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A systematic review of climate change and its health outcomes on populations in Nigeria

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Abstract

Climate change poses increasing threats to population health, particularly in low- and middle-income countries with high environmental and socioeconomic vulnerability. Nigeria experiences diverse climate hazards, including rising temperatures, flooding, drought, and rainfall variability, which may adversely affect multiple health outcomes. This systematic review synthesized available evidence on climate change-related health outcomes among Nigerian populations.

A systematic review was conducted following PRISMA 2020 guidelines. Five electronic databases (PubMed/MEDLINE, Scopus, Web of Science Core Collection, ScienceDirect, and African Journals Online) were searched for eligible studies published between 2012 and 2026. Original quantitative, qualitative, and mixed-methods studies examining climate-related exposures and health outcomes in Nigeria were included. Methodological quality was assessed using the Mixed Methods Appraisal Tool 2018, and findings were synthesized narratively. Quality appraisal identified nine high-quality, eighteen moderate-quality, and five low-quality studies.

Thirty-two studies were included, comprising predominantly cross-sectional surveys, alongside time-series, qualitative, and mixed-methods studies. Five major climate–health pathways were identified: thermal stress and heat-related morbidity, waterborne and vector-borne infectious diseases, food and nutrition insecurity, mental health and psychosocial distress, and respiratory and cardiovascular conditions. Flooding and temperature-related exposures were the most frequently investigated climate hazards. The evidence base was geographically uneven, with urban settings and the Southwest geopolitical zone most represented.

Climate change is already exerting substantial and multifaceted health impacts across Nigeria. However, important geographical and methodological gaps remain. Strengthening climate-sensitive surveillance, climate-resilient health systems, and longitudinal and intervention-based research is essential to support evidence-informed adaptation and public health responses.

Key words: climate change, health outcomes, Nigeria, populations; infectious diseases.

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Introduction

Climate change represents a major global health threat of the 21st century.[1] Its health impacts are increasingly recognized as unevenly distributed, with low- and middle-income countries, particularly in sub-Saharan Africa, bearing a disproportionate burden despite minimal contribution to global greenhouse gas emissions.[2] This imbalance reflects structural vulnerabilities, including weak health systems, limited adaptive capacity, and high dependence on climate-sensitive livelihoods.[3] Nigeria, Africa's most populous country, exemplifies this vulnerability, with over 220 million inhabitants exposed to multiple and interacting climate hazards.[4] These include rising mean temperatures (approximately 0.8°C since the pre-industrial era), increasingly erratic rainfall, prolonged dry spells in the northern Sahelian belt, and intensified flooding in coastal and riverine regions.[5]

Recent evidence highlights the severity of these impacts. The Lancet Countdown on Health and Climate Change reported that in 2024 Nigerians experienced an average of 33.2 heatwave days per person, the majority of which would not have occurred without anthropogenic climate change.[6] Similarly, the 2022 floods displaced over 2 million people and triggered widespread health emergencies, including cholera outbreaks and acute malnutrition.[7] These climatic pressures interact with entrenched structural challenges such as poverty, insecurity, rapid urbanization, and a health system ranked 187th out of 191 globally.[8] Over 60% of urban residents live in informal settlements with limited water, sanitation, and drainage infrastructure, increasing vulnerability to climate-sensitive diseases.[9] Nigeria's ecological diversity further compounds this burden, with distinct climate-health profiles across the Sahel, savannah, and coastal zones.[10] Despite growing research interest, evidence on climate change and health outcomes in Nigeria remains fragmented across disciplines, outcomes, and methodologies. Existing studies have examined flooding and cholera, heat stress, malaria, malnutrition, and mental health outcomes, but findings have not been systematically synthesized.[11] Although global and regional reviews exist, they often include only limited Nigeria-specific data, restricting contextual interpretation.[12]

This systematic review therefore aims to synthesize Nigeria-specific evidence on climate change and health outcomes in order to: i) map the range of climate-sensitive health outcomes studied; ii) identify thematic and geographic evidence gaps; and iii) inform national climate–health policy, including Nigeria's Climate Change Act (2021) and related adaptation strategies.[13]

Objectives of the study

The primary objective of this systematic review was to synthesize peer-reviewed evidence on the health outcomes of climate change among populations in Nigeria. The specific objectives were the following: i) to identify and characterize the range of health outcomes that have been empirically linked to climate change exposure in Nigerian settings; ii) to map the geographical distribution, study designs, and population subgroups represented in the existing literature; iii) to identify key thematic pathways through which climate change affects health in Nigeria; iv) to critically appraise the methodological quality of included studies; v) to highlight evidence gaps and provide recommendations for future research and policy.

