# Supplementary Document

**Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) Checklist**

| SECTION       | ITEM | PRISMA-ScR CHECKLIST ITEM                                                                 | REPORTED ON PAGE # |
|---------------|------|-------------------------------------------------------------------------------------------|--------------------|
| **TITLE**     |      |                                                                                           |                    |
| Title         | 1    | Identify the report as a scoping review.                                                   | 1                  |
| **ABSTRACT**  |      |                                                                                           |                    |
| Structured summary | 2    | Provide a structured summary that includes (as applicable): background, objectives, eligibility criteria, sources of evidence, charting methods, results, and conclusions that relate to the review questions and objectives. | 1-3                |
| **INTRODUCTION** |      |                                                                                           |                    |
| Rationale     | 3    | Describe the rationale for the review in the context of what is already known. Explain why the review questions/objectives lend themselves to a scoping review approach. | 2                  |
| Objectives    | 4    | Provide an explicit statement of the questions and objectives being addressed with reference to their key elements (e.g., population or participants, concepts, and context) or other relevant key elements used to conceptualize the review questions and/or objectives. | 3                  |
| **METHODS**   |      |                                                                                           |                    |
| Protocol and registration | 5    | Indicate whether a review protocol exists; state if and where it can be accessed (e.g., a Web address); and if available, provide registration information, including the registration number. | Supplementary document |
| Eligibility criteria | 6    | Specify characteristics of the sources of evidence used as eligibility criteria (e.g., years considered, language, and publication status), and provide a rationale. | 3                  |
| Information sources* | 7    | Describe all information sources in the search (e.g., databases with dates of coverage and contact with authors to identify additional sources), as well as the date the most recent search was executed. | 2                  |
| Search        | 8    | Present the full electronic search strategy for at least 1 database, including any limits used, such that it could be repeated. | Supplementary document |
| Selection of sources of evidence† | 9    | State the process for selecting sources of evidence (i.e., screening and eligibility) included in the scoping review. | 3-4                |
| Data charting process‡ | 10   | Describe the methods of charting data from the included sources of evidence (e.g., calibrated forms or forms that have been tested by the team before their use, and whether data charting was done independently or in duplicate) and any processes | 3-4                |
| SECTION | ITEM | PRISMA-ScR CHECKLIST ITEM | REPORTED ON PAGE # |
|---------|------|---------------------------|--------------------|
|         |      | for obtaining and confirming data from investigators. | |
| Data items | 11   | List and define all variables for which data were sought and any assumptions and simplifications made. | 4 |
| Critical appraisal of individual sources of evidence§ | 12   | If done, provide a rationale for conducting a critical appraisal of included sources of evidence; describe the methods used and how this information was used in any data synthesis (if appropriate). | n/a |
| Synthesis of results | 13   | Describe the methods of handling and summarizing the data that were charted. | 3-4 |
| RESULTS |      |                           |                    |
| Selection of sources of evidence | 14   | Give numbers of sources of evidence screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally using a flow diagram. | 2-3; Fig.1 |
| Characteristics of sources of evidence | 15   | For each source of evidence, present characteristics for which data were charted and provide the citations. | Tables 1-2 |
| Critical appraisal within sources of evidence | 16   | If done, present data on critical appraisal of included sources of evidence (see item 12). | n/a |
| Results of individual sources of evidence | 17   | For each included source of evidence, present the relevant data that were charted that relate to the review questions and objectives. | Tables 1-5 |
| Synthesis of results | 18   | Summarize and/or present the charting results as they relate to the review questions and objectives. | 4-6 |
| DISCUSSION |      |                           |                    |
| Summary of evidence | 19   | Summarize the main results (including an overview of concepts, themes, and types of evidence available), link to the review questions and objectives, and consider the relevance to key groups. | 4-6 |
| Limitations | 20   | Discuss the limitations of the scoping review process. | 6 |
| Conclusions | 21   | Provide a general interpretation of the results with respect to the review questions and objectives, as well as potential implications and/or next steps. | 7 |
| FUNDING |      |                           |                    |
| Funding | 22   | Describe sources of funding for the included sources of evidence, as well as sources of funding for the scoping review. Describe the role of the funders of the scoping review. | 7 |

JBI = Joanna Briggs Institute; PRISMA-ScR = Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews.

* Where sources of evidence (see second footnote) are compiled from, such as bibliographic databases, social media platforms, and Web sites.
† A more inclusive/heterogeneous term used to account for the different types of evidence or data sources (e.g., quantitative and/or qualitative research, expert opinion, and policy documents) that may be eligible in a scoping review as opposed to only studies. This is not to be confused with information sources (see first footnote).
‡ The frameworks by Arksey and O’Malley (6) and Levac and colleagues (7) and the JBI guidance (4, 5) refer to the process of data extraction in a scoping review as data charting.
§ The process of systematically examining research evidence to assess its validity, results, and relevance before using it to inform a decision. This term is used for items 12 and 19 instead of "risk of bias" (which is more applicable to systematic reviews of interventions) to include and acknowledge the various sources of evidence that may be used in a scoping review (e.g., quantitative and/or qualitative research, expert opinion, and policy document).

