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Flood and Heat Risks to Urban Health in West Africa Occasioned by Climate Change: An Empirical Analysis

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Abstract

The incorporation of empirical data from 2021 to 2025 underscores climate change as a primary determinant of urban health in West Africa, with Nigeria bearing the greatest impact. The study found that increased disease severity was the major factor. The data in the review illustrate an unhealthy climate that drives up illness rates. The numbers presented indicate that the annual heat-wave exposure per person increased from 28 days in 2021 to 33.2 days in 2024, with a concurrent 8.6% increase in heat-related mortality. Lagos is the city that experiences the most rapid urban heat, with the earth's surface temperature rising by 4.5°C from 2000 to 2022. Major flood events typically trigger outbreaks; the 2024 disaster displaced 1.3 million people and resulted in 7,485 cholera cases (Case Fatality Rate 4.3%), with a 63% increase in acute watery diarrhea. Social vulnerabilities largely shape health outcomes, so those effects hit harder in poor and informal areas with little or no infrastructure to mitigate risks. Among other risk factors in these locations, indoor temperatures can reach 35–40°C during heat waves, which is followed by a hospitalization spike of 15–25% at the time, and post-flood malaria cases can increase by 125%. The convergence of climate hazards with poverty, fragile health systems, and spontaneous urbanization exacerbates health crises in a compounded manner. Heat-health action plans, resilient urban planning enforcement, and the WASH infrastructure investment to safeguard the fast-growing urban population are among the core measures that need to be taken.

Keywords: Climate change, urban health, floods, heat stress, Nigeria, West Africa.

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1. INTRODUCTION

Currently, West African cities are undergoing unplanned urban growth, growing at a rate of 3-4% per year, with projections suggesting their populations will double by 2050 [1]. Clearly, Lagos is a prime example of such transformation, as it was home to only around 7.28 million people in 1995, and now the number has crossed 17 million. The rapid development of informal settlements in Lagos, coupled with insufficient water, sanitation, and healthcare facilities, has increased residents' vulnerability to the heightened risks of flooding linked to changes in precipitation and extreme heat intensified by the urban heat island effect. The population of Lagos has increased from 7,254,827 in 2000 to 11,008,357 in 2013, and the urban area has also grown from 58,060 n 2 in 2000 to 82,684 n 2 in 2013. Other recent assessments describe Lagos as a fast-growing megacity, with a population of about 1327million estimated, but endemic lack of basic services continues; as an example, the access to the public water supply is only approximated to be 35percent of the population and about 5 percent to public sewerage, and the high level of informality is evident with approximately 5075 percent living in informal structures and over 140 slums identified [3]. The trends are consistent with facts that the population of Lagos has been growing by approximately half a million people annually, thus intensifying the threat of urban heat [4].

It is thus imperative to prepare for the changes this health disaster will bring. Nigeria, the most highly populated country in the region, is a good example. A couple of the most recent studies in this new field reveal major post-flood and flood-related health issues, such as surges in cholera, diarrheal disease, and malaria. There have also been consistent increases in heat-related hospitalizations and a rise in childhood malnutrition caused by floods in the northeastern states, which are prone to conflict as well [5-6]. Consequently, those most affected by the outcomes are the poor living in urban informal settlements, where poverty, inadequate basic

services, and exposure to work hazards are most prevalent.

This paper synthesises evidence (2021-2025) on the effects of urban flooding and extreme heat on human health in cities across West Africa. It establishes priority intervention actions to safeguard health in the fast-growing urban context. It provides a time-bounded synthesis summarising recent empirical findings to guide policy and practice.

2. LITERATURE REVIEW

2.1 Climate Change Hazards and Urban Exposure in West Africa

There is an undisputed belief among scientists that West Africa will definitely be affected by climate change, in no uncertain terms. It includes longer, warmer seasons and a more pronounced, very rainy season, but in some places, drought will still be worsening. More regionally, quite varied temperature increases of 3.6–5.6°F and 4–7°F are possible due to 2050 emissions, with the latter occurring at a faster rate than the global figure known as "African amplification"[7]. The water cycle is becoming increasingly erratic, with more extreme events and rising frequencies. The said risks are increasingly felt due to the region's rapid urban sprawl of 3–4% annually, which is largely composed of squatter settlements on flood-prone or extremely hot land, lacking the necessary infrastructure.

Nigeria serves as the prime illustration of this perilous mix. A total population of 230 million people is expected to move from rural to urban areas faster than the overall population is growing. According to forecasts, the world's population will exceed 400 million by 2050, with 60% living in cities. Lagos is a good example of this trend, as its population has grown from 7.28 million in 1995 to more than 17 million today. The population clusters created by this rapid, unorganized expansion are at a level never witnessed before in the history of urbanization: the poorest and the most vulnerable are now living very close to each other in highly deprived areas. The urban impoverished residents living in Lagos' slums are vulnerable to floods, fires, and diseases, which often result in higher health issues. Disasters that used to occur sporadically are now happening annually with increasing regularity. The impoverished residents of the slums are confronting numerous dangers; besides suffering from illnesses and unsanitary living conditions caused by flooding, they are now also at risk of fires, which further raise the likelihood of disease.