Methods

Study design

This systematic review followed PRISMA 2020 guidelines,[14] and included peer-reviewed studies and eligible grey literature reporting original empirical findings on climate change and health outcomes in Nigeria.

Information sources

A comprehensive search was conducted across five databases: PubMed/MEDLINE, Scopus, Web of Science Core Collection, ScienceDirect, and African Journals Online for articles published between 2012 and 2026. These sources were selected to capture both international and regionally indexed literature . Reference lists of eligible studies were also screened for additional records.

Search strategy

The search combined MeSH terms and keywords across three domains: climate change, health outcomes, and Nigeria. Boolean operators (AND/OR) were used. No language restrictions were applied. An example of PubMed/MEDLINE search strategy include: ("Climate Change" OR "Global Warming" OR "climate change" OR "global warming" OR "climate variability" OR "climate variability" OR "extreme weather" OR "heatwave" OR "heat waves" OR "heat stress" OR "high temperature" OR "temperature rise" OR "flood" OR "flooding" OR "drought" OR "rainfall variability" OR "sea level rise" OR "air pollution") AND ("Health" OR "Morbidity" OR "Mortality" OR "Disease" OR "Malaria" OR "Cholera" OR "Malnutrition" OR "Mental Health" OR "Respiratory Tract Diseases" OR "Cardiovascular Diseases" OR health OR morbidity OR mortality OR disease OR malaria OR cholera OR malnutrition OR mental health OR respiratory disease OR cardiovascular disease) AND ("Nigeria" OR Nigeria OR Nigerian). Filters applied: publication dates from January 1, 2012 to January 31, 2026; human studies; English language.

Eligibility criteria

Inclusion criteria

Studies were included if they involved human populations in Nigeria; examined climate-related exposures (*e.g.*, temperature rise, flooding, drought, rainfall variability, climate-related air pollution, sea level rise); reported health outcomes (morbidity, mortality, nutrition, mental health, infectious or non-communicable diseases, health system impacts); used quantitative, qualitative, or mixed-methods designs (cross-sectional, cohort, case-control, time-series, quasi-experimental, or qualitative studies); were published peer-reviewed articles or eligible grey literature with sufficient methodological detail, published between January 2012 and January 2026, and available in English.

Exclusion criteria

Excluded studies were non-human studies; studies outside Nigeria or involving diaspora populations; studies focusing only on seasonal variation without explicit climate change linkage; studies limited to knowledge, attitudes, or perceptions without health outcomes; editorials, commentaries, conference abstracts without full data; reprints without peer review; books and book chapters; published before January 1 2012; non-English studies without translation access.

Risk of bias assessment

Methodological quality was assessed using the Mixed Methods Appraisal Tool (MMAT) 2018.[15] Each study was rated as high quality/low risk of bias (≥80%), moderate quality/moderate risk of bias (50-79%), and low quality/high risk of bias (<50%). Grey literature (where included) was assessed using MMAT-adapted criteria based on available methodological reporting. The risk of bias assessment is presented in *Supplementary Table 1*.

Study selection

Two independent reviewers screened studies at title/abstract and full-text stages. Disagreements were resolved through discussion or third-party adjudication. Reasons for exclusion were documented.

Data extraction and synthesis approach

Data extracted included author, year, design, location, sample size, exposures, outcomes, and findings. Due to heterogeneity in design and outcomes, meta-analysis was not feasible. Data were synthesized using thematic narrative synthesis, grouping findings into recurring climate-health pathways.

