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A mapping review of epidemiological evidence on outdoor air pollution and human health in Bangladesh

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Systematic Review

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Abstract

Background

Epidemiological evidence on the health effects of outdoor air pollution remains limited in low-income countries, particularly in Bangladesh. This study aims to systematically map the existing epidemiological evidence on the association between outdoor air pollution and human health outcomes in Bangladesh.

Methods

This mapping review followed established methodological guidelines for health science evidence mapping and was reported in accordance with the PRISMA. Literature searches were conducted in PubMed and Web of Science from database inception to 15 January 2026, using the Population-Exposure-Outcome (PEO) framework. Studies examining exposure to outdoor air pollution within epidemiological designs and conducted in Bangladesh were included.

Results

Of the 567 records identified, 11 studies met the inclusion criteria. The earliest eligible study was published in 2017, with no clear increasing publication trend through January 2026. Most studies were based on Dhaka city. $PM_{2.5}$ (particles that are 2.5 microns or less in diameter) was the most frequently assessed exposure, while cardiovascular and respiratory diseases were the most commonly reported health outcomes. Study populations included pregnant women, children, and adults. Cross-sectional and ecological designs predominated.

Conclusion

Most included studies examined short-term effects and consistently reported adverse health outcomes associated with $PM_{2.5}$ exposure. This mapping review highlights the limited but growing evidence base on outdoor air pollution and health in Bangladesh and may inform policy development, targeted public health interventions, and research funding priorities.

1. Introduction

Outdoor air pollution is a major modifiable risk factor for a wide range of respiratory, cardiovascular, and other health conditions, contributing to an estimated 8.1 million deaths globally in 2021 [1]. Key ambient pollutants include particulate matter (PM), ground-level ozone (O_3), carbon monoxide (CO), sulfur dioxide (SO_2), and nitrogen dioxide (NO_2), with fine particulate matter ($PM_{2.5}$, aerodynamic diameter ≤ 2.5 μm) receiving the greatest attention due to its strong association with adverse health outcomes. Recent years have witnessed substantial growth in research on the health effects of air pollution. A meta-analysis of 799 original epidemiological studies, predominantly conducted in Asia, Europe, and North America have reported that 95.2% of research demonstrated significant associations between air pollution and various health outcomes [2]. However, these findings cannot be fully generalized to low-income countries (LICs), where socioeconomic conditions, baseline health status, and exposure patterns differ substantially. Globally, LICs bear a disproportionate burden of air pollution, particularly from $PM_{2.5}$, yet high-quality epidemiological evidence from these regions remains limited [3].

This gap is evident in South Asian countries, especially in Bangladesh. Despite being consistently ranked among the most polluted countries worldwide, the health impacts of air pollution in Bangladesh are poorly characterized. $PM_{2.5}$ concentrations in the country have risen markedly between 2000 and 2020 across all 64 major cities, ranging from 55.1 to 159.4 μg/m³ in winter season which is 11 to 32 times higher than the World Health Organization Air Quality Guideline (annual mean ≤ 5 μg/m³) and 4 to 11 times above the Bangladesh National Ambient Air Quality Standard (annual mean ≤ 15 μg/m³) [4]. While numerous studies have assessed $PM_{2.5}$ exposure, source apportionment, and chemical composition using both ground-based monitoring and remote sensing, robust epidemiological evidence on population health impacts in Bangladesh remains scarce [5].

Therefore, to better understand the evolution of research in this field, it is essential to examine the characteristics of existing studies and the primary health outcomes associated with exposure to various air pollutants. In Bangladesh, no prior systematic synthesis of epidemiological evidence on air pollution exists. Mapping such evidence are critical to identify research gaps, inform future epidemiological studies, and guide evidence-based policy formulation and implementation. Mapping reviews are a valuable research tool for categorizing and visualizing existing literature, highlighting knowledge gaps, and directing further research efforts [6]. Accordingly, the aim of this paper is to systematically map and describe the characteristics of epidemiological studies investigating outdoor air pollution and related health outcomes in Bangladesh.

2. Methods

2.1 Guidelines

A systematic mapping review is one of the fourteen recognized review types within the broader family of systematic review research [7]. Unlike systematic reviews, mapping reviews do not typically include a formal quality appraisal of individual studies. Nevertheless, they play a critical role in identifying research trends, knowledge gaps, and evidence clusters, thereby informing future research directions, guiding funding priorities, and supporting evidence-based policymaking [8]. This review approach has been widely adopted in health sciences, where it is particularly useful for synthesizing large and heterogeneous bodies of literature [9]. Accordingly, this study employed a systematic mapping review to visualize and summarize the existing epidemiological evidence on the relationship between outdoor air pollution and human health in Bangladesh. The review followed a structured methodological framework consisting of three key stages including gathering, selection, and data extraction [7, 9].