From: Tricco AC, Lillie E, Zarin W, O’Brien KK, Colquhoun H, Levac D, et al. PRISMA Extension for Scoping Reviews (PRISMA-ScR): Checklist and Explanation. Ann Intern Med. 2018;169:467–473. doi: 10.7326/M18-0850.
Study Protocol

Topic: The Impact of Environmental Conditions on Non-Communicable Diseases in Sub-Saharan Africa: A Scoping Review of Epidemiologic Evidence

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Abstract

Objective: To review and synthesize epidemiologic evidence of any environmental exposure with an impact on incidence, prevalence, and/or mortality of non-communicable diseases (NCD) in Sub-Saharan Africa (SSA).

Introduction: The burden of non-communicable diseases (NCD) is increasing in Sub-Saharan Africa (SSA). Environmental conditions such as heavy metals and air pollution have been linked with incidence and mortality of chronic diseases such as cancer, cardiovascular and respiratory diseases (RD). Environmental exposures can increase the risk of chronic diseases.

Inclusion criteria: The Population Intervention/Exposure Comparison Outcome Study Design (PICOS) will be used for data extraction. The inclusion criteria include, any SSA population or country (P), any direct physical environmental exposure (I/E), any type of comparison (C), any reported incidence, prevalence, and mortality of NCDs (O), and only empirical studies (S)

Methods: Database searches will be conducted using African Index Medicus, Ovid Medline, Scopus, Web of Science, and Greenfile without start date restriction through February 2023. The search will be restricted to only studies published in English. Only epidemiologic or quantitative studies will be included.

Dissemination: The results will be disseminated through a peer-reviewed publication

Introduction
The burden of non-communicable diseases (NCD) is increasing in Sub-Saharan Africa (SSA). Environmental conditions such as heavy metals and air pollution have been linked with incidence and mortality of chronic diseases such as cancer, cardiovascular and respiratory diseases (RD) in high income countries [1,2]. Mortality and morbidity attributable to chronic diseases in SSA are projected to surpass infectious diseases in 2030 [3]. The projection is due to poor environmental conditions such as high levels of air pollution, flooding, unplanned sanitation infrastructure and limited investments in mitigation of and/or adaptation to adverse impacts of climate change [4–6]. In SSA, efforts and investments to reduce NCDs are relatively low and inadequate to address risks [7]. Previous work, including reviews, has been limited in scope and most studies have focused on a single environmental condition such as air pollution or flood exposure. The objective of this scoping review is to review and synthesize epidemiologic evidence of any environmental exposure with an impact on incidence, prevalence, and/or mortality of NCDs in SSA.
Eligibility Criteria

Inclusion criteria for relevant articles are: the presence of certain keywords related to any type of physical environmental exposure, any type of epidemiologic and empirical study, any type of NCDs, and any SSA country or population. The specified keywords will be identified in the title, abstract, or full text.

Exclusion criteria will include a sole focus on any communicable or infectious disease, and any non-SSA country or population. Studies using proxy measures of environmental exposure such as proximity to point sources of pollution, and frequency of the usage of biomass cooking fuel will be excluded. Review articles and fully qualitative investigations will also be excluded.

Types of Sources

This scoping review will consider epidemiologic and quantitative studies including experimental and quasi-experimental study designs such as randomized controlled trials, non-randomized controlled trials, before and after studies and interrupted time-series studies. In addition, analytical observational studies including prospective and retrospective cohort studies, case-control studies and analytical cross-sectional studies will be considered for inclusion. This review will also consider descriptive observational study designs including case series, individual case reports and descriptive cross-sectional studies for inclusion. No qualitative study will be included.

Methods

The proposed scoping review will be conducted in accordance with the JBI methodology for scoping reviews [8]

Search Strategy

The search strategy will aim to locate both published and unpublished studies. Literature searches will be conducted without start date restriction through February 2023 using African Index Medicus, Ovid Medline, Scopus, Web of Science, and Greenfile to identify relevant articles. With the assistance of a reference medical librarian, certain search keywords related to non-communicable diseases, environment, climate, and Sub-Saharan Africa will be used. Sample search keywords will include “climate”, “chemical exposure”, “environment”, “weather”, “flood”, “cancer”, “stroke”, “cardiovascular”, “diabetes”, “respiratory”, “incidence”, “epidemiology”, “Africa South of the Sahara”, “Sub-Saharan Africa”. Only studies published in English language will be included. The search results will be exported to Rayyan online tool to enhance the article selection process and ease collaboration between the reviewers. Duplicates will be removed. There will be two reviewers who will independently screen the article titles and abstracts based on the study inclusion and exclusion criteria, and conflicts will be resolved by discussion until consensus was reached. The full texts of included articles will be independently assessed by both reviewers for their relevance. All conflicts were resolved by discussion.

Data Extraction and Article Selection

The PICOS [9] model will be used to design the search strategy and criteria for inclusion and exclusion of studies in the scoping review.
| P (population) | Any Sub-Saharan Africa population (or country) |
|---------------|-----------------------------------------------|
| I/E (Intervention/Exposure) | Any direct physical environmental exposure including flooding, air pollution, water pollution, etc. Excluding proxy measures of exposure such as proximity/frequency in the use of biomass cookstoves |
| C (Comparison) | Any type of comparison, including none |
| O (Outcome) | Incidence, prevalence, and/or mortality of Non-infectious/Non-communicable diseases (including cancer, all forms of cardiovascular diseases, all forms of respiratory diseases, and diabetes, all forms of chronic kidney diseases, all forms of mental illnesses, injuries, etc.). Exclude communicable diseases like HIV/AIDS, sexually transmitted infections, etc. |
| S (Study design) | Empirical studies only (including case control studies, cohort studies, randomized controlled trials, and cross-sectional studies). Reviews, protocols, letters to the editor, or perspectives/opinion articles will be excluded |

**Data Analysis and Presentation**

Data will be charted following the extant literature [10], and according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR). The charted data will be reviewed for accuracy by one author. Items that will be charted from each study will include, study characteristics, NCD, environmental condition, and disease outcome. The evidence from included studies will be summarized.