Screening procedure

A total of 5138 records were identified. After removing duplicates (n=1392), 3746 records were screened. Following full-text assessment of 428 studies, 32 studies were included in the final synthesis. This selection and screening procedure is as follows.

Records identified through database searching: total (n=5138) - PubMed (n=1247), Scopus (n=1583), Web of Science (n=1102), ScienceDirect (n=894), African Journals Online (n=312). Records of duplicates removed: n=1392. Records screened (title/abstract): n=3746. Records excluded: n=3318. Full-text articles assessed for eligibility: n=428. Full-text articles excluded: n=396 - reasons: not Nigeria-specific (n=87), no health outcome measured (n=112), commentary/editorial (n=94), conference abstract (n=58), duplicate data (n=27), outside date range (n=18). Studies included in

synthesis (n=32). Figure 1 presents the PRISMA 2020 flow diagram of study selection.

Quality appraisal

Of the 32 included studies,[9,10,16-45] 9 were rated as high quality, 18 were rated as moderate quality, and 5 were rated as low quality. High-quality studies typically used objective exposure data (meteorological or surveillance datasets), appropriate statistical modeling, and adjustment for confounders. Moderate-quality studies relied largely on cross-sectional designs with limited confounder adjustment. Low-quality studies showed weak methodological rigor including small sample sizes and unclear exposure definitions. The evidence base was dominated by cross-sectional designs, limiting causal inference. *Supplementary Table 1* presents the quality appraisal of the included studies.

Results

Characteristics of eligible included studies

The 32 included studies were published between 2012 and 2026, with increasing output after 2020.[9,10,16-45] Study designs include cross-sectional studies (majority), time-series analyses, mixed-methods studies, qualitative studies, no cohort or case-control studies were identified. Most frequently reported exposures include flooding (most common), temperature increase and heat stress, rainfall variability, drought, and climate-related air pollution. Health outcomes clustered into infectious diseases (notably cholera, malaria), malnutrition and food insecurity, heat-related illness, mental health outcomes, and respiratory and cardiovascular conditions. Several studies reported multiple outcomes concurrently. Studies covered all six geopolitical zones, although urban and peri-urban settings were over represented. Rural-only studies were limited. As previously noted, most studies were moderate quality. High-quality studies were more likely to use longitudinal or time-series data and objective exposure measurements.

The evidence indicates a growing but fragmented body of literature on climate change and health in Nigeria. However, methodological limitations particularly reliance on cross-sectional designs restrict causal interpretation. Key gaps include underrepresentation of longitudinal and intervention studies, geographic concentration in urban areas, limited integration of climate and health surveillance systems, and potential publication bias toward disaster-related events. These limitations constrain the policy utility of existing evidence.The characteristics and summary of findings of the included studies is presented in *Supplementary Table 2*.

Quality appraisal of the included studies

Quality appraisal using the MMAT revealed a heterogeneous evidence base with varied methodological rigor. Among the 32 included studies,[9,10,16-45] 9 were rated as high quality, 18 as moderate quality, and 5 as low quality. High-quality studies were characterized