2.2 Data sources and search strategy

The literature search was conducted using the PubMed and Web of Science databases, as these platforms are widely recognized and extensively used by researchers for health-related studies. The search was restricted to publications written in the English language. In PubMed, both Title/Abstract fields and Medical Subject Headings (MeSH) terms were employed during keyword development to ensure comprehensive coverage of relevant studies. The final search was completed on 15 January 2026. This review followed the PEO framework (Population, Exposure, Outcome) to structure the search strategy and guide study identification. Detailed descriptions of the key concepts and corresponding search terms are presented in S. Table 1.

2.3 Eligibility Criteria

Several general criteria were applied to screen articles for inclusion in this review. First, all included studies were required to be peer-reviewed and to employ epidemiological study designs with quantitative analyses. Studies investigating short- or long-term health outcomes associated with exposure to outdoor air pollution, regardless of pollutant type, were eligible for inclusion. All epidemiological study designs were considered. In contrast, systematic review articles addressing this topic were excluded. Studies focusing on indoor or household air pollution, as well as those examining industrial occupational exposure, were also excluded. Furthermore, multi-country study with pooled estimates were not taken into account. Additionally, studies centred on air pollution monitoring or health risk assessment using hazard quotient (HQ) approaches, without direct epidemiological health outcome analyses, were excluded. A comprehensive description of the inclusion and exclusion criteria is provided in S. Table 2.

2.4 Data Extraction and Analysis

The purpose of the data extraction was to systematically capture and summarize key characteristics of the included studies, rather than to synthesize effect estimates or assess study quality, consistent with the objectives of a systematic mapping review. Paper were extracted into an excel spreadsheet. For the analysis and discussion of the results, the following information was extracted from each included study: author(s), year of publication, study location, study design, study period, population characteristics, sample size, source of health data, type of outdoor air pollutants assessed, exposure assessment methods, statistical methods, health outcomes examined, time scale of exposure (short-term or long-term), and key epidemiological findings.

Developing the research questions (RQs) is one of the key methodological aspects of systematic mapping review [10]. Hence, the questions of this mapping review are:

RQ1. What is the temporal and spatial distribution of epidemiological studies on air pollution and health in Bangladesh?

RQ2. What air pollutants and health outcomes have been investigated in these studies?

RQ3. What are the main methodological characteristics of these studies (study design, exposure assessment methods, health data sources)?

RQ4. What associations between air pollutants and health outcomes reported in the existing epidemiological literatures?

3. Results

3.1 Literature Search

A total of 758 records were identified through database searching including 306 from PubMed and 452 from the Web of Science. After removing the duplicates, 567 unique articles remained and were screened based on their titles and abstracts according to predefined inclusion criteria. Following the screening process, 43 articles were deemed eligible for full text assessment. After applying the exclusion criteria to the full-text articles, 11 studies finally included in the mapping review (Fig. 1).

3.2 Research Question 1: Temporal and spatial distribution of epidemiological studies

The earliest study included in this review was published in 2017. Overall, no consistent temporal trend in publication volume was observed. The highest number of publications ($n = 3$) appeared in 2023, followed by two publications each in 2019 and 2025. Only one study was published in 2017, 2021, and early 2026, respectively (Fig. 2). Among the total

of 11 studies reviewed, the majority (n = 8) were conducted in the Dhaka region, while only three studies used nationally representative data.

3.3 Research Question 2: Investigated health outcomes and air pollutants

Of the 11 articles included in this review, nine focused specifically on particulate matter air pollution in Bangladesh, while two studies examined criteria air pollutants to assess the health impacts of air pollution. Across these studies, five broad categories of health outcomes were investigated. Respiratory outcomes were the most frequently examined, including chronic obstructive pulmonary disease (COPD), lung function impairment, and asthma. Cardiovascular disease (CVD) outcomes represented the second most commonly studied category; however, these analyses were limited to all-cause cardiovascular morbidity and mortality rather than cause-specific CVD outcomes. In the birth and pregnancy category, outcomes such as low birth weight and preterm birth were evaluated. Child growth and nutritional outcomes, including stunting and wasting, were assessed in one study. Additionally, one study examined metabolic outcomes, focusing on diabetes among adults.

Table 1
Investigated health outcomes and air pollutants category

Health Outcomes	Particulate Matter	Criteria air pollutants
Cardiovascular Mortality and Morbidity	3	-
Acute and Chronic Respiratory	4	-
Birth and Pregnancy	-	2
Child Growth and Nutrition	1	-
Metabolic	1	-

3.4 Research Question 3: main methodological characteristics

The study populations of reviewed evidence demonstrated considerable heterogeneity, encompassing pregnant women (particularly focusing on low birth weight and preterm birth), children, adults, and, in some cases, individuals across all age groups (Table 2). In terms of methodological approaches, most studies employed either cross-sectional or ecological designs, with a smaller number using quasi-experimental, time-series, case-crossover, or retrospective designs. Exposure assessment methods varied, with researchers using both ground-level monitoring systems and satellite-based measurements to estimate air pollutant concentrations. Notably, the majority of Dhaka based studies

relied on clinical data obtained from specialized hospitals and national health institutes, whereas nationwide studies predominantly used large-scale survey or modelled datasets.