**Funding**

None

**Conflicts of Interest**

None

**References**

1. Rodopoulou S, Samoli E, Chalbot M-CG, Kavouras IG. Air pollution and cardiovascular and respiratory emergency visits in Central Arkansas: A time-series analysis. Sci Total Environ. 2015;536:872–9. Medline:26232212 doi:10.1016/j.scitotenv.2015.06.056

2. Coleman NC, Burnett RT, Higbee JD, Lefler JS, Merrill RM, Ezzati M, et al. Cancer mortality risk, fine particulate air pollution, and smoking in a large, representative cohort of US adults. Cancer Causes Control. 2020;31:767–76. Medline:32462559 doi:10.1007/s10552-020-01317-w

3. Holmes MD, Dalal S, Volmink J, Adebamowo CA, Njelekela M, Fawzi WW, et al. Non-communicable diseases in sub-Saharan Africa: the case for cohort studies. PLoS Med. 2010;7:e1000244. Medline:20485489 doi:10.1371/journal.pmed.1000244
4. Opoku SK, Filho WL, Hubert F, Adejumo O. Climate Change and Health Preparedness in Africa: Analysing Trends in Six African Countries. Int J Environ Res Public Health. 2021;18:4672. Medline:33925753 doi:10.3390/ijerph18094672

5. Suhr F, Steinert JI. Epidemiology of floods in sub-Saharan Africa: a systematic review of health outcomes. BMC Public Health. 2022;22:268. doi:10.1186/s12889-022-12584-4

6. Glenn BE, Espira LM, Larson MC, Larson PS. Ambient air pollution and non-communicable respiratory illness in sub-Saharan Africa: a systematic review of the literature. Environmental Health. 2022;21:40. doi:10.1186/s12940-022-00852-0

7. Li Z, Shi J, Li N, Wang M, Jin Y, Zheng Z. Temporal trends in the burden of non-communicable diseases in countries with the highest malaria burden, 1990–2019: Evaluating the double burden of non-communicable and communicable diseases in epidemiological transition. Globalization and Health. 2022;18:90. doi:10.1186/s12992-022-00882-w

8. Peters MDJ, Godfrey C, McInerney P, Khalil H, Larsen P, Marnie C, et al. Best practice guidance and reporting items for the development of scoping review protocols. JBI Evidence Synthesis. 2022;20:953. doi:10.11124/JBIES-21-00242

9. Nang C, Piano B, Lewis A, Lycett K, Woodhouse M. Using The PICOS Model To Design And Conduct A Systematic Search: A Speech Pathology Case Study. :51.

10. Mudie K, Jin MM, Tan, Kendall L, Addo J, dos-Santos-Silva I, et al. Non-communicable diseases in sub-Saharan Africa: a scoping review of large cohort studies. Journal of Global Health. 2019;9:020409. doi:10.7189/jogh.09.020409.
Ovid Medline search terms and results

| Search Term | Count |
|-------------|-------|
| ("Africa South of the Sahara*" or Sub-Saharan Africa or Subsaharan Africa or Angola* or Benin or Edo or Botswana* or Burkina Faso or Burkinabe or Burundi* or Cameroon* or Central African Republic or Chad or Chadian* or Congo* or Comoros or Comoran* or Cote d'Ivoire or Ivorian* or Democratic Republic of the Congo or Equatorial Guinea or Equatoguinean* or Eritrea* or Ethiopia* or Gabon* or Gambia* or Ghana* or Guinea-Bissau or Bissau-Guinean* or Kenya* or Lesotho or Mosotho* or Basotho* or Liberia* or Madagascar or Malagasy* or Malawi* or Mali or Mauritania* or Mozambique* or Namibia* or Niger* or Nigeria* or Republic of Congo or Rwanda* or "Sao Tome and Principe" or Sao Tomean* or Senegal* or Sierra Leone* or Somalia* or South Africa* or Sudan* or Swaziland or Swazi* or Tanzania* or Togo* or Uganda* or United Republic of Tanzania or Zambia* or Zimbabwe*) and mp. or exp "Africa South of the Sahara"/ | 380435 |
| (exp environment/ or exp environmental health/ or environment*.mp.) not ((built environment* or social environment* or work environment*) and mp. or exp built environment/ or exp environment design/) | 2573100 |
| exp environmental pollution/ or exp environmental exposure/ or exp air pollution/ | 618335 |
| exp climate/ or exp climatic processes/ or exp air movements/ or exp climate change/ or exp cyclonic storms/ or exp droughts/ or exp floods/ or exp greenhouse effect/ or exp tidal waves/ or exp weather/ | 724975 |
| (climate* or storm* or drought* or flood* or greenhouse or tidal wave* or weather or pollut* (or environment* adj3 expos*) or (chemical* adj3 expos*)) and mp. | 773757 |
| 2 or 3 or 4 or 5 | 2967947 |
| exp respiratory tract diseases/ or exp lung diseases/ or exp pleural diseases/ or exp thoracic diseases/ or exp asthma/ or exp Noncommunicable Diseases/ | 1686116 |
| exp cardiovascular diseases/ or exp heart diseases/ or exp vascular diseases/ or exp stroke/ or exp diabetes mellitus/ or exp neoplasms/ | 6628021 |
| ((disease* adj3 (noncommunicable or respiratory or lung* or pleural or thoracic or cardiovascular or heart or vascular)) or (stroke* or diabet* or neoplas* or cancer* or asthma*)) and mp. | 5893645 |
| 7 or 8 or 9 | 8898629 |
| 10 | 4618 |
| 1 and 6 and 10 | 4344 |
| limit 11 to english language | 9287794 |
| seroprevalence or seroincidence or seroepidemiol* or screening) mp. or exp epidemiologic methods/ or exp epidemiologic studies/ or exp sentinel surveillance/ or exp seroepidemiologic studies/ or exp cohort studies/ or exp cross-sectional studies/ or exp longitudinal studies/ or exp follow-up studies/ or exp prospective studies/ | 3425 |
| 14 and 13 | 319 |
| limit 14 to (letter or "review") | 3106 |