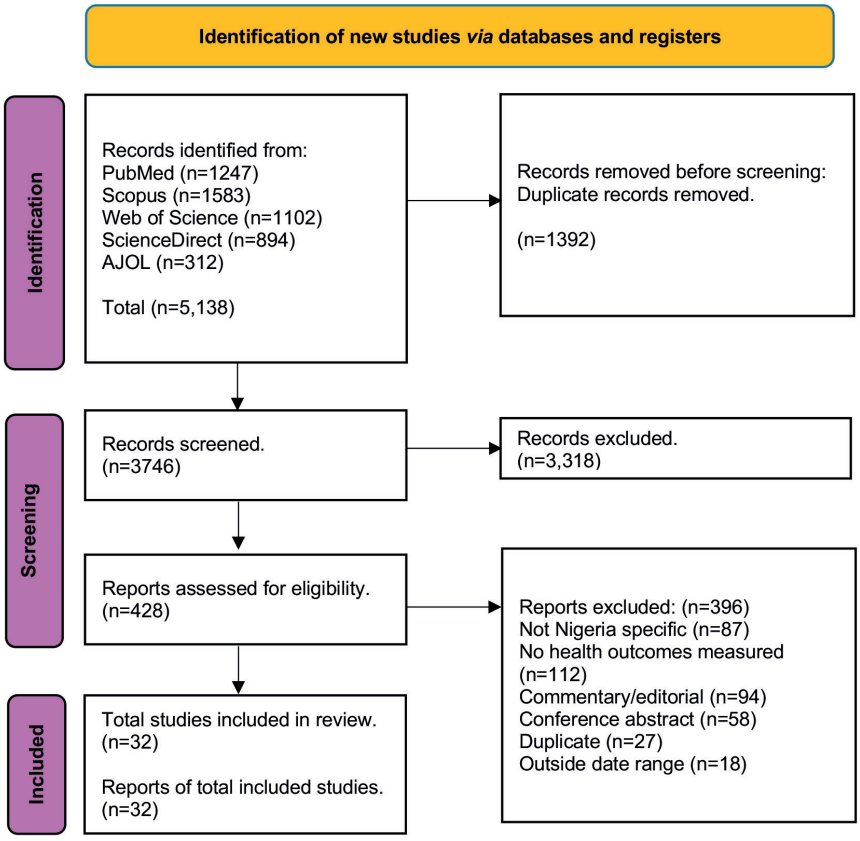

Figure 1. Diagram of the PRISMA 2020 Process for Systematic Reviews and Meta-Analyses.

by clearly defined research questions, appropriate sampling strategies with adequate sample sizes, validated measurement instruments or objective data sources (*e.g.*, meteorological records, hospital surveillance data), and appropriate statistical analyses that accounted for potential confounders. Studies employing time-series or geospatial designs with long temporal coverage demonstrated particular methodological strengths, including rigorous validation of exposure data and transparent reporting of analytical procedures. Moderate-quality studies, which constituted the majority, typically employed cross-sectional designs with reasonable sample sizes and clear outcome definitions. Low-quality studies exhibited multiple methodological weaknesses which include very small sample sizes without justification; absence of power calculations; poorly defined or inconsistent exposure and outcome measures; inadequate statistical analyses; and failure to acknowledge or address potential sources of bias.

The predominance of cross-sectional designs represents a fundamental limitation of the evidence base. Cross-sectional studies can identify associations between climate exposures and health outcomes but cannot establish temporality or causality. The absence of longitudinal cohort studies tracking the same populations over time as climate conditions change constitutes a significant evidence gap. Similarly, the lack of quasi-experimental or intervention studies evaluating the effectiveness of adaptation strategies limits the policy utility of the existing literature.

Thematic review/key synthesis

The synthesis of the 32 included studies identified five principal thematic pathways through which climate change affects health outcomes in Nigerian populations:[9,10,16-45] i) thermal stress and heat-related morbidity; ii) waterborne and vector-borne infectious diseases; iii) food and nutrition insecurity; iv) mental health and psychosocial distress; and v) respiratory and cardiovascular conditions.

Thermal stress and heat-related morbidity

Rising ambient temperatures and increasing frequency of heatwaves constitute a direct and expanding health risk across Nigeria. Analysis of 40 years of ERA5-HEAT reanalysis data demonstrated significant upward trends in heat stress, with "very strong" heat stress conditions occurring consistently between March and May annually.[28] Spatial modeling indicates that the Guinea and Sahel ecological zones exhibit the highest increases in thermal stress indices, with expansion of high-risk heat exposure zones over time, suggesting progressive geographic spread of heat vulnerability.[32] At the population level, heat fatigue was the most commonly reported heat-related condition, with higher prevalence during dry-season months compared to wet seasons, indicating predictable seasonal vulnerability patterns.[17] Clinical associations further demonstrate heterogeneous vulnerability. Temperature increases were positively associated with hospital admissions for epilepsy, with children showing greater sensitivity to temperature variation and adults more affected by humidity-related triggers.[29] This suggests that heat-sensitive morbidity extends beyond traditional heat illness categories to include neurological conditions.