Table 2
Methodological characteristics of selected publications

Author	Location	Population	Study design	Exposure measure	Health data sources
Brooks et al., (2023) [11]	Mirzapur, Dhaka	Adults and Children	Quasi-experimental	Low cost ground sensors	Household survey
Goyal and Canning (2017) [12]	Nationwide	Pregnant Women	Cross sectional	Satellite	DHS
Khan et al., (2019) [13]	Dhaka	Emergency Room Visits	Case-crossover	CAMS	National Institute of Cardiovascular Diseases, Dhaka
Nahian et al., (2023) [14]	Dhaka	Pregnant Women	Cross sectional	Air Quality Index (AQI)	Child Health Training Institute, Dhaka
Nayeem and Islam (2025) [5]	Dhaka	Not Specified	Ecological	CAMS	Medical college Hospitals in Dhaka
Partha et al., (2025) [15]	Nationwide	Pregnant Women	Ecological	Satellite	Global Burden of Disease 2019 ;Poverty Mapping of the World version 2.01
Rahman et al., (2021) [16]	Dhaka	All ages	Ecological time-series	CAMS	National Institute of Cardiovascular Diseases, Dhaka
Rahman et al., (2022) [17]	Dhaka	All category (0 to 50 + years)	Ecological time-series	CAMS	National Institute of Chest Diseases and Hospital (NICDH)
Rana et al., (2026) [18]	Nationwide	Adults	Retrospective study	Satellite and CAMS	DHS

Notes : CAMS = Continuous Air Monitoring Station ; DHS = Demographic Health Survey

Author	Location	Population	Study design	Exposure measure	Health data sources
Saira et al., (2019) [19]	Dhaka	School Children (9–16 years)	Cross sectional	Ground monitor	Spirometry Measure
Sherris et al., (2021) [20]	Dhaka	Children less than five years of age	Ecological time-series	Ground Monitor	icddrb surveillance data

Notes : CAMS = Continuous Air Monitoring Station ; DHS = Demographic Health Survey

3.5 Research Question 4: Associations between air pollutants and health outcomes

Across the reviewed studies, exposure to $PM_{2.5}$ consistently showed adverse effects on multiple health outcomes in Bangladesh (Table 3). Higher $PM_{2.5}$ levels were linked to substantially increased odds of COPD and respiratory symptoms among adults, greater respiratory emergency visits, reduced lung function indicators and a modest rise in pneumonia incidence following short-term exposure. Cardiovascular impacts were similarly pronounced, with $PM_{2.5}$ associated with higher risks of CVD mortality, increased emergency room visits, elevated hospitalizations and deaths at short time lags. Adverse birth outcomes were also evident, with air pollution linked to substantial numbers of preterm births nationally, as well as increased risks of low birth weight and prematurity. Additionally, long-term $PM_{2.5}$ exposure elevated the risk of stunting among children and was associated with a higher incidence of diabetes in adults, particularly those with obesity.

Table 3
Summary results of effects of air pollution on human health

Study	Outcome	Results
Acute and Chronic Respiratory		
Brooks et al., (2023) [11]	Respiratory	Higher $PM_{2.5}$ was associated with 2.23 times higher odds of COPD (95% CI: 1.15–4.33) and 4.2 times higher odds of respiratory symptoms (95% CI: 2.7–6.8) among adults.
Rahman et al., (2022) [17]	Respiratory Emergency visit	A 10-µg/m increase in PM2.5 was associated with a 0.84% rise in respiratory emergency department visits (95% CI: 0.33% − 1.35%).
Saira et al., (2019) [19]	Lung Function	An inverse association was observed, with both peak expiratory flow (PEF) and forced expiratory volume in 1 second (FEV) decreasing as $PM_{2.5}$ levels increased.
Sherris et al., (2021) [20]	Upper respiratory infection	Total $PM_{2.5}$ mass was associated with a modest increase in pneumonia incidence, with a peak effect two days after exposure (rate ratio = 1.032; 95% CI: 1.008–1056).
Cardiovascular Mortality and Morbidity		
Nayeem and Islam (2025) [5]	CVD deaths	A 10 µg/m increase in $PM_{2.5}$ concentration was associated with a 3.1% increase in CVD mortality at lag 0 (95% CI: 1.1% − 5.2%).
Khan et al., (2019) [13]	CVD Emergency Room visit	An IQR increase (103 µg/m3) in $PM_{2.5}$ at lag 3 was significantly associated with a 12% (RR: 1.12; 95% CI: 1.01–1.23) increase in CVD emergency room visits.
Rahman et al., (2021) [16]	All cause CVD mortality and morbidity	A 10-µg/m increase in $PM_{2.5}$ was associated with higher risks of cardiovascular emergency visits [0.27%, (0.07% − 0.47%)], hospitalizations [0.32% (0.08% to 0.55%)] at lag-0, and deaths [0.87%, (0.27% − 1.47%)] at lag-1.
Birth and Pregnancy		
Partha et al., (2025) [15]	Preterm Birth	CO, O3, $PM_{2.5}$, SO2, and NO_2 exposure combinedly caused 0.18–0.20 million preterm births yearly in Bangladesh.
Nahian et al., (2023) [14]	Low Birith Weight, Prematurity	For every 10,000 AQI value increase in cumulative exposure, low birth weight and preterm birth increased by 4% and 2%, respectively.
Child Growth and Nutrition		
Goyal and Canning	Stunting	Relative risks of stunting was 1.074 (95% CI: 1.014–1.138), 1.150 (95% CI: 1.069–1.237), and 1.132 (95%