https://access.ovid.com/custom/redirector/index.html?dest=https://go.openathens.net/redirector/mcw.edu?url=http://ovidsp.ovid.com/ovidweb.cgi?T=JS&NEWS=N&PAGE=main&SHAREDSEARCHID=WaOGkinWeponcEng5CK97U5gNO1YUcrU54ExPpc3vTNXPFXPtZTEQyCLDorGmDg
Scopus search terms and results

TITLE-ABS-KEY (climate* OR storm* OR drought* OR flood* OR greenhouse OR "tidal wave*" OR weather OR pollut* OR (environment* W/3 expos*) OR (chemical W/3 expos*))

TITLE-ABS-KEY (environment* AND NOT ("built environment*" OR "social environment*" OR "work environment*"))

TITLE-ABS-KEY ("Africa South of the Sahara*" OR "Sub-Saharan Africa" OR "Subsaharan Africa" OR angola* OR benin OR edo OR botswana* OR "Burkina Faso" OR burkinabe OR burundi* OR cameroon* OR "Central African Republic" OR chad OR chadian* OR congo* OR comoros OR comoran* OR "Cote d'Ivoire" OR ivorian* OR "Democratic Republic of the Congo" OR "Equatorial Guinea" OR equatoguinean* OR eritrea* OR ethiopia* OR gabon* OR gambia* OR ghana* OR "Guinea-Bissau" OR "Bissau-Guinean*" OR kenya* OR lesotho OR mosotho* OR basotho* OR liberia* OR madagascar OR malagas* OR malawi* OR mali OR mauritania* OR mozambi* OR namibia* OR niger* OR nigeria* OR "Republic of Congo" OR rwanda* OR "Sao Tome and Principe" OR "Sao Tomean*" OR senegal* OR "Sierra Leone*" OR somalia* OR "South Africa*" OR sudan* OR swaziland OR swazi* OR tanzania* OR togo* OR uganda* OR "United Republic of Tanzania" OR zambia* OR zimbabwe*)

((TITLE-ABS-KEY (climate* OR storm* OR drought* OR flood* OR greenhouse OR "tidal wave*" OR weather OR pollut* OR (environment* W/3 expos*) OR (chemical W/3 expos*))) OR (TITLE-ABS-KEY (environment* AND NOT ("built environment*" OR "social environment*" OR "work environment*"))))) AND (TITLE-ABS-KEY ("Africa South of the Sahara*" OR "Sub-Saharan Africa" OR "Subsaharan Africa" OR angola* OR benin OR edo OR botswana* OR "Burkina Faso" OR burkinabe OR burundi* OR cameroon* OR "Central African Republic" OR chad OR chadian* OR congo* OR comoros OR comoran* OR "Cote d'Ivoire" OR ivorian* OR "Democratic Republic of the Congo" OR "Equatorial Guinea" OR equatoguinean* OR eritrea* OR ethiopia* OR gabon* OR gambia* OR ghana* OR "Guinea-Bissau" OR "Bissau-Guinean*" OR kenya* OR lesotho OR mosotho* OR basotho* OR liberia* OR madagascar OR malagas* OR malawi* OR mali OR mauritania* OR mozambi* OR namibia* OR niger* OR nigeria* OR "Republic of Congo" OR rwanda* OR "Sao Tome and Principe" OR "Sao Tomean*" OR senegal* OR "Sierra Leone*" OR somalia* OR "South Africa*" OR sudan* OR swaziland OR swazi* OR tanzania* OR togo* OR uganda* OR "United Republic of Tanzania" OR zambia* OR zimbabwe*))

TITLE-ABS-KEY (((((disease* W/3 (respirat* OR lung* OR pleural OR thoracic OR cardiovascular OR heart OR vascular)) OR (stroke* OR diabet* OR neoplas* OR cancer* OR asthma*))))