Vulnerability to heat stress is strongly socially patterned. Older adults experienced higher rates of climate-sensitive illnesses, particularly respiratory disease and diarrhea, with income, housing quality, and healthcare access acting as key determinants of risk.[35] In addition, poor awareness of heatwave risks and protective behaviors was reported in rural populations, particularly among non-farming groups, indicating gaps in risk communication.[23] Critically, Nigeria currently lacks a coordinated national heat-health early warning and response system, limiting the translation of meteorological information into public health action and increasing preventable heat-related morbidity.

Waterborne and vector-borne infectious diseases

Climate variability influences infectious disease transmission through flooding, altered rainfall patterns, and temperature-dependent changes in vector ecology. Flooding emerged as the most consistently reported climate-related exposure associated with infectious disease outbreaks. In Borno State, flood events disrupted water and sanitation systems, facilitating outbreaks of cholera, malaria, and diarrhea diseases, while simultaneously undermining food security.[16] Cholera surveillance data (2020-2024) showed strong seasonal clustering, with peak incidence during the rainy season (notably August) and concentration in flood-prone urban and peri-urban areas.[24] The 2021 outbreak accounted for nearly 59% of total cases within the period, with a case fatality rate of 2.6%, rising to 6.7% among older adults.[24] Rainfall variability was quantitatively linked to disease incidence, explaining approximately 38% of cholera variation in Damaturu, highlighting a measurable climatic driver of transmission dynamics.[19]

Vector-borne diseases, particularly malaria, demonstrated strong climate sensitivity. Time-series analysis in Ibadan identified significant lagged associations between rainfall, temperature, and malaria incidence, with peak transmission occurring 1-2 months following rainfall peaks.[21] These associations were supported by additional modeling studies identifying rainfall and temperature as key predictive variables.[46] However, more complex modeling suggests non-linear temperature effects, with extreme heat potentially reducing mosquito survival and transmission efficiency.[47] Perceived expansion of vector habitats was widely reported among communities and health workers, with emerging risk for diseases such as dengue fever and yellow fever in previously lower-risk regions.[31] This aligns with ecological projections of climate-driven geographic expansion of vector suitability zones.

Food and nutrition insecurity

Climate change affects food security through reduced agricultural productivity, flood-related crop destruction, and disrupted food distribution systems. These impacts translate directly into nutritional deficits, particularly among vulnerable households. Approximately 48% of farming households were classified as food insecure, with flooding identified as a major contributing factor.[34] Drought and rainfall variability were also associated with reduced crop yields and seasonal food shortages.[25] Households adopting climate adaptation strategies, such as drought-resistant crops and dry-season farming, demonstrated improved food security outcomes, although uptake remains limited by financial, institutional, and informational barriers.[25,34]

Severe nutritional consequences were observed in children and women, particularly in northeastern Nigeria, where climate shocks significantly increased the likelihood of child wasting and acute malnutrition.[45] Severely food-insecure households had approximately three times higher odds of child malnutrition compared to food-secure households.[45] In the Niger Delta, flooding and rainfall irregularity reduced dietary diversity and agricultural output, disproportionately affecting women and children.[26] Climate-induced livelihood loss also contributed to catastrophic health expenditure, as households redirected limited income to manage climate-sensitive illnesses while experiencing reduced agricultural productivity.[27,39]

This reflects a reinforcing cycle linking climate shocks, poverty, and deteriorating health outcomes.

Mental health and psychosocial distress

Mental health impacts of climate change in Nigeria remain under-researched relative to physical health outcomes; however, available evidence indicates substantial psychosocial burden. Flood exposure was consistently associated with elevated anxiety, depression, and post-traumatic stress symptoms, particularly among individuals experiencing loss of property and livelihoods.[30] Qualitative evidence further highlighted emotional distress, hopelessness, and chronic stress in flood-affected communities linked to displacement and livelihood disruption.[20] Gendered impacts were pronounced, with women disproportionately affected due to caregiving burdens, loss of assets, and increased vulnerability in displacement contexts.[20]

Climate variability has also been linked to resource scarcity and farmer–herder conflicts, which exacerbate psychological distress through displacement, violence exposure, and social disruption.[40] Women and children were particularly affected due to disrupted education, social networks, and healthcare access. Emerging evidence suggests increasing climate-related anxiety among young populations, although Nigeria-specific studies remain limited.[20,40] Mental health system capacity remains critically constrained, with very limited workforce availability and minimal integration of psychosocial support into disaster response frameworks, limiting care for climate-affected populations.