Study	Outcome	Results
(2017) [12]		CI: 1.031–1.243) across the second, third, and fourth quartiles of $PM_{2.5}$ exposure, respectively.
Metabolic		
Rana et al., (2026) [18]	Diabetes	A 10 μg/m^3 increase in 3-year average $PM_{2.5}$ concentration (with a 1-year lag) was associated with a 10% higher risk of diabetes with a stronger effect observed among individuals with obesity.

4. Discussions

This study represents the first mapping review synthesizing epidemiological evidence on the health impacts of outdoor air pollution in Bangladesh. A total of 11 epidemiological studies were identified through searches in PubMed and Web of Science. The earliest available study was published in 2017, with no consistent trend in publication frequency over time. Most studies were Dhaka-centric, reflecting a substantial geographic imbalance in the evidence. $PM_{2.5}$ was the most commonly examined pollutant, and respiratory and cardiovascular health outcomes were the most frequently investigated across the included studies. Nearly all studies reported adverse associations between air pollution exposure and human health, though the majority focused on short-term effects. In terms of methodological design, cross-sectional and ecological studies predominated.

Compared with other South Asian countries, Bangladesh has far fewer epidemiological studies on air pollution and health [21]. Although global research in this field is growing rapidly, Bangladesh-specific evidence remains limited. Nevertheless, the findings from existing Bangladeshi studies are generally consistent with global patterns. A few multi-country longitudinal studies that included Bangladesh were not part of this review because they reported pooled or regional associations rather than Bangladesh-specific estimates. For example, a multi-country prospective cohort study including Bangladesh found that a 10 μg/m increase in $PM_{2.5}$ was associated with increased risks of cardiovascular events (hazard ratio 1.05 [95% CI 1.03–1.07]), myocardial infarction (1.03 [1.00–1.05]), stroke (1.07 [1.04–1.10]), and cardiovascular mortality (1.03 [1.00–1.05]) [22]. Similarly, an analysis of Demographic and Health Surveys from India, Pakistan, and Bangladesh (1998–2016) showed that each 10 μg/m increment in PM2.5 increased the odds of pregnancy loss (OR 1.03 [95% CI 1.02–1.05]) [23]. These broader findings align with the evidence observed in the Bangladeshi studies included in this review.

Despite these contributions, several important gaps have been identified in the current evidence. First, most studies relied on cross-sectional and ecological designs. While these provide useful snapshots of population-level or individual-level associations, they cannot

establish temporal relationships or causality. The lack of longitudinal and cohort studies limits understanding of how long-term exposure to air pollution contributes to the development of chronic diseases over time. This is particularly relevant in Bangladesh, where rapid urbanization, industrial growth, and high population density may result in cumulative exposure effects that short-term studies cannot capture. Second, almost all studies are conducted in urban centres, particularly Dhaka, limiting the generalizability of findings. Populations in other district cities, suburban areas, and rural regions are also exposed to significant outdoor air pollution from traffic, brick kilns, and biomass burning [24]. Assessing the health impacts across these diverse settings is crucial for developing national interventions. Third, investigations of vulnerable populations remain very limited. Most studies focus on the general population, with few examining children, the elderly, or individuals with pre-existing conditions. Notably, there are no studies assessing occupationally exposed groups such as outdoor workers, traffic police personnel, or street vendors, who are likely to experience higher levels of exposure and associated health risks. Fourth, the range of health outcomes examined is narrow. The majority of studies focus on cardiovascular and respiratory conditions, whereas global research increasingly documents associations between air pollution and broader outcomes, including DNA methylation, mental health disorders, neurodevelopmental effects, dementia, and autism spectrum disorder (ASD) [25–27]. Expanding the spectrum of outcomes studied in Bangladesh would provide a more comprehensive understanding of the population-level burden of pollution. Finally, there is a critical need to investigate long-term effects of air pollution on morbidity and mortality, particularly for chronic diseases. Evidence on long-term impacts is essential to inform public health policy, guide preventive strategies, and allocate resources effectively to reduce the burden of air pollution in Bangladesh. Without such evidence, policymakers and health professionals lack the information necessary to implement targeted interventions that protect vulnerable populations and mitigate adverse health effects.