AND (((((TITLE-ABS-KEY (climate* OR storm* OR drought* OR flood* OR greenhouse OR "tidal wave*" OR weather OR pollut* OR (environment* W/3 expos*) OR (chemical W/3 expos*)) AND (TITLE-ABS-KEY (environment* AND NOT ("built environment*" OR "social environment*" OR "work environment*"))))) AND (TITLE-ABS-KEY ("Africa South of the Sahara*" OR "Sub-Saharan Africa" OR "Subsaharan Africa" OR angola* OR benin OR edo OR botswana* OR "Burkina Faso" OR burkinabe OR burundi* OR cameroon* OR "Central African Republic" OR chad OR chadian* OR congo* OR comoros OR comoran* OR "Cote d'Ivoire" OR ivorian* OR "Democratic Republic of the Congo" OR "Equatorial Guinea" OR equatoguinean* OR eritrea* OR ethiopia* OR gabon* OR gambia* OR ghana* OR "Guinea-Bissau" OR "Bissau-Guinean*" OR kenya* OR lesotho OR mosotho* OR basotho* OR liberia* OR madagascar OR malagas* OR malawi* OR mali OR mauritania* OR mozambi* OR namibia* OR niger* OR nigeria* OR "Republic of Congo" OR rwanda* OR "Sao Tome and Principe" OR "Sao Tomean*" OR senegal* OR "Sierra Leone*" OR somalia* OR "South Africa*" OR sudan* OR swaziland OR swazi* OR tanzania* OR togo* OR uganda* OR "United Republic of Tanzania" OR zambia* OR zimbabwe*))))) AND (LIMIT-TO (LANGUAGE, "English")))
(TITLE-ABS-KEY (prevalence OR incidence OR epidemiol* OR survey OR "rapid assessment" OR "situation assessment" OR "situational assessment" OR cohort OR surveillance OR seroprevalence OR seroincidence OR seroepidemiol* OR screening OR "sentinel surveillance" OR "cross-sectional stud"* OR "longitudinal stud"* OR "follow-up stud"* OR "prospective study") AND (TITLE-ABS-KEY (disease* W/3 (noncommunicable or respirat* OR lung* OR pleural OR thoracic OR cardiovascular OR heart OR vascular)) OR (stroke* OR diabet* OR neoplas* OR cancer* OR asthma*)) AND ((TITLE-ABS-KEY (climate* OR storm* OR drought* OR flood* OR greenhouse OR "tide wave"* OR weather OR pollut* OR (environment* W/3 expos*)) OR (chemical W/3 expos*)) OR (TITLE-ABS-KEY (environment* AND NOT ("built environment" OR "social environment" OR "work environment"))) AND (TITLE-ABS-KEY ("Africa South of the Sahara"* OR "Sub-Saharan Africa" OR "Subsaarian Africa" OR angola* OR benin OR edo OR botswana* OR "Burkina Faso" OR burkinabe OR burundi* OR cameroon* OR "Central African Republic" OR chad OR chadian* OR congo* OR comoros OR comoran* OR "Cote d'Ivoire" OR ivorian* OR "Democratic Republic of the Congo" OR "Equatorial Guinea" OR equatoguinean* OR eritrea* OR ethiopia* OR gabon* OR gambia* OR ghana* OR "Guinea-Bissau" OR "Bissau-Guinean"* OR kenya* OR lesotho OR mosotho* OR basotho* OR liberia* OR madagascar OR malagas* OR malawi* OR mali* OR mauritania* OR mozambl* OR namibia* OR niger* OR nigeria* OR "Republic of Congo" OR rwanda* OR "Sao Tome and Principe" OR "Sao Tomean"* OR senegal* OR "Sierra Leone"* OR somalia* OR "South Africa"* OR sudan* OR swaziland OR swazi* OR tanzania* OR togo* OR uganda* OR "United Republic of Tanzania" OR zambia* OR zimbabwe*))))) AND (LIMIT-TO (LANGUAGE, "English")) AND (EXCLUDE (DOCTYPE, "re") OR EXCLUDE (DOCTYPE, "le"))
### Web of Science search terms and results

| Query | Results |
|-------|---------|
| #1 AND #7 | 961 |
| #2 AND #5 AND #6 and English (Languages) and Review Article or Letter (Exclude Document Types) | 1,893 |
| TS=("Africa South of the Sahara*" OR "Sub-Saharan Africa" OR "Subsaharan Africa" OR angola* OR benin OR edo OR botswana* OR "Burkina Faso" OR burkinabe OR burundi* OR cameroon* OR "Central African Republic" OR chad OR chadian* OR congo* OR comoros OR comoran* OR "Cote d'Ivoire" OR ivorian* OR "Democratic Republic of the Congo" OR "Equatorial Guinea" OR equatoguinean*) | 579,728 |
| #3 OR #4 | 4,645,950 |
| TS=(climate* OR storm* OR drought* OR flood* OR greenhouse OR "tidal wave*" OR weather OR pollut* OR (environment* NEAR/3 expos*) OR (chemical NEAR/3 expos*)) | 1,788,058 |
| TS=((environment*) NOT ("built environment*" OR "social environment*" OR "work environment*")) | 3,457,233 |
TS=((disease* NEAR/3 (noncommunicable OR respirat* OR lung* OR pleural OR thoracic OR cardiovascular OR heart OR vascular)) OR (stroke* OR diabet* OR neoplas* OR cancer* OR asthma*))