Respiratory and cardiovascular conditions

Climate change affects respiratory and cardiovascular health through multiple exposure pathways, including increased heat-related air pollution, desert dust storms, biomass fuel combustion, gas flaring, and urban emissions. In slum environments, elevated PM2.5 exposure above World Health Organization thresholds was associated with approximately twofold increases in asthma prevalence.[43] In the Niger Delta, proximity to gas flaring sites was associated with increased respiratory symptoms, dermatological conditions, and hypertension.[33] Self-reported respiratory symptoms, such as cough, wheezing, and dyspnea, were widely reported and linked to perceived deterioration in air quality.[38] Biomass fuel use further compounds exposure, particularly among low-income households, contributing to chronic respiratory morbidity.[38]

Despite increasing burden, no studies identified in this review used objective clinical or physiological measures of respiratory or cardiovascular function in relation to climate exposures. This limits the precision of effect estimation and constrains causal inference.Given projected increases in dust storms, heat extremes, and air pollution across West Africa, this represents a significant and growing evidence gap.

Discussion

Synthesis of principal findings

This systematic review synthesized evidence from 32 studies to characterize the health impacts of climate change in Nigeria.[9,10,16-45] The evidence demonstrates that climate change is already producing measurable and geographically widespread health effects across multiple disease domains. Five dominant pathways were identified: thermal stress, infectious diseases (waterborne and vector-borne), food and nutrition insecurity, mental health and psychosocial distress, and respiratory and cardiovascular conditions associated with air pollution. Collectively, these findings indicate that climate change in Nigeria is not a prospective risk but an ongoing public health stressor interacting with structural vulnerabilities such as poverty, weak health systems, and environmental degradation. The clustering of studies in recent years (2020-2025) reflects increasing scientific attention, but the evidence base remains fragmented and uneven in methodological quality and spatial coverage.

Comparison with existing research

The findings of this review align with broader global and regional evidence linking climate variability to adverse health outcomes.[46-58] The observed association between flooding and outbreaks of waterborne diseases is consistent with evidence from other flood-prone low- and middle-income country settings, where disruption of water and sanitation systems drives infectious disease transmission. Similarly, the documented relationships between rainfall, temperature variability, and malaria transmission correspond with established findings from sub-Saharan Africa, where climate variability influences vector ecology and disease seasonality.[13] Food insecurity and malnutrition pathways identified in this review also mirror global projections that climate change will disproportionately undermine nutritional outcomes in low-income and climate-sensitive agricultural systems.[4,57-59]

However, the Nigerian evidence base highlights several context-specific dimensions. First, heat stress emerges as a significant but underecognized health burden, shaped by limited adaptive infrastructure such as cooling systems, housing quality, and occupational exposure. This finding is particularly important given persistent underestimation of heat vulnerability in tropical settings.[8] Second, the interaction between climate variability and conflict introduces a compounded vulnerability pathway in Nigeria, particularly in northern and central states.[40] Climate-related resource scarcity appears to intensify existing socio-political tensions, producing displacement and indirect health consequences that extend beyond direct climatic exposure.[58] Third, the mental health impacts observed are consistent with global literature but are amplified in Nigeria by repeated displacement, livelihood insecurity, and limited access to mental health services.[20,30,54-56,59] The psychological burden is therefore both climate-induced and structurally mediated.

Geographical and demographic disparities

A key finding is the pronounced geographical imbalance in the evidence base. The Southwest region is disproportionately represented, likely reflecting research infrastructure concentration and institutional presence, while several states in the Southeast and parts of the North remain entirely or minimally represented.[9,21,29,35,37,43] This uneven distribution introduces a significant evidence bias, as climate–health interactions are highly context-dependent and shaped by ecological, infrastructural, and socioeconomic conditions. Consequently, current evidence may overrepresent urbanized and research-accessible settings while under-representing rural and structurally vulnerable populations.