The limited epidemiological evidence on air pollution and health in Bangladesh likely reflects structural and systemic constraints rather than a lack of scientific interest. First, Bangladesh does not have a nationally integrated disease surveillance system capable of linking environmental exposure data with individual-level demographic and social information [28]. In addition, the country lacks a complete and reliable death registration system. Policymakers therefore have limited access to accurate cause-of-death data for evidence-based decision-making. Studies show that only about 17% of adult deaths are registered in the civil registration system, and fewer than 36% are reported within the legally required timeframe [29, 30]. Although the Directorate General of Health Services (DGHS) collects hospital data, these records are typically aggregated and not consistently available across district-level hospitals, particularly outside major cities [5]. This makes it difficult to estimate population-level morbidity and mortality attributable to air pollution.

Air quality monitoring is another major constraint. In most district towns, only one continuous air quality monitoring station operates. A single station cannot provide spatially detailed exposure estimates representative of individual-level exposure, which are necessary for most epidemiological study designs beyond ecological analyses. Eventually, limited domestic research funding and reliance on international collaborations restrict both the number and scope of studies that can be conducted. Addressing these upstream barriers by strengthening civil registration systems, expanding ambient monitoring networks across 64 districts, and investing in epidemiological capacity building is therefore just as important as calling for more research.

This mapping review will guide the government of Bangladesh in tracking existing interventions and supporting targeted health initiatives. Most importantly, it may assist the government and international agencies in prioritizing funding for health research in Bangladesh. This study will also facilitate policymakers and future researchers in identifying areas where evidence is robust and where further investigation is needed. However, this review has several limitations. First, the search was limited to only two databases, PubMed and Web of Science, which may have resulted in the exclusion of relevant studies indexed in other databases such as Scopus, Embase, or regional databases. Second, the review included only peer-reviewed journal articles published in English, which may have excluded relevant studies published in other languages, particularly Bangla, thereby introducing potential language bias. Third, the review focused only on peer-reviewed literature and did not include grey literature such as government reports, NGO publications, policy documents, and technical reports from international organizations, which may contain important information on health research activities in Bangladesh. Finally, as this study was a mapping review, it primarily aimed to describe the distribution of available evidence rather than assess the methodological quality or risk of bias of the included studies.

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Consent for publication

Not applicable.

Clinical trial number

Not Applicable.

Contributions

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Ethical statement

Ethical approval was not required.

Declaration of competing interest

Not Applicable.

References

1. Health Effects Institute. State of Global Air Report 2024 | Special Report.Boston, MA: Health Effects Institute. https://www.stateofglobalair.org/resources/archived/state-global-air-report-2024. Accessed 1 Mar 2026.
2. Sun Z, Zhu D. Exposure to outdoor air pollution and its human health outcomes: A scoping review. https://doi.org/10.1371/journal.pone.0216550
3. Rentschler J, Leonova N. Global air pollution exposure and poverty. Nat Commun. 2023;14:4432. https://doi.org/10.1038/s41467-023-39797-4.
4. Ali MA, Assiri ME, Bilal M, Tariq S, Leeuw GD, Islam MN, et al. Long-term PM2.5 exposure in Bangladesh: identification of pollution hotspots, trends, sources and health risk assessment. Air Qual Atmos Health. 2025. https://doi.org/10.1007/s11869-025-01768-7.
5. Nayeem AA, Islam M. Effects of fine particulate matter air pollution on cardiovascular mortality in Dhaka, Bangladesh, from 2020 to 2024. J Epidemiol Popul Health. 2025;73:203151. https://doi.org/10.1016/j.jeph.2025.203151.
6. Craig GM, Daftary A, Engel N, O'Driscoll S, Ioannaki A. Tuberculosis stigma as a social determinant of health: a systematic mapping review of research in low incidence countries. 2017. 56:90–100.
7. McDaniel Peters BC, Wood W. Autism and Equine-Assisted Interventions: A Systematic Mapping Review. J Autism Dev Disord. 2017;47:3220–42. https://doi.org/10.1007/s10803-017-3219-9.
8. Khalil H, Welch V, Grainger M, Campbell F. Methodology for mapping reviews, evidence maps, and gap maps. Res Synth Methods 16:786–96.