TS=((prevalence OR incidence OR epidemiol* OR survey OR "rapid assessment" OR "situation assessment" OR "situational assessment" OR cohort OR surveillance OR seroprevalence OR seroincidence OR seroepidemiol* OR screening OR "sentinel surveillance" OR "cross-sectional stud*" OR "longitudinal stud*" OR "follow-up stud*" OR "prospective stud*"))
| #  | Query         | Limiters/Expanders | Last Run Via               | Results |
|----|---------------|--------------------|---------------------------|---------|
| S6 | S1 AND S4 AND S5 | Expanders - Apply equivalent subjects | Interface - EBSCOhost Research Databases | 376     |
| Expander - Apply equivalent subjects | Interface - EBSCOhost Research Databases |
|-------------------------------------|----------------------------------------|
| (disease* N3 (noncommunicable OR respirat* OR lung* OR pleural OR thoracic OR cardiovascular OR heart OR vascular) OR (stroke* OR diabet* OR neoplas* OR cancer* OR asthma*)) | 20,779 |
| Search modes - Find all my search terms | Search Screen - Advanced Search |
|                                      | Database - GreenFILE |
| S4 | S2 OR S3 |
|----|---------|
|    | Expanders - Apply equivalent subjects |
|    | Search modes - Find all my search terms |
|    | Interface - EBSCOhost Research Databases |
|    | Search Screen - Advanced Search |
|    | Database - GreenFILE |
|    | 856,040 |
| (climate* or storm* or drought* or flood* or greenhouse or tidal wave* or weather or pollut* or (environment* N3 expos*) or (chemical* N3 expos*)) | Expanders - Apply equivalent subjects | Interface - EBSCOhost Research Databases |
| --- | --- | --- |
| Search modes - Find all my search terms | Search Screen - Advanced Search | 371,063 |
|  | Database - GreenFILE |  |
| SZ | (environment* NOT ("built environment*" OR "social environment*" OR "work environment*")) | Expanders - Apply equivalent subjects | Interface - EBSCOhost Research Databases |
|----|---------------------------------------------------------------------------------|--------------------------------------|-----------------------------------------|
|    |                                                                                 | Search modes - Find all my search terms | Search Screen - Advanced Search         |
|    |                                                                                 | Database - GreenFILE                  | 769,754                                 |
"Africa South of the Sahara" OR "Sub-Saharan Africa" OR "Subsaharan Africa" OR angola* OR benin OR edo OR botswana* OR "Burkina Faso" OR burkinabe OR burundi* OR cameroon* OR "Central African Republic" OR chad OR chadian* OR congo* OR comoros OR comoran* OR "Cote d'Ivoire" OR ivorian* OR "Democratic Republic of the Congo" OR "Equatorial Guinea" OR equatoguinean* OR eritrea* OR ethiopia* OR gabon* OR gambia* OR ghana* OR "Guinea-Bissau" OR "Bissau-Guinean"* OR kenya* OR lesotho OR mosotho* OR basotho* OR liberia* OR madagascar OR malagas* OR malawi* OR mali OR mauritania* OR mozambi* OR namibia* OR niger* OR nigeria* OR "Republic of Congo" OR rwanda* OR "Sao Tome and Principe" OR "Sao Tomean"* OR senegal* OR "Sierra Leone"* OR somalia* OR "South Africa"* OR sudan* OR swaziland OR swazi* OR tanzania* OR togo* OR uganda* OR "United Republic of Tanzania" OR zambia* OR zimbabwe*
### African Index Medicus search terms and results

| Term                                                                 | Count |
|----------------------------------------------------------------------|-------|
| climate* or storm* or drought* or flood* or greenhouse or "tidal wave" or "tidal waves" or weather or pollut* or environment* or "chemical exposure" or "chemical exposures" |       |
| noncommunicable or respirat* or lung* or pleural or thoracic or cardiovascular or heart or vascular or stroke* or diabet* or neoplas* or cancer* or asthma* or disease* |       |
| limited to AIM and English                                           |       |
| `tw:((climate* OR storm* OR drought* OR flood* OR greenhouse OR "tidal wave" OR "tidal waves" OR weather OR pollut* OR environment* OR "chemical exposure" OR "chemical exposures")) AND (tw:(noncommunicable OR respirat* OR lung* OR pleural OR thoracic OR cardiovascular OR heart OR vascular OR stroke* OR diabet* OR neoplas* OR cancer* OR asthma* OR disease*)) AND (collection_gim:("AIM") AND la:("en"))` | 445   |
### Characteristics of studies included.