Demographic gaps are also evident. While children, older adults, and pregnant women are occasionally examined, there is a complete absence of studies focusing on people with disabilities and limited evidence on occupationally exposed groups such as outdoor workers, informal sector workers, and fishing communities.[18] These omissions represent critical blind spots in the current evidence base and limit equity-oriented policy formulation.

Methodological considerations

The predominance of cross-sectional designs significantly constrains causal inference, as temporality between exposure and outcome cannot be established. This limits the ability of existing studies to move beyond association toward causal attribution. In addition, substantial heterogeneity in exposure measurement was observed. Studies variably used objective meteorological datasets, proxy indicators, or self-reported perceptions of climate change. This inconsistency introduces comparability challenges and reduces the potential for quantitative synthesis. Similarly, health outcome measurement varied widely, ranging from clinically confirmed diagnoses to self-reported symptoms. This variability increases measurement error risk and limits cross-study integration.

A particularly important gap is the near absence of longitudinal and quasi-experimental designs, which are essential for identifying cumulative, lagged, and dose–response relationships between climate exposures and health outcomes. Likewise, the absence of intervention studies limits the evidence base for evaluating adaptation effectiveness. As a result, the current literature is primarily descriptive rather than evaluative or predictive.

Strengths and limitations of the study

Strengths

This review provides the most comprehensive synthesis to date of climate change and health outcomes specific to Nigeria. Its strengths include adherence to PRISMA 2020 guidelines, systematic searches across multiple databases, and rigorous dual screening and data extraction procedures. The inclusion of diverse methodological designs enabled a broad synthesis across quantitative and qualitative evidence, enhancing interpretive depth. Furthermore, structured thematic synthesis allowed integration of heterogeneous evidence into coherent analytical pathways, while geographic mapping of included studies enabled identification of spatial evidence gaps critical for national policy planning.

Limitations

The findings of this review should be interpreted in light of several limitations. First, heterogeneity in study designs, exposures, and outcome measures precluded meta-analysis and limited quantitative synthesis. Second, the dominance of cross-sectional studies restricts causal inference and limits temporal interpretation of climate–health relationships. Third, geographical concentration of studies in a limited number of regions reduces national representativeness and may bias conclusions toward more research-active areas. Fourth, variation in study quality introduces uncertainty, particularly where low-quality studies contribute to thematic conclusions. Finally, although grey literature was considered, variability in reporting quality limited its comparability with peer-reviewed studies. These limitations reflect structural weaknesses in the underlying evidence base rather than methodological shortcomings of the review itself. This review is also limited by potential publication bias, as studies with significant findings are more likely to be published. Language bias may exist due to exclusion of non-English studies. The dominance of cross-sectional designs limits inference strength. Additionally, regional evidence gaps may reflect underlying disparities in research capacity rather than true absence of climate-health impacts.

Conclusions

This review demonstrates that climate change is already exerting substantial and multidimensional health impacts across Nigeria. The evidence base, although growing, remains methodologically limited and geographically uneven. Climate-related health risks are distributed across infectious, non-communicable, nutritional, and mental health domains, indicating a complex and interdependent burden profile. Importantly, the findings reinforce that climate change constitutes a current public health emergency in Nigeria rather than a future risk. Existing policy frameworks, including the Climate Change Act (2021) and national adaptation strategies, provide an enabling structure; however, implementation gaps remain substantial.

Recommendations

Based on the findings of this systematic review, the following recommendations are advanced:

1. Strengthen integrated climate–health surveillance systems linking meteorological and disease data across all states.
2. Develop a national heat-health action plan, including early warning systems and public risk communication.
3. Invest in climate-resilient health infrastructure, particularly in flood- and heat-vulnerable regions.
4. Integrate mental health services into disaster preparedness and climate adaptation frameworks.
5. Scale up climate-smart agriculture and nutrition-sensitive interventions for vulnerable populations.
6. Prioritize air pollution control measures, including clean energy transition and regulation of industrial emissions.
7. Expand climate–health research funding toward longitudinal, intervention, and implementation studies.
8. Address geographical and demographic inequities in research and policy targeting, particularly in underrepresented regions and vulnerable groups.