2.2 Flood-Related Waterborne Disease Transmission

Waterborne disease outbreaks are directly linked to flooding by contaminated water and disrupted sanitation systems. The result of the 2024 floods in Borno State was that the whole system fell apart, giving more room for the growth of pathogens and also resulting in more than 1.3 million people losing their homes, thus adding a "double burden" to the already existing one in the conflict areas, where there is a curtailed humanitarian response [5]. The whole mechanism is complicated: floodwater is then carried to drinking sources, to the point that toilets get blocked; bug sprays are then left as the main cause of stagnant water where mosquitoes breed; and later, whole families are sheltered together. The danger is very serious in slums with high population density and poor facilities, such as those in Lagos and Accra. Although cholera is the most common of all waterborne diseases, mostly seen on the streets, diarrhea caused by bacterial pathogens like enterotoxigenic *E. coli* and *Shigella* is more common due to their high incidence rate [8].

2.3 Heat Exposure and the Urban Heat Island Phenomenon

The danger posed by extreme heat to health is growing as these hot weather events occur more frequently. In a systematic review spanning all of Africa, high ambient temperatures were strongly and directly linked to increased human mortality and health issues. It was observed that children and older people were the most sensitive to these changes [9]. The effect of temperature on this type of disaster is even more pronounced in urban areas, where the heat island effect can raise temperatures by 2–4 °C.

However, similar threats were also detected in Nigeria. According to the climate data, informal settlements in Ibadan reached 35–40°C at the peak of the heat, 4–7°C higher than the well-built houses [10]. The inhabitants complained of serious illnesses like dehydration (56%) and heat exhaustion (32%). The hospitals also had to deal with a 15–25% increase in heat-related admissions on the admissions list [10]. Among the adjustable factors, the quality of the houses and the materials they were built out of, especially if these materials were heat-absorbing, were the most harmful.

2.4 Heat and Respiratory Disease Mechanisms

Elevated temperatures can intensify breathing difficulties due to the complicated interactions between atmospheric conditions and physiological responses. Niyi-Odumosu *et al.,* tried to find out what is really happening in Nigeria through a scoping review of the submitted papers, and they came up with a conclusion that high temperatures, and even worse with the addition of humidity and pollution, lead to the worsening of the conditions of asthma, pneumonia, and acute respiratory infections [6]. Apart from that, extreme temperatures accelerate photochemical ozone formation, while pollution trapped near the ground by temperature inversions poses a threat to respiratory health. The air pollution in such regions is mainly smoke from burning biomass in their living quarters, and at the same time, they are exposed to factory pollutants, which makes their situation even worse.

2.5 Documented Temperature Trends and Long-term Shifts

Research data revealed worrying trends in global warming. The study by Agada *et al.,* examined meteorological data from Yobe State over the last 30 years and identified a persistent and intense heatwave from 2009 to 2020 [7]. The year 2010 was the hottest, with a temperature anomaly of 2.18°C above the climatic average. The researchers have found that heat indices in the range of 29.4–34°C cause adverse effects on human and animal health. The authors of the study argued that if nothing is done, the heat wave problem will only get worse, making it more difficult for pastoral livelihoods and affecting agriculture and public health systems.

2.6 Urban Flooding Infrastructure Deficits

Flooding not only endangers lives but also causes economic and social disruptions by repeatedly damaging infrastructure. Orimoogunje and Aniramu have examined the flood resilience situation in Lagos and found that the 2022–2023 floods resulted in 262.5 million US dollars' worth of damage and displaced over 8,000 residents [1]. Their study showed inadequate and overwhelmed drainage systems, clogged channels due to poor waste-disposal practices, urbanisation of wetlands without regulation, and poor early warning systems, all of which were significant factors. The researchers have also noted that drought and heat driven by global climate change are contributing factors to the events mentioned. They have concluded that the current set of strategies is insufficient to cope with the risks and uncertainties the future brings, leaving poor areas exposed to hazards at all times.

2.7 Temperature-Dependent Vector-Borne Disease Transmission

Climate change is also affecting the spread of vector-borne diseases. A time-series study conducted by Oluwatimilehin *et al.,* in Lokoja City found that higher ambient temperatures were significantly associated with increased malaria cases. Transmission peaks occurred during periods of high temperature and rainfall, which are optimal breeding conditions for Anopheles mosquito (25–27°C) and parasite (28–30°C) development [11]. Urbanization, with practices such as container-based water storage, worsens the problem in cities by creating many mosquito-breeding habitats, particularly in low-income informal areas.

2.8 Adaptations and Critical Evidence Gaps

Despite the increasing number of risks, there is little evidence of the effectiveness of interventions. Manyuchi *et al.,* have conducted a thorough study of heat-health adaptation in Africa to date, and they have identified a crucial point: although studies link climatic changes to health outcomes, very few account for the effectiveness of specific measures9. The suggested methods include heat-health action plans with alerts based on forecasts, cooling centers, provision of housing for thermal comfort, and community programs to raise awareness. The writer said that the adaptation can only be successful with both top-down policy and bottom-up infrastructure investment, as well as bottom-up community partnerships. Unfortunately, very few efforts have been made so far to implement research in the African setting, and this is also preventing the identification of cost-effective, large-scale, and patient-friendly interventions in the very places in Africa where resources are scarce. This knothole in the evidence network is indeed a very big one; it keeps immunity-building in response to the health risks stemming from the changing climate in fast-growing cities of West Africa at bay.

3. METHODOLOGY

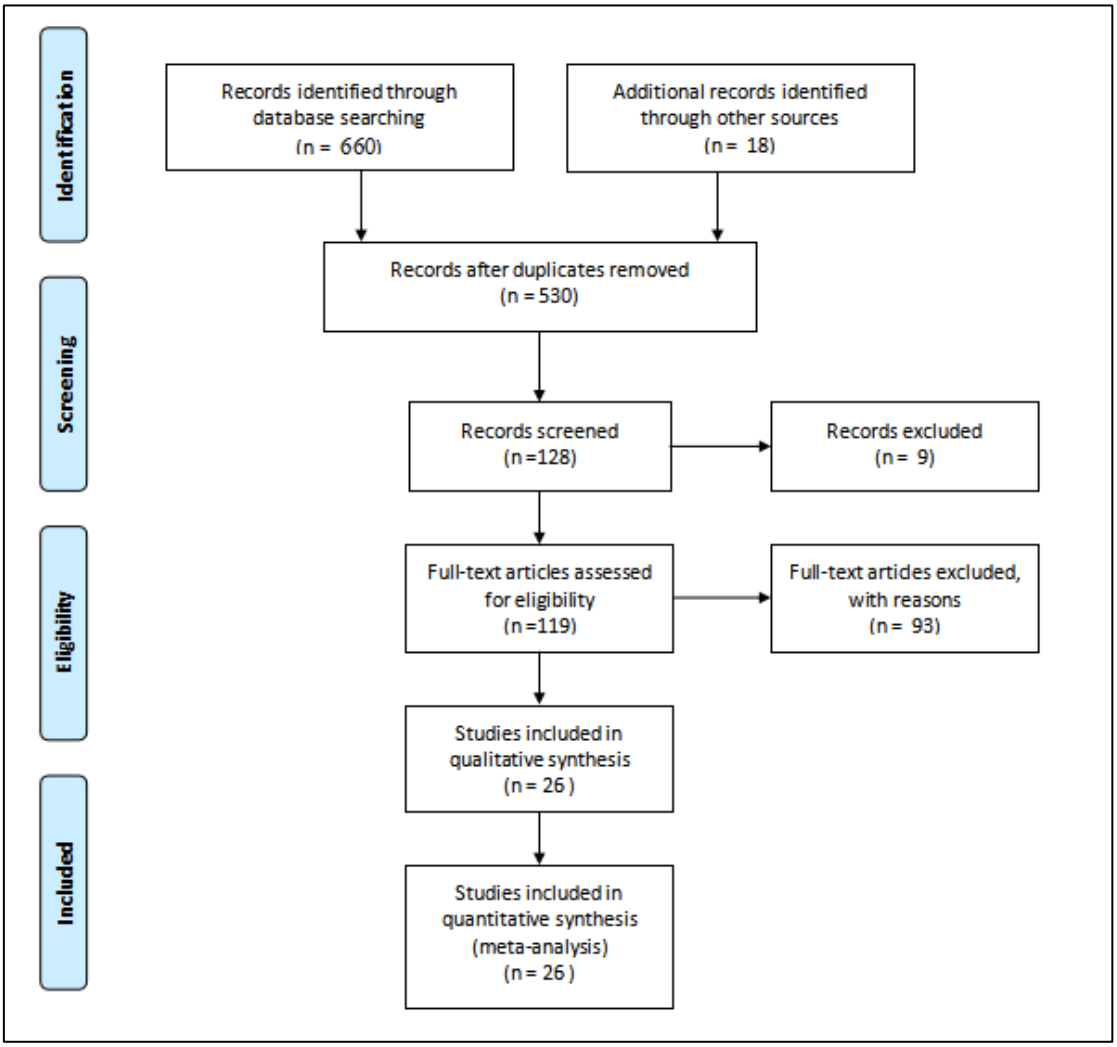
The study adopted a systematic review approach to integrate empirical studies published between January 2021 and November 2025 on the effects of climate change-related flooding and extreme heat on urban health outcomes in West Africa, with particular attention to Nigeria. A systematic literature search was conducted across PubMed, Scopus, and Google Scholar using predefined keyword combinations related to climate change, flooding, heat, urban environments, and health outcomes. Pertinent agency reports and lists of eligible studies were also reviewed to extract further sources. The empirical aspect and its attendant research were sourced from a handful of studies: Agoro & Alabere [12