| Study                        | DOI                        | Study Design       | Country     | NCD                                      | Environmental Condition | Outcome          |
|------------------------------|----------------------------|--------------------|-------------|------------------------------------------|--------------------------|-------------------|
| Wyndham (1986)               | https://pubmed.ncbi.nlm.nih.gov/3952586/ | Cohort             | South Africa | Respiratory disease                      | Air temperature and age specific |                    |
| Hinzo and Sluis-Cremer (1991) | DOI: 10.1136/oem.48.1.53     | Cohort             | South Africa | Lung cancer                              | Silica, tobacco smoking | Mortality         |
| Churchyard et al. (2004)     | doi:10.1136/oem.2003.010967 | Cross-sectional    | South Africa | Silicosis                                | Silica dust             | Prevalence        |
| Farai et al. (2006)          | DOI: 10.1016/j.jererd.2006.06.003 | Cross-sectional    | Nigeria      | Cancer                                   | Soil radioactivity      | Incidence         |
| Kilabuko et al. (2007)       | DOI: 10.3390/ijerph2007010007 | Cross-sectional    | Tanzania     | Acute respiratory infection              | Indoor and outdoor air pollution (PM$_{2.5}$, NO$_2$, CO) | Prevalence |
| Norman et al. (2007)         | Cross-sectional            | South Africa       |             | Mortality and YLLs from lung cancer and cardiopulmonary disease in adults (30 years and older), and from acute respiratory infections (ARIs) in children aged 0 - 4 years. | Outdoor air pollution (PM$_{2.5}$) | Mortality         |
| Kistnasamy et al. (2008)     | doi:10.7196/sajch.598       | Cross-sectional    | South Africa | Asthma among children                     | Air pollution (PM$_{10}$, NO$_x$, SO$_2$) | Prevalence |
| Zeleke et al. (2011)         | DOI: 10.1186/1471-2466-11-50 | Case-control       | Ethiopia     | Chronic respiratory symptoms             | Dust exposure            | Prevalence        |
| Sakwari et al. (2011)        | DOI: 10.1186/1471-2466-11-54 | Cross-sectional    | Tanzania     | wheezing, chest-tightness,               | Dust exposure            | Prevalence        |
| Wichmann and Voyi (2012)     | DOI: 10.3390/ijerph9113978   | Case-crossover     | South Africa | Respiratory disease, CVD, cerebrovascular disease | Outdoor air pollution (24-h average PM$_{10}$, SO$_2$, NO$_2$) | Mortality         |
| Naidoo et al. (2013)         | doi:10.7196/sajch.598       | Cross-sectional    | South Africa | Asthma among school children              | Outdoor air pollution (PM$_{2.5}$, PM$_{10}$, SO$_2$, NO$_2$, NO) | Prevalence |
| Tungu et al. (2014)          | DOI: 10.1097/JOM.0000000000000057 | Time-series        | Tanzania     | Chronic respiratory symptoms, lung function, COPD | Dust exposure            | Prevalence        |
| Gomez et al. (2014)          | DOI: 10.1016/j.jstrokecerebrovasdis.2013.02.012 | Case-control       | Mozambique   | Stroke hospitalization                    | Relative daily humidity, relative daily humidity, Incidence |
| Gomez et al. (2015)          | DOI: 10.1016/j.clinneo.2014.12.002 | Case crossover    | Mozambique   | Stroke hospitalization                    | Relative daily humidity, Incidence |
| Lontchi-Yimamou (2016)       | DOI: 10.1186/s12889-016-3090-1 | Cross-sectional    | Cameroon     | Diabetes                                 | Precipitation and prevalence |
| Monamele et al. (2017)       | DOI: 10.1371/journal.pone.0186914 | Time-series        | Cameroon     | Influenza                                | Humidity                | Incidence         |
| Nkhama et al. (2017)         | DOI: 10.3390/ijerph14111351 | Cross-sectional    | Zambia       | Respiratory symptoms (PM$_{2.5}$ and PM$_{10}$) | Incidence |
| Mbelambela et al. (2017)     | DOI:10.1185/s12199-017-0608-9 | Cross-sectional    | Congo        | Impaired pulmonary function              | SO$_2$                  | Prevalence        |
| Rusibamayilla et al. (2018)  | doi:10.29024/aogbh.2323    | Cross-sectional    | Tanzania     | Impairment                                | Dust                    | Prevalence        |
| Allyu and Botai (2018)       | doi:10.2991/japh.2018.04.002 | Cross-sectional    | Nigeria      | Respiratory symptoms (PM$_{2.5}$ and PM$_{10}$, CO, SO$_2$) | Incidence |
| Nightingale et al. (2019)    | DOI: 10.1164/rccm.201805-0936OC | Cross-sectional    | Malawi       | Chronic respiratory symptoms             | Air pollution (PM$_{2.5}$, CO) | Prevalence        |
| Authors                  | DOI/URL                                      | Study Type    | Country       | Outcome                                                                 | Exposure/Other Variables                                                                 |
|-------------------------|----------------------------------------------|---------------|---------------|-------------------------------------------------------------------------|------------------------------------------------------------------------------------------|
| Michellier et al. (2020)| [https://doi.org/10.1186/s12940-020-00615-9](https://doi.org/10.1186/s12940-020-00615-9) | Cross-sectional | DRC          | Acute respiratory symptoms                                              | Air pollution (SO₂)                                                                      |
| Olanuyan et al. (2020)  | DOI: 10.1016/j.envres.2020.109606           | Cross-sectional | South Africa | Respiratory symptoms                                                    | Air pollution (NO₂, PM₂.₅)                                                              |
| Mortimer et al. (2020)  | doi: 10.1016/j.chest.2020.03.064           | Randomized controlled trial | Malawi     | Pneumonia                                                              | Air pollution (CO)                                                                      |
| Oloyede et al. (2020)   | [https://pubmed.ncbi.nlm.nih.gov/32150634/](https://pubmed.ncbi.nlm.nih.gov/32150634/) | Cross-sectional | Nigeria      | Respiratory symptoms                                                    | Air pollution (PM₂.₅, PM₁₀)                                                              |
| Foko et al. (2021)      | DOI: 10.1016/j.admp.2021.04.008             | Cross-sectional | Senegal      | Respiratory symptoms                                                    | Heavy metals                                                                            |
| Cai et al. (2021)       | DOI: 10.3390/ijerph18189729                 | Cross-sectional | 21 SSA countries | Acute lower respiratory infection                                       | (PM₂.₅)                                                                                 |
| Iyer et al. (2021)      | DOI: 10.1016/j.envres.2020.110307          | Cross-sectional | Uganda, South Africa, Tanzania | Diabetes, hypertension, obesity, total cholesterol                      | Neighborhood greenness                                                                   |
| Thabete et al. (2021)   | DOI: 10.1007/s11356-021-13778-w            | Case-crossover  | South Africa  | Respiratory and cardiovascular diseases                                  | Ambient air pollution(PM₁₀, NO₂, SO₂)                                                  |
| Bektie et al. (2021)    | DOI: 10.1007/s11869-021-01109-4             | Cross-sectional | Ethiopia      | Respiratory diseases                                                    | Air pollution (PM₂.₅, PM₁₀, CO₂, NO₂, SO₂)                                              |
| Kawano et al. (2022)    | [https://dx.doi.org/10.1186/s12289-022-12577-3](https://dx.doi.org/10.1186/s12289-022-12577-3) | Cross-sectional | Senegal      | Acute respiratory infections                                            | Air pollution (NO₂)                                                                      |
| Adebayo-Ojo et al. (2022)| DOI: 10.3390/ijerph19138078              | Cross-sectional | South Africa | Cardiovascular and respiratory diseases                                  | Air pollution (PM₁₀, NO₂, SO₂, O₃)                                                     |
| Eghomwanre and Oguntoke (2022)| DOI: 10.1007/s10661-022-10026-7            | Cross-sectional | Nigeria      | Asthma                                                                  | Indoor air pollution (CO₂, SO₂, NO₂)                                                   |
| Shirinde and Wichmann (2022)| DOI: 10.1080/09603123.2022.2076813         | Case-crossover  | South Africa  | Respiratory diseases                                                    | Indoor and outdoor air pollution (PM₁₀, PM₂.₅, PM₁₀)                                    |
| Eghomwanre et al. (2022)| DOI: 10.1007/s10661-022-10135-3           | Cross-sectional | Nigeria      | Asthma                                                                  | Indoor and outdoor air pollution (PM₁₀, PM₂.₅, PM₁₀)                                    |
| Negash et al. (2023)    | DOI: 10.1186/s12890-023-02338-2            | Cross-sectional | Ethiopia      | Chronic respiratory symptoms                                            | Paper dust                                                                               |
Table 1. Summary of the characteristics of included studies