Implications of the study

The findings of this systematic review have important implications for policy, health practice, research prioritization, and international collaboration in Nigeria.

Policy implications

This review provides an evidence base to support the operationalization of Nigeria's Climate Change Act (2021) and the National Climate Change and Health Adaptation Plan (Federal Ministry of Health, 2024).[15] The documented evidence of climate-sensitive health impacts across all geopolitical zones confirms that climate change is a nationwide public health concern requiring coordinated federal-state responses rather than isolated regional interventions. The identification of disproportionately affected populations including children, women, older adults, urban informal settlement residents, and conflict-affected communities provides a clear basis for equity-focused adaptation planning and resource allocation. These findings support the need for targeted vulnerability-based policy design rather than uniform intervention approaches.

Implications for health practice

The review highlights the urgent need to integrate climate risk considerations into routine health service delivery. Health workers

require structured training to identify and manage climate-sensitive conditions, including heat-related illness, climate-associated infectious disease outbreaks, and disaster-related mental health conditions. Primary healthcare systems should incorporate standardized protocols for climate-related health risks, including heatwave response, outbreak preparedness, and psychosocial support following climate shocks. In parallel, surveillance systems should be strengthened to detect climate-sensitive disease patterns in real time and enable early response mechanisms.

Implications for research

This review clarifies the current structure of evidence and highlights significant methodological and geographical gaps. Future research funding should prioritize longitudinal and cohort-based designs, intervention and implementation research, health economic and burden-of-disease studies, health system resilience assessments, and studies in under-represented regions and populations. In addition, methodological diversification is required to move beyond descriptive cross-sectional studies toward analytical and evaluative research capable of informing policy and practice.

Implications for global and development partners

The findings position climate change as a core health system challenge rather than solely an environmental issue. Strengthening climate-resilient health systems in Nigeria should be recognized as a critical component of global health security, given the interconnected risks of climate-sensitive disease emergence and cross-border health threats. International climate finance mechanisms, including adaptation funding streams, should be more explicitly aligned with health system strengthening priorities identified in this review.

Future directions

Future research on climate change and health in Nigeria should prioritize the following strategic areas.

Longitudinal and cohort studies

Multi-site prospective cohort studies across Nigeria's ecological zones are needed to establish temporal and causal relationships between climate exposures and health outcomes. These studies should integrate environmental, health, and socioeconomic variables to capture cumulative and lagged effects.

Evaluation of adaptation interventions

There is an urgent need for rigorous evaluation of adaptation strategies using quasi-experimental, experimental, and mixed-methods designs. Priority areas include heat-health early warning systems, climate-resilient water and sanitation infrastructure, climate-smart agriculture interventions, and disaster-related mental health interventions.

Economic and burden estimation studies

Future studies should quantify the morbidity, mortality, and economic burden attributable to climate change using burden-of-disease and cost-of-illness frameworks. Such evidence is essential for national planning, advocacy, and resource allocation.

Health system resilience research

Systematic assessments of health system preparedness, including infrastructure resilience, workforce capacity, and surveillance integration, are needed to guide climate-resilient health system strengthening.

Expansion of evidence on under-studied outcomes

Research should expand beyond infectious diseases to include cardiovascular and respiratory diseases, mental health outcomes, occupational health risks, and reproductive and maternal health impacts.

Addressing geographic and population gaps

Future studies should prioritize underrepresented regions (particularly the Southeast and parts of the North), rural communities, people with disabilities, and high-exposure occupational groups.

Integrated climate-health data systems

Development of interoperable data systems linking meteorological, environmental, and health datasets is essential to enable real-time surveillance, predictive modelling, and policy responsiveness.

Interdisciplinary and participatory research

Climate-health research should be strengthened through interdisciplinary collaboration across epidemiology, climatology, social sciences, and health systems research. Community engagement should be embedded as a core component of study design, implementation, and dissemination to ensure contextual relevance and uptake.

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Online supplementary material:

Supplementary Table 1. Risk of bias and quality assessment scores of the included studies.

Supplementary Table 2. Summary of the included studies.

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