



# Exposure and health: A progress update by evaluation and scientometric analysis

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## Abstract

Several hands are now working worldwide to reduce exposure to air pollution, especially in developing nations. Future steps should be determined and classified as possible research solutions and gaps from the massive bulk of research output. Therefore, a scientometric approach has been applied using VOSviewer to show an accurate picture and trend in the mentioned area “Air pollution exposure and health,” and its signify issues. According to the proposed study, complete 26,859 documents were retrieved from the database (ISI Web of Science) related to air pollution exposure and health effects during 2018–2022. The mapping analysis is been conducted on the country’s collaboration, co-authorship, institutional collaboration, and co-occurrence of keywords. The data collected shows the information about published articles (upward trend) over the years. Based on the citations and publication database, countries like China and the USA play a prominent role in air pollution exposure and health-related research. The study clearly defines the 3 domains of research and 4 major themes that have been currently focused. The case studies related to pollution and its impact on climate and health, studies involving chemical characteristics and management practices, also Hazardous health effects, theme like association of air pollutants, chemical composition and characterization of aerosols, health impacts due to exposure and modelling and analytical approach have been the most researched topics in the past 5 years. The developing and developed countries might potentially change the research network and work structure in order to obtain advancement in the field of Air pollution and enhance measures on exposure and health. The following research attempts to provide insights to the researchers and health sectors by straightening out developments up to date and raveling the research gaps that are needed to be addressed regarding Air pollution health and exposure.

**Keywords** Air pollution · Exposure · Health · Developing countries · VOSviewer · Scientometric

## 1 Introduction

Maximum countries of the world are developing a policy on society’s quality of life (Meira et al. 2020). Industrialization and urbanization result from these efforts, which are responsible for energy consumption and waste generation that will increase the severe environmental issues, especially deterioration of air quality. On the other hand, developing countries face a total concentration of air pollutants due to the unplanned rapid growth of industrial activities with no rigid environmental rules and regulations (Fotourehchi

2016). Many researchers (Kumar et al. 2022; Gautam et al. 2020, 2022; Atash 2007; Sathaye et al. 1994; Faiz 1993) have noticed that the reason like an increased number of private vehicles, old vehicles without maintenance, poor fuel quality, unpaved road, or inadequate transportation/infrastructure in high-density areas like Calcutta, Beijing, Tehran, etc. Therefore, air pollution control is complex, with no rigid environmental regulations. Now, air pollution keeps its steps in every area like a food chain, climate change, and ecosystems and highlights its presence with various effects. Sun et al. (2017) found that air pollution, directly and indirectly, affects plant growth and food security for living things, respectively. A new trend in air pollution and epidemiological research is the relationship between air pollutants and the risk of diseases (i.e., air pollution and type 2 diabetes, air pollution and Parkinson’s, air pollution and incident chronic obstructive pulmonary disease, and air

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pollutants and respiratory issues) (Di et al. 2019; Hendryx et al. 2019; Liu et al. 2019; Kasdagli et al. 2019). According to published articles, it can easily understand that the impact of air pollution on developing countries is much higher than in developed nations, which affects the socio-industrial condition of developing countries.

Similarly, we can say that still the steps toward exposure to air pollution are scattered and vague in developing countries. Targeted policymaking can be feasible; it is necessary to clarify the trend of organized research work on air pollution with the cost of research and avoid repetitive work. Therefore, to investigate recent atmospheric problems and associated dynamic researchers in the field of air pollution exposure and health effects, providing the platform to scientists/researchers and policymakers to solve the problems related to exposure to air pollutants is essential. A scientific review of articles published in recent years should first be undertaken to provide a theoretical basis and determine the practical directions for controlling air pollution or reducing exposure in developing countries. Although many studies have already been reported on air pollution, sampling, and strategies for monitoring, different sources, and related health impact; however, no Scientometric articles have been found on the air pollution exposure and health (Feng et al. 2020; Idrees and Zheng 2020; Yang et al. 2020; Wang et al. 2019) suggested scientometric review as a reliable and valuable method for visualizing the scientific research pattern and getting scientific outputs. Here, the presented techniques highlight research insights by using the output of publications (i.e., authors, countries, keywords, citation and co-citations, and collaboration to enhance research on scientific platforms. Many researchers (Li et al. 2018; Sweilesh et al., 2018; Song et al. 2020) are now focusing on scientometric studies to explore the area of air pollution (i.e., haze particles, air pollution, respiratory health, air pollution & human health, and gaseous pollutants, etc. The present work aims to the bibliography and scientometric analysis of the research articles in air pollution exposure and health field to equip the researchers from institutes and industries with a platform of their interest and relevant research fields. Bibliography or scientometric analysis would provide the exact sketch of necessary research articles for their research in their desired arena either it can study the exposure of air pollution or the sampling techniques, not in the field of air pollution but in various fields of their interest using software like VOSviewer. Commendable and extensive studies have been widely employed using bibliometric analysis like Ranjbari et al. 2022a; Ranjbari et al. 2022b; Ranjbari et al. 2022c; Ranjbari et al. 2022d, their research has encouraged the quality of review papers by implementing these techniques to provide a new dimension in the systematic reviews. Based on the personal opinion and the authors;

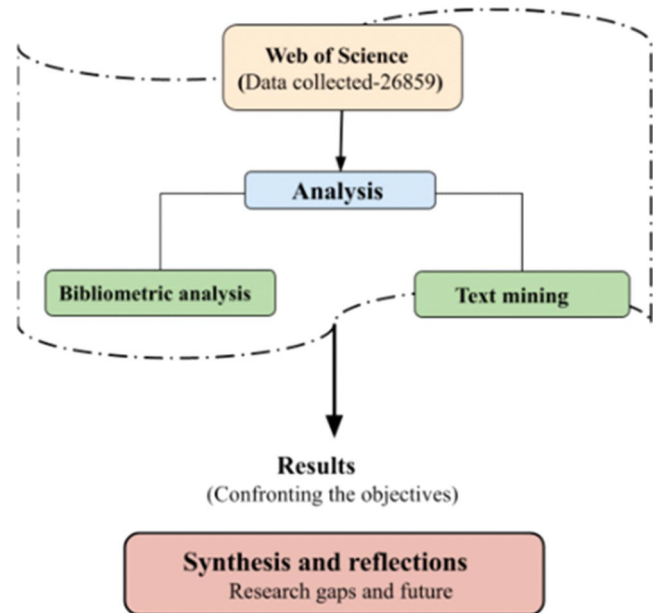


Fig. 1 Framework of the research

best knowledge, the presented work is the first approach to applying scientometric methods to air pollution exposure and health. The authors review the progress of air pollution sources and their possible effects on human health in the study. Moreover, the authors investigated the critical environmental conditions that affect source and level of concentration and the techniques for source apportionment. The study and outcomes introduce the future perspective on air pollution exposure and health based on their current status.

## 2 Methodology

This research analysis incorporates a bibliography and transforms the texts into structured formats to find new insights (Ranjbari et al. 2021, 2022a). The concept of mapping and estimating the area of air pollution in the branch of health and exposure is followed by a study that is divided into bibliometric analysis and text mining, which also includes bibliographic coupling (Ranjbari et al., 2022; Esfandabadi et al., 2022) The articles collectively gather to form various clusters based on the similarities by references that are cited. Text mining analysis is validated to uncover diverse themes in this field of air pollution concerning health and exposure. The extracted datasets are mined by excluding the nouns used by the researchers/authors. The co-occurrence linkages later cluster the abstracts and titles of the articles and later form different themes for discovery (Waltman et al. 2010). Eventually, the outputs would highlight it needs to focus on the area of air pollution and provide insights on atmospheric

**Table 1** Steps of the data collection process

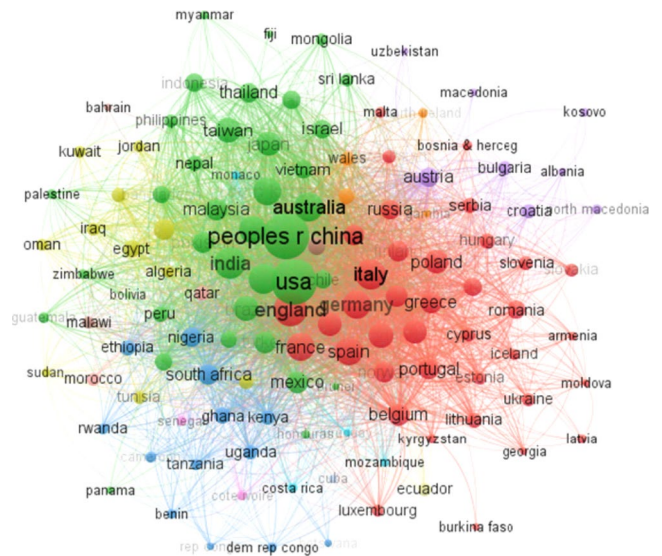
Search string	“Air Pollution” “Chemical Characterization” “Health-Exposure” or “Air Pollution-Chemical Characterization” or “Air Pollution-Health” or “Air Pollution-Exposure “ and “Exposure”
Fields mined	Article Titles, Abstracts, Author Keywords
Database	Web of Science
Final sample	26,859 articles
Search date	March 8,2022
Inclusion	Journals and review articles

complications caused in health due to exposure. Figure 1 represents the research structure for this study.

A systematic review requires a well-structured arrangement of desired literature of relevant research (Chaudhary et al. 2021), therefore strings used to construct are different pools of keywords “air pollution”, “chemical characterization”, “health “and “exposure” as they fabricate the skeleton of the present review. The data extracted from ISI Web of Science, also known as Web of Knowledge, as it contains a directory of bibliographic citations for versatile fields (medical, humanities, scientific and social sciences(citing web of science)) database involved search strings like “Air Pollution -Chemical Characterization-Health-Exposure” or “Air Pollution -Chemical Characterization” or “Air Pollution-Health” or " Air Pollution - Exposure” and Exposure. After all, the research objective is to consider the related works in Air pollution& health and exposure. In the final data sampled from 2018–2022, around 26859 documents were retrieved, these data were stored in batches of 105 plain text formats. The data collected were scrutinized by selecting the reliability conditions, peer-reviewed articles, conference proceedings, editorial notes, book chapters, and materials apart from English were factored out. Table 1 abridges the steps carried out to attain the final sample.

### 3 Scientometric analysis

Evaluating the factual production statistically and mapping the research structure is done by bibliometric analysis. It achieves various interpretations by linking articles, journals, authors, keywords with co-citations, and co-occurrences networks (Feng et al. 2017), which can aid future trends and directions. VOSviewer (1.616) was used to perform this analysis adopted by Van Eck and Waltman (2010). The geographical distribution of publications, productivity, and influence of the author working in the field of air pollution, health and exposure, keyword analysis is followed to discover hotspots for the research liabilities and main journals publishing research articles in this field. Data cleaning is performed usually as it removes the redundant keywords like plural words and singular words, short forms and complete

**Fig. 2** Co-authorship Networking on Air pollution, Exposure and Health

forms are merged, etc., to arrive at the accurate occurrences of the keywords used by authors. The manuscripts’ titles and abstracts have been extracted and text mined; this is one of the indicators coined with the algorithm to follow the co-occurrences. Data cleaning is also carried out before the text mining analysis. These indicators give various clusters and patterns related to the themes generated after the analysis of air pollution concerning health and exposure.

## 4 Results and discussion

This section will discuss the results of both analyses which will confront the research questions.

## 5 Geographical distribution of publications

The sample is geographically and spatially disseminated, to provide information on the leading countries contributing in the field of air pollution, health, and exposure. One hundred twenty-four countries have been part of the co-authorship network out of 169 countries that have published articles in this field. Figure 2 traces the co-authorship networks to the countries, the size describes the node quantity of published articles in that particular country, and the links based on the thickness evaluate the strength between each pair based on co-authorship. Tables 2 and 3 represent the top 10 countries concerning collaborating countries, published articles, and the overall co-authored articles and their citations. This is understood by noting the number of links and total link strength between each node pair.

**Table 2** Top 10 countries in terms of overall published articles and number of co-author countries

Rank	Articles published (Number of Articles)	Number of co-author countries (Number of countries)
1	China (8239)	USA (116)
2	USA (7444)	England (110)
3	England (2022)	Germany (102)
4	Italy (1399)	France (100)
5	Canada (1198)	China (96)
6	Germany (1091)	Italy (92)
7	Australia (1195)	India (92)
8	India (1520)	Spain (92)
9	Spain (984)	Canada (91)
10	France (977)	Australia (91)

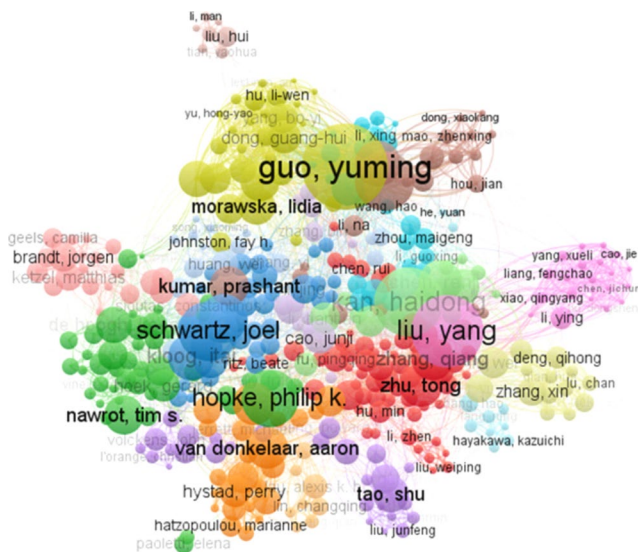
**Table 3** Top 10 countries in terms of overall co-authorship and citations number

Rank	Total co-authorship (Number of co-authorship)	Citations (Number of citation)
1	USA (7571)	China (95,351)
2	China (5431)	USA (91,187)
3	England (4546)	England (31,197)
4	Germany (2646)	Italy (18,279)
5	Italy (2264)	Canada (17,914)
6	Australia (2212)	Germany (17,857)
7	France (2205)	Australia (17,311)
8	Spain (2084)	India (14,494)
9	Canada (1950)	Spain (13,639)
10	India (1432)	France (12,596)

**Table 4** The most productive authors in air pollution health and exposure

Author name	Author	Articles	Citations	Co-author	Total co-authorship
Guo, Yuming	Dr. Yuming Guo	157	2524	99	867
Liu, Yang	Dr. Yang Liu	131	2462	84	407
Kan, Haidong	Dr. H. Kan	127	1868	107	523
Li, Shanshan	Dr. Shanshan Li	108	1880	67	607
Schwartz, Joel	Dr. Joel Schwartz	108	1673	45	242
Hopke, Philip K.	Dr. Philip K. Hopke	105	1449	23	95
Chen, Gongbo	Dr. Gongbo Chen	84	1537	67	594
Brauer, Michael	Dr. Michael Brauer	78	1718	57	177
Zhang, Qiang	Dr. Qiang Zhang	78	1450	41	217
Van Donkelaar, Aaron	Dr. Aarom Van Donkelaar	77	1612	73	406

116 countries and 7571 collaborations and ranks second with 7444 articles published in the area of air pollution, health, and exposure. England ranks third in collaboration, citation, and articles published (31,197 citations 4546 collaboration, 2022 articles), and second rank in co-author countries. Countries like Italy, France, Germany, India, Canada, Spain, and Australia have also been ranked after China, The USA, and England in the top 10 countries in all four categories.



**Fig. 3** Network Visualization of most influential authors

As noticed in Table 2, China has the highest number of articles published and cited with 8239 articles and 95,351 citations. The USA has the highest co-author countries with

## 6 Authors' productivity and influence

### 6.1 Most productive author

In an academic field, research authors engage in assessment development (Guo et al. 2021). A total of 90,343 authors have contributed to the research in this field of air pollution considering health and exposure, among which 1000 authors contributed at least five articles. Table 4 lists the most productive and Table 5 list the most influential authors.

The authors who have contributed the highest number of articles are considered the most productive authors in our dataset. Similarly, the authors whose articles have been cited the most are considered the most influential authors



**Table 5** The most influential author in air pollution health and exposure

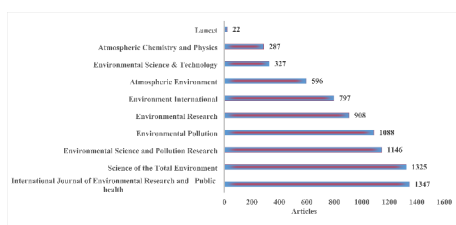
Author name format in VOSviewer	Author	Citations	Article	Co-author	Total co-authorship
Guo, Yuming	Dr. Yuming Guo	2524	157	99	867
Liu, Yang	Dr. Yang Liu	2462	131	84	407
Li, Shanshan	Dr. Shanshan Li	1880	108	67	607
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visualization of the top 1000 authors and their spatial distribution based on their number of citations and co-authorships.

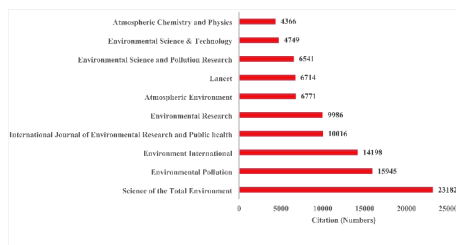
### 6.2 Most influential authors

### 6.3 Core journals

The articles which deal with air pollution, health, and exposure within our dataset are 26,859 and 651 journals have published these articles. This collection of journals has published at least five articles from our dataset. Figures 4 and 5 emphasize the top 10 journals that have most published articles and most cited articles in the particular journals. The figures provide the line graphs to understand the different journals and their number of publications and articles cited the most. *International Journal of Environment Research and Public Health* has the highest number of published articles i.e. 1347 marking the top as being the most productive journal, *Science of The Total Environment* journal has the highest citation numbers i.e., 23,182 securing the most influential journal in terms of the number of citations by their articles. There is no significant gap between the *International Journal of Environment Research and Public Health* and *Science of The Total Environment* in terms of productivity. The other productive journals like *Environmental Science and Pollution Research* and *Environmental Pollution* have published 1146 and 1108 articles. Based on citations the second most influential journal is *Environmental Pollution* having 15,945 citations, followed by 14,198 citations from *Environmental International* respectively.



**Fig. 4** Top productive journals in terms of published articles



**Fig. 5** Top influential journal in terms of the number of citations in the article

with their co-authors and co-authorships. Yuming Guo is the most productive and influential author among 90,343 authors from our dataset. Figure 3 represents the network

## 7 Articles

This section is concerned mainly with analysis conducted for articles citations and bibliographic coupling.

### 7.1 Influential articles

The articles are often cited related to the research field. Hence it is considered an influential article (Merigó et al. 2015). Table 6 represents the top 10 highly cited articles within this field of air pollution, health, and exposure. The table lists two papers with 235 citations in the 8th and 9th positions. Landrigen et al. (2018) demonstrated the research on pollution and its chemical and biological contamination in air and water impacted health like chronic diseases like cancers, diabetes, and heart diseases, as well as endocrine disruptions and neuroendocrine disorders in humans with other such reasons like premature deaths of infants and complications during pregnancy, were discussed in this research

**Table 6** Top 10 highly cited articles in the field of air pollution, chemical characterization, health, and exposure

Rank	Author	Title	Journal	Citation
1	Landri-gen et al. (2018)	The Lancet Commission on Pollution and Health	The Lancet	1419
2	Burnett et al. (2018)	Global estimates of mortality associated with long term exposure to outdoor fine particulate matter	Proceedings of National Academy of Sciences of The United State of America	685
3	Rajagopalan (2018)	Air pollution and cardiovascular disease jack state of art review	Journal of the American college of cardiology	322
4	Lelieveld et al. (2019)	Cardiovascular disease burden from ambient pollution in Europe reassesses using novel hazard ratio functions	European heart journal	318
5	Ferronato & Torretta (2019)	Waste mismanagement in developing countries: a review of global issues	International journal of environmental research and public health	309
6	Ann (2019)	Severe haze in northern China: a synergy of anthropogenic emissions and atmospheric processes	Proceedings of the national academy of sciences of the united states of America	306
7	Kalpana Balakrishnan (2019)	The impact of air pollution on deaths, disease burden and life expectancy across the states of India: the global burden of disease stud	The Lancet Planetary Health	236
8	Wu (2020)	Air pollution and covid – 19 mortality in the United States, strengths and limitations of an ecological regression analysis	Science Advances	235
9	Coccia (2020)	Factors determining the diffusion of covid – 19 and suggested strategies to prevent future accelerated viral infectivity similar to covid	Science of total environment	235
10	Huang (2018)	Health impacts of Chinas air pollution prevention and control action plan: an analysis of national air quality monitoring and mortality data	Lancet planetary health	217

article published by *The Lancet*. This article recorded the

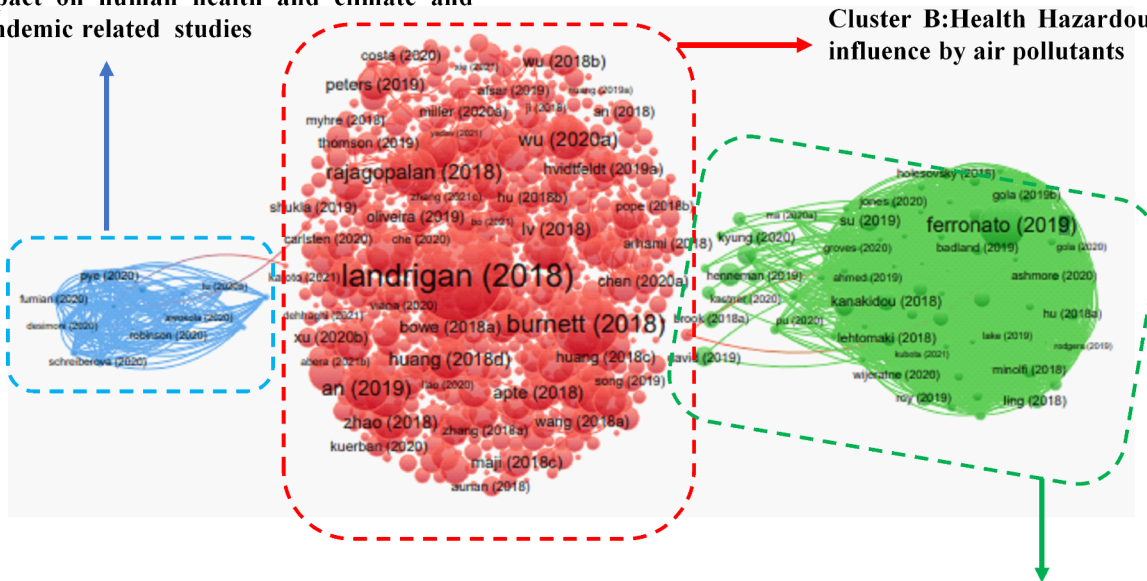
highest cited article within our dataset with 1419 citations and earned the most influential article among 400 selected articles out of 3679.

Burnett et al. (2018) focuses on the global health concerns that dealt with exposure to outdoor fine particulate matter by studying mortality risk factors by using GEMM (Global exposure Mortality Model) to predict and compare the risk functions when exposed to PM<sub>2.5</sub> at higher concentrations. This article has the second-highest citations with 685 and it's been published in *Proceedings of the National Academy of Sciences (PNAS)* a peer-reviewed journal. The highly influential article (Rajagopalan et al. 2018) which has 322 citations, emphasized air pollution as a major reason for environmental risk factors that causes disability, global cardiovascular mortality based on long-term exposure, and short-term exposure to the fine particulate matter. This article was published in *Journals of the American College of Cardiology*. The other articles by Lelieveld et al. (2019) also focus on GEMM (Global exposure Mortality Model) to discuss coherent studies that require reevaluation of disease burden by understanding the reduction of life expectancy caused by air pollution, the following article has 318 citations and is the fourth influential article in our dataset. Ferronato & Torretta (2019) indicated their views about the crucial influence of mismanagement of waste and major health issues due to the pollutant emissions by water soil and air contamination which are the medium to spread disease when not disposed of treated, and managed properly. This article is published in the *International Journal of Environmental Research and Public Health* with 309 citations. Wu et al. (2020) studied the probabilities of long-term exposures to air pollution that increased the complications in health and mortality due to COVID-19, with 235 citations and is published in *Science Advances*. Coccia (2020) also have 235 citations, the research focuses on the industrial pollution that triggered the viral infectivity by the human transmission of COVID-19 from long-term exposure to PM<sub>10</sub>. Overall, articles discuss air pollution and its exposure affecting health. Highlighted influential articles have been published in significant journals with high impact factors. These articles are cited every day as contributing studies related to awareness and opening new areas of research that can reduce and control these effects on the environment and human health.

## 8 Bibliographic coupling of articles

Bibliographic coupling of articles is performed to find admissible categories and prime themes in Air pollution associated with Health and Exposure based on their shared references. Of 26,859 research articles, 400 articles were

**Cluster A : Case studies of different countries affected by pollution and its impact on human health and climate and pandemic related studies**



**Cluster B: Health Hazardous that have influence by air pollutants**

**Cluster C: Chemical composition and management practices of aerosols and particulate matter.**

**Fig. 6** Bibliographic coupling of the articles within the field of air pollution, chemical characterization, health, and exposure

**Table 7** Top 5 articles based on Case studies and Pandemic related articles

*Research Category A: the case studies of different countries affected by pollution and its impact on human health and climate and pandemic related studies*

References	Article citation
Pye & Nenes (2020)	10
Fumian (2020)	9
Robinson et al. (2021)	6
Lee (2020)	6

**Table 8** Top 5 articles based on Health Hazards influenced by air pollutants

*Research Category B: Top 5 articles based on the health hazards that have a direct influence by air pollutants*

References	Article citation
Landrigan et al. (2018)	1419
Rajagopalan (2018)	322
Wu (2020)	235
Huang (2018)	217
Zhao (2018)	156

selected with at least one common reference to each other. Figure 6 conceptualizes three main clusters.

The blue cluster represents the case studies of different countries affected by pollution and its impact on human health and climate and pandemic-related studies. The red cluster represents the health hazards that directly influence

**Table 9** Top three articles on chemical composition and management practices of aerosols and particulate matters

*Research Category C: Top three papers based on Chemical composition and Management practices of aerosols and particulate matters.*

References	Article citation
Ferronato & Torretta (2019)	309
Kanakidou et al. (2018)	40
Su (2019)	39

**Keyword Analysis: Research tendencies and hotspots**

air pollutants. The green cluster deals with the articles that deal with chemical compositions and management practices to control these effects of pollution; safety policies, pollution prevention, and pollution mitigation is highlighted. The intersecting outlines describe the incorporation of two major themes. The size of the links denote the number of citation, the size of the bubbles demonstrates the co-occurrences between the pairs —Tables 7 and 8, and Table 9 list each theme’s top 5 highly cited articles. Few studies (Pye & Nenes, 2020; Fumian, 2020; Robinson et al., 2021) from the blue clusters (Cluster A) have been the major papers in this research category research area during the pandemic based on health and environment. Pye & Nenes (2020) suggested the atmospheric acidity of particles and clouds and its impacts on human health by providing new model calculations. Fumain (2020) discussed the research is about





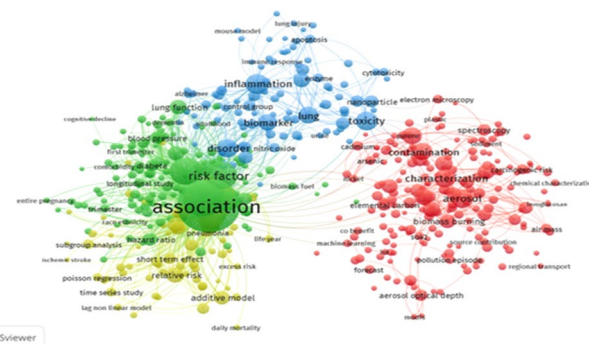
**Table 11** The most frequent pairs of author keywords consider air pollution as the pivotal keyword

Keyword 1	Keyword 2	Frequency
Air pollution	Particulate matter	763
Air pollution	PM2.5	269
Air pollution	COVID-19	229
Air pollution	Mortality	191
Air pollution	Asthma	176
Air pollution	Ozone	166
Air pollution	Air quality	126
Air pollution	China	125
Air pollution	PM <sub>10</sub>	119
Air pollution	Environment	104
Air pollution	Oxidative stress	103
Air pollution	Indoor air quality	28
Air pollution	Fine particulate matter	17
Air pollution	Pollution	8

**Table 12** The most frequent pairs of author keywords excluding Air pollution

Keyword 1	Keyword 2	Frequency
Chemical Composition	PM 2.5	19
Chemical Composition	Source Apportionment	14
Chemical Composition	Particulate Matter	11
Chemical Composition	PM <sub>10</sub>	10
Health	Air Pollution	77
Health	Environment	32
Health	Air Quality	27
Health	Pollution	20
Health	Climate Change	18
Health	Particulate Matter	17
Health	Mortality	13
Health	China	11
Health	Exposure	10
Health	Urban	10
Health	Policy	8
Health	Emissions	8
Health	Climate	8
Exposure	Air Pollution	63
Exposure	PM2.5	31
Exposure	Particulate Matter	29
Exposure	Air Quality	18
Exposure	Black Carbon	13
Exposure	Indoor Air Quality	11
Exposure	Children	11
Exposure	Asthma	11
Exposure	Mortality	9
Exposure	Traffic	9
Exposure	Public Health	9
Exposure	Health Risk	8
Exposure	Indoor	8
Exposure	Health Risk	8
Exposure	Ozone	8
Exposure	Health Risk	8

of the most frequent pairs of keywords without taking air



**Fig. 8** The network display of prime studies carried out inside air pollution, health and exposure categories

pollution keywords into account, Table 12 lists chemical composition, health, and exposure keywords that are linked with their most frequent keywords. Chemical composition has most occurrences with PM<sub>2.5</sub>, source apportionment, particulate matter, and PM<sub>10</sub> by 19, 14, 11, and 12. Health and Exposure have the keyword “air pollution” as the most frequent pair with 77 and 63 occurrences. These keywords are in queue with the bibliographic coupling analysis.

### 9 Text mining results

Text mining is performed on the 26,859 collected articles from the Web of Science to identify the various research themes. Before the data cleaning, there were 359,922 noun phrases discovered, since the large dataset, the minimum occurrences of each term is selected to 35 and 2395 meet the threshold. For each of 2395 terms, a relevant score was calculated for 60% most relevant terms. After data cleaning, 800 noun phrases were selected, the total collected data collected, unrelated nouns like repetitive abbreviations were manually unchecked from the list, and the rest remained to build the clusters based on the co-occurrences of the terms to unfold the research themes. The four major themes that have been identified are.

1. Associations of air pollutants and their risk factors on health and the environment,
2. Chemical Composition and Characterization of aerosol and fine particulate matter,
3. Human Health effects due to air pollution and exposure, and.
4. Modeling and Analytical approaches to reduce and eradicate the effects of air pollution.

Figure 8 represents the thematic diagram for air pollution, health, and exposure. Similar to Fig. 6 as seen in (bibliographic coupling) the larger the circles and the links between the pairs show the highest co-occurrences based on

their occurrences respectively. The green cluster has main research themes based on the terms association, risk factor, lung function, and blood pressure. Blue cluster has the main terms as inflammation, disorder, biomarker, and toxicity. A short-term effect, relative risk, pneumonia, and additive model as its major terms presented in the yellow cluster. The red cluster has main terms like contamination, characterization, and aerosol as research areas.

These research themes are based on the association of air pollution, Chemical composition of aerosol, and fine particulate matter. Human health and effects due to air pollution and exposure, validation of modeling and analytical approaches to reduce, control and measure the effects of air pollution caused by long-term or short-term exposure on human health and the environment. The direct and indirect association with the contaminated air leads to a high risk of health degradation (Weichenthal et al. 2014). Some studies have been published on the effects of air pollution resulting in respiratory and cardiovascular issues (Strak et al., 2010). Health risks have been countered due to an increase in air pollution exposures irrespective of sources. PM<sub>2.5</sub> exposures lead to neutrophilic pulmonary inflammation and oxidative stress in adults. O<sub>3</sub>, PM<sub>2.5</sub>, NO<sub>x</sub>, and black carbon are some specific residence-specific air pollutants; their higher concentrations are modeled to monitor their effects from the late 90s. They mainly contribute to worsening lung health and obstruct airflow flowed by an increase in mortality ratios. The immune system is also at risk at the molecular stage due to environmental pollution.

Their research area focuses on PM<sub>10</sub> having a positive association with autoimmune diseases, stating a risk of 7% is by an increase in 10 µg/m<sup>3</sup>. Risk of rheumatoid arthritis, an increase in PM<sub>2.5</sub> exposure leads to inflammatory bowel diseases and connective tissue diseases (Adami et al., 2022). Air pollution exposure leads to respiratory or chronic diseases and disorders like psychiatric and schizophrenia, and depression. Residential air pollution is evident to cause mood disorders (Newbury et al., 2021). The cardiac functionality is caused by the variations in the bloodstream by the long-term exposure to ultrafine particles found in the bloodstream. Coronary arteriosclerosis is also reported due to pollutants released due to traffic emissions (Hoffmann B 2007). Exposure due to NO<sub>2</sub> reports ventricle hypertrophy in human beings. While short-term exposure leads to stroke and myocardial infarction. Based on these organic aerosols' chemical and biological composition, the carcinogenic properties impact deterioration of health in all age groups, especially in infants and pregnant women. To understand the complexity of these pollutants biomarkers are introduced. Biomarkers unravel the complex relationship between air pollutant exposure and respiratory health issues. Nonetheless, the individuality of the air pollutants is complex and

distinctive based on their inorganic and organic nature; their effects on health are tedious and vigorous to be discovered. Sometimes due to the weather conditions and traffic density, the variability of pollutants causes complex scrutiny by biomarkers (Suhaimi and Jalaludin 2015). Global warming and climate shifts also instigate the situation. Additive models like generalized additive models and many more are used to measure and analyze air pollutants' long-term and short-term effects. Therefore, the intention to understand the leading themes in air pollution, health and exposure are research areas that deal with studying the exposure levels of resident pollutants and the effects of those pollutants on human beings. These cited articles provide remarkable approaches and reviews to measure, analyze, and control these effects of pollutants on human health and the environment. The future aspect of the study relates that air pollution and health as a merging research area and certain relevant studies have not been clear about the severity and need to explore in these domains. Even though there is commendable research done by the researchers over the past years yet the need for the latest sampling techniques, physical, chemical characterization and its impacts on health and environment, control and measure, and management strategies are some categories that have to be explored more, invested and mitigated. Our study attempted to find these research gaps to address the main research areas, authors working in this area, type of journals that have been published in these field-related articles, hotspots in these 5 years by analyzing the keywords, and lastly understanding the 3 domains in the field of air pollution related to health and exposure causing scientist and researchers to have a elucidate study for their reference.

## 10 Conclusion

This study attempted systematic evaluation and scientometric analysis of air pollution, health, and exposure by referring to 26,859 research articles from the Web of Science. The result is mapped by using scientometric analysis which includes (i) the geographical distribution of publications; (ii) authors' influence and productivity; (iii) influential articles; (iv) bibliographic coupling of articles; (v) keyword analysis; and (vi) text mining. In the bibliographic coupling of articles three different clusters are identified related to the case studies of different countries affected by pollution and its impact on human health and climate and pandemic-related studies, the second cluster was about the health hazards and the last cluster was based on chemical composition and management practices. The research themes and areas of research are mostly on the associations and risk factors based on the resident pollutants, the effects of the pollutants on human beings, and modeling and analyzing long-term

and short-term effects of air pollution. Few research articles talk about the environmental degradation that impacts health by air pollution. The overall understanding of this research was to learn the areas covered in air pollution about health and exposure, with this outcome, one could understand the need for research in this domain. The themes that are emerging in this field but lack evident studies to impose the need to work in this arena. Our study unraveled 4 themes that are falling in the above criteria are associations of air pollutants and their risk factors on health and the environment, chemical composition and characterization of aerosol and fine particulate matter, human health effects due to air pollution and exposure, and modeling and analytical approaches to reduce and eradicate the effects of air pollution. There are limited studies to outline these direct influence of exposure to pollutants and knowing that modern lifestyle and industrialization are one of the major links for daily deaths. This has an indirect effect on the economy and welfare of the country. Specific studies cannot provide definite conclusions because of the unavailability of data due to negligent behavior by the management.

Moreover, essential preventive measures are not fully applicable in low-income countries, and providing health care equally is nearly impossible. There are some limitations to our research. We considered only the Web of Science database; assimilating Scopus, data would enhance the reliability of the current research and extend the further findings. Secondly, as our search was constrained to five years of data, our research did not recognize prior work that would have the most outstanding research. Lastly, some non-English documents were removed from our research, which probably would have caused us to miss some specific research and practices in air pollution health and exposure.

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**Informed consent statement** Not applicable.

**Ethical approval** Not applicable.

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**Compliance with ethical standards** Not applicable.

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