| Characteristics | Studies n (%) |
|-----------------|--------------|
| **Year of publication** |          |
| 1986 - 2006     | 4 (11.1)    |
| 2007 - 2011     | 5 (13.8)    |
| 2012 - 2016     | 6 (16.6)    |
| 2017 - 2021     | 15 (41.6)   |
| 2022 - February 2023 | 6 (16.6) |
| **Countries represented** |          |
| Cameroon        | 2 (5.5)     |
| Congo           | 2 (5.5)     |
| Ethiopia        | 3 (8.3)     |
| Malawi          | 2 (5.5)     |
| Mozambique      | 2 (5.5)     |
| Nigeria         | 5 (13.8)    |
| Senegal         | 2 (5.5)     |
| South Africa    | 11 (30.5)   |
| Tanzania        | 4 (11.1)    |
| Zambia          | 1 (2.7)     |
| **Multi-country study** | 2 (5.5) |
| **Study design** |          |
| Case-control    | 1 (2.7)     |
| Case-crossover  | 4 (11.1)    |
| Cohort          | 2 (5.5)     |
| Cross-sectional | 26 (72.2)   |
| Randomized controlled trial | 1 (2.7) |
| Time series     | 2 (5.5)     |
**Table 2.** Summary of the type of NCD, environmental conditions, and reported outcomes in terms of prevalence, incidence, and mortality.

| Characteristics | n (%)
|-----------------|---|
| **Non-communicable diseases** | |
| Respiratory diseases (Lung cancer, asthma, influenza, acute respiratory infections, respiratory symptoms) | 25 (69.4)
| Cancer (other than lung cancer) | 1 (2.7)
| Stroke | 2 (5.5)
| Diabetes | 1 (2.7)
| Two or more chronic diseases (Cardiovascular, respiratory, cerebrovascular, diabetes, hypertension, total cholesterol) | 7 (19.4)
| **Environmental conditions** | |
| Air pollution | 21 (58.3)
| Dust (including paper and silica dust) | 7 (19.4)
| Heavy metals | 1 (2.7)
| Soil radioactivity | 1 (2.7)
| Neighborhood greenness | 1 (2.7)
| Meteorological variables (Temperature, rainfall, relative humidity, precipitation) | 5 (13.8)
| **Disease outcomes** | |
| Mortality | 6 (16.6)
| Incidence | 11 (30.5)
| Prevalence | 18 (50.0)
| Incidence and prevalence | 1 (2.7)
Fig. 1. PRISMA flowchart for study screening and selection process