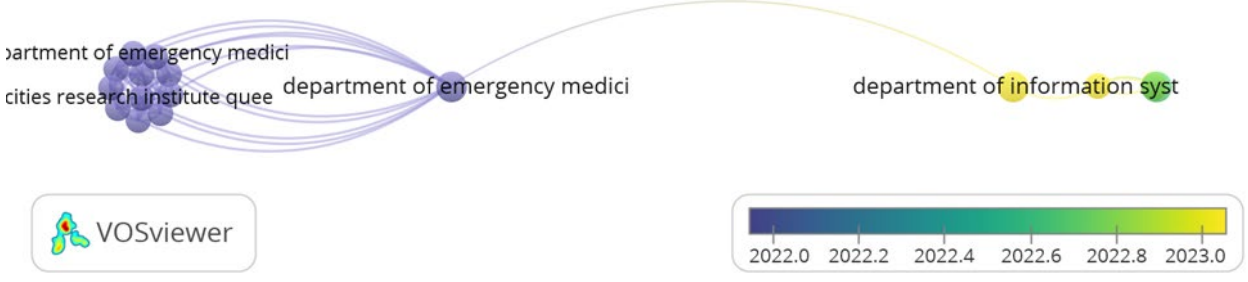

Figure 4: Overlay visualization of organizational co-authorship in wildfire exposure and human health research (1980–2026).

wildfire-related health risks. Increasing temperatures, prolonged droughts, and more frequent extreme weather conditions have substantially intensified wildfire activity, thereby amplifying population exposure to smoke and fine particulate matter (PM2.5). Evidence suggests that a considerable proportion of recent increases in burned area and smoke pollution can be attributed to anthropogenic climate change, highlighting its direct role in deteriorating air quality and health outcomes [27]. In parallel, wildfire-derived PM2.5 has been increasingly recognized as a major contributor to premature mortality and morbidity, with growing global burden estimates linking fire emissions to respiratory and cardiovascular outcomes [28]. This evolving evidence base has contributed to a conceptual shift toward a climate–health framework, in which wildfires are no longer treated as isolated environmental hazards but as climate-sensitive public health events embedded within broader socio-ecological systems [15]. Furthermore, recent projections indicate that continued warming may substantially increase wildfire smoke exposure and associated mortality burden in coming decades, reinforcing the need for anticipatory adaptation strategies rather than reactive disaster response [29]. Overall, the emergence of the climate–health paradigm reflects a fundamental transition from hazard-centric perspectives to integrated systems-based approaches for managing wildfire-related health risks.

Future research should prioritize strengthening interdisciplinary collaboration between public health, environmental sciences, and disaster risk management to address the current fragmentation in the field. In addition, more geographically inclusive studies, particularly from low- and middle-income regions, are needed to improve the global representativeness and practical relevance of wildfire health research.

This study presents a methodologically robust bibliometric analysis of health-related wildfire research, with a focus on preparedness and community resilience. The application of multiple complementary bibliometric techniques further strengthens the analysis by capturing both intellectual structures and collaboration patterns, while temporal visualization enables the identification of evolving thematic trends, particularly the shift toward a climate–health and resilience-oriented framework.

However, the study is limited by its exclusive reliance on PubMed, which may introduce disciplinary bias by underrepresenting environmental and interdisciplinary research indexed in databases such as Scopus and Web of Science. In addition, bibliometric methods are sensitive to variations in terminology and indexing practices, which may affect network accuracy and coherence. Finally, network-based indicators reflect relational structures rather than research quality or causal influence, and the cross-sectional design does not fully capture the rapidly evolving nature of this field.

Conclusion

This bibliometric analysis identified major trends in research on wildfire preparedness and health. The findings showed a strong interdisciplinary focus on wildfire exposure, health outcomes, disaster preparedness, mental health, environmental risks, and public health communication. The research landscape also shifted from emergency response toward preparedness, climate-related risks, and adaptation. Community resilience did not emerge as a distinct dominant cluster. However, resilience-related concepts were reflected across several major research themes. These included preparedness, communication, emergency management, and mental health. This pattern suggests that resilience is increasingly addressed as part of an integrated wildfire preparedness framework. Future research should further examine community resilience as a multidimensional outcome. Greater collaboration across public health, environmental sciences, disaster management, and community-based research is also needed. Such approaches may support more effective preparedness and resilience to the growing health impacts of wildfires.

Acknowledgments

The authors acknowledge the use of ChatGPT5.6 (OpenAI) solely for language editing and grammatical proofreading. No external funding was received for this study. The authors take full responsibility for the content and interpretation of the manuscript.

Authors contribution

MSh: conceptualized the study, designed the methodology, conducted the formal analysis, and drafted the original manuscript. KhZ: conceptualized the study, supervising the project, reviewing and editing the manuscript. AB: Writing – Original Draft, Data Analysis and Data Collection. MN: literature search and preparation of the initial draft of the manuscript. All authors reviewed, revised, and approved the final version of the manuscript.

Funding Statement

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Competing interests

The authors declare that they have no competing interests.

Ethical Considerations

Ethical approval was not required because this study used only publicly available bibliographic data and involved no human participants or identifiable personal information.

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