https://doi.org/10.1017/rsm.2025.25

9. Dominski FH, Lorenzetti Branco JH, Buonanno G, Stabile L, Gameiro da Silva M, Andrade A. Effects of air pollution on health: A mapping review of systematic reviews and meta-analyses. Environ Res. 2021;201:111487. https://doi.org/10.1016/j.envres.2021.111487.
10. Fernández-Sotos P, Torio I, Fernández-Caballero A, Navarro E, González P, Dompablo M et al. Social cognition remediation interventions: A systematic mapping review. https://doi.org/10.1371/journal.pone.0218720
11. Brooks N, Biswas D, Hossin R, Yu A, Saha S, Saha S, et al. Health consequences of small-scale industrial pollution: Evidence from the brick sector in Bangladesh. World Dev. 2023;170. https://doi.org/10.1016/j.worlddev.2023.106318.
12. Goyal N, Canning D. Exposure to Ambient Fine Particulate Air Pollution in Utero as a Risk Factor for Child Stunting in Bangladesh. Int J Environ Res Public Health. 2018;15:22. https://doi.org/10.3390/ijerph15010022.
13. Khan R, Konishi S, Ng CFS, Umezaki M, Kabir AF, Tasmin S, et al. Association between short-term exposure to fine particulate matter and daily emergency room visits at a cardiovascular hospital in Dhaka, Bangladesh. Sci Total Environ. 2019;646:1030–6. https://doi.org/10.1016/j.scitotenv.2018.07.288.
14. Al Nahian M, Ahmad T, Jahan I, Chakraborty N, Nahar Q, Streatfield P, AND HEALTH. Air pollution and pregnancy outcomes in Dhaka, Bangladesh. JOURNAL OF CLIMATE CHANGE. 2023;9. https://doi.org/10.1016/j.joclim.2022.100187
15. Partha DB, Yasmin S, Nath H. Preterm births attributable to criteria air pollutant exposure in Bangladesh during 2015–2019. Environ Pollut. 2025;368:125742. https://doi.org/10.1016/j.envpol.2025.125742.
16. Rahman MM, Begum BA, Hopke PK, Nahar K, Newman J, Thurston GD. Cardiovascular morbidity and mortality associations with biomass- and fossil-fuel-combustion fine-particulate-matter exposures in Dhaka, Bangladesh. Int J Epidemiol. 2021;50:1172–83. https://doi.org/10.1093/ije/dyab037.
17. Rahman MM, Nahar K, Begum BA, Hopke PK, Thurston GD. Respiratory Emergency Department Visit Associations with Exposures to Fine Particulate Matter Mass, Constituents, and Sources in Dhaka, Bangladesh Air Pollution. Ann Am Thorac Soc. 2022;19:28–38. https://doi.org/10.1513/AnnalsATS.202103-252OC.
18. Rana J, Dey AK, Islam RM, Dey S, Moraga P, Kaufman JS. Long-term exposure to fine particulate matter and diabetes in Bangladeshi adults: Can clean air targets curb the rising diabetes burden? Sci Total Environ. 2025;1013:181270. https://doi.org/10.1016/j.scitotenv.2025.181270.
19. Tasmin S, Ng CFS, Stickley A, Md N, Saroar G, Yasumoto S, et al. Effects of Short-term Exposure to Ambient Particulate Matter on the Lung Function of School Children

in Dhaka, Bangladesh. Epidemiology. 2019;30(Suppl 1):S15–23. https://doi.org/10.1097/EDE.0000000000001012.

20. Sherris AR, Begum BA, Baiocchi M, Goswami D, Hopke PK, Brooks WA, et al. Associations between ambient fine particulate matter and child respiratory infection: The role of particulate matter source composition in Dhaka, Bangladesh. Environ Pollut. 2021;290:118073. https://doi.org/10.1016/j.envpol.2021.118073.
21. Health Effects Institute. Database of South Asia – Air Pollution and Health (DoSAAH). Health Effects Institute. 2024. https://www.healtheffects.org/global/database-south-asia-air-pollution-and-its-health-effects-dosaah. Accessed 3 Mar 2026.
22. Hystad P, Larkin A, Rangarajan S, AlHabib KF, Avezum Á, Calik KBT, et al. Associations of outdoor fine particulate air pollution and cardiovascular disease in 157 436 individuals from 21 high-income, middle-income, and low-income countries (PURE): a prospective cohort study. Lancet Planet Health. 2020;4:e235–45. https://doi.org/10.1016/S2542-5196(20)30103-0.
23. Xue T, Guan T, Geng G, Zhang Q, Zhao Y, Zhu T. Estimation of pregnancy losses attributable to exposure to ambient fine particles in south Asia: an epidemiological case-control study. Lancet Planet Health. 2021;5:e15–24. https://doi.org/10.1016/S2542-5196(20)30268-0.
24. Ali MA, Assiri ME, Bilal M, Tariq S, Leeuw GD, Islam MN, et al. Long-term PM2.5 exposure in Bangladesh: identification of pollution hotspots, trends, sources and health risk assessment. Air Qual Atmos Health. 2025. https://doi.org/10.1007/s11869-025-01768-7.
25. Ji HW, Kang J, Kim H-C, Jung J, Lee S-J, Jung JY, et al. The association between cumulative exposure to PM2.5 and DNA methylation measured using methyl-capture sequencing among COPD patients. Respir Res. 2024;25:335. https://doi.org/10.1186/s12931-024-02955-3.
26. Huang X, Steinmetz J, Marsh EK, Aravkin AY, Ashbaugh C, Murray CJL, et al. A systematic review with a Burden of Proof meta-analysis of health effects of long-term ambient fine particulate matter (PM2.5) exposure on dementia. Nat Aging. 2025;5:897–908. https://doi.org/10.1038/s43587-025-00844-y.
27. Amnuaylojaroen T, Parasin N, Saokaew S. Exploring the association between early-life air pollution exposure and autism spectrum disorders in children: A systematic review and meta-analysis. Reprod Toxicol. 2024;125:108582. https://doi.org/10.1016/j.reprotox.2024.108582.
28. Uddin M, Ashrafi SAA, Azad AK, Chowdhury A, Chowdhury HR, Riley ID, et al. Improving coverage of civil registration and vital statistics, Bangladesh. Bull World Health Organ. 2019;97:637–41. https://doi.org/10.2471/BLT.18.219162.

29. Tahsina T, Iqbal A, Rahman AE, Chowdhury SK, Chowdhury AI, Billah SM et al. Birth and Death Notifications for Improving Civil Registration and Vital Statistics in Bangladesh: Pilot Exploratory Study. JMIR Public Health Surveill. 2022;8(8):e25735 https://publichealth.jmir.org/2022/8/e25735. 2022. https://doi.org/10.2196/25735
30. Haider MR, Rahman MM, Islam F, Khan MM. Association of Low Birthweight and Indoor Air Pollution: Biomass Fuel Use in Bangladesh. J Health Pollut. 2016;6:18–25. https://doi.org/10.5696/2156-9614-6-11.18.

Figures

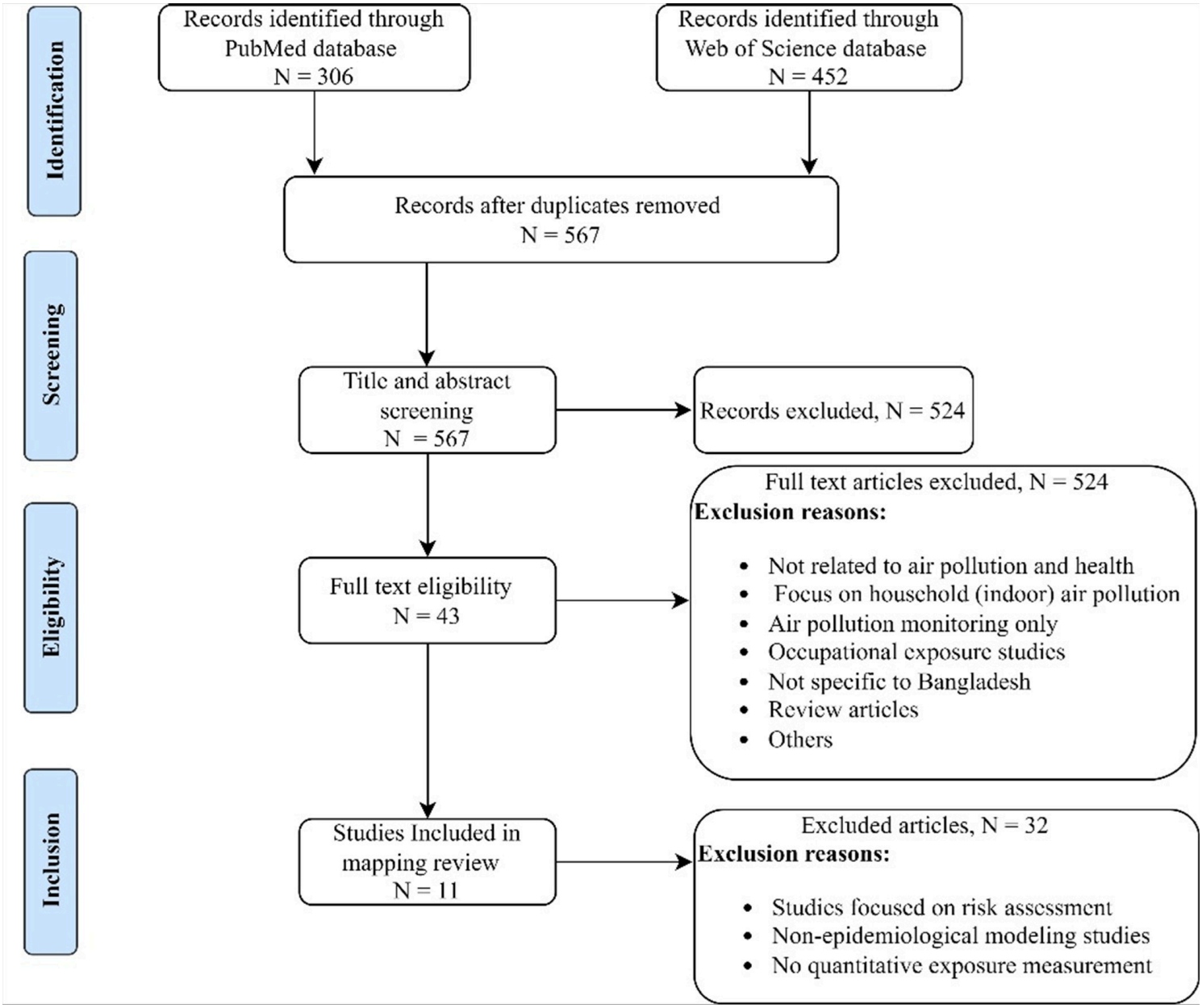


Figure 1

PRISMA diagram illustrating the study search and selection process

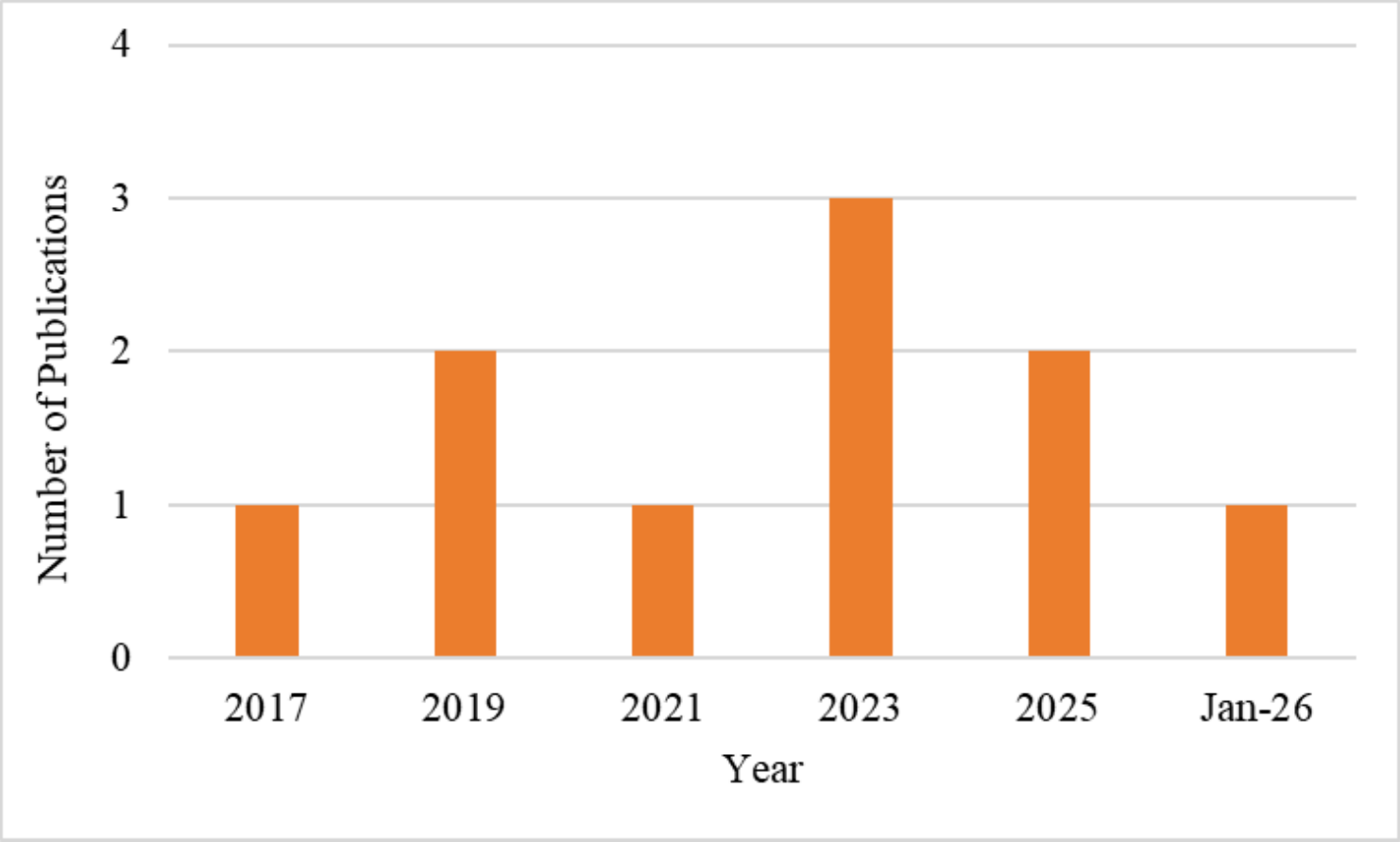


Figure 2

Number of published articles per year on effects of air pollution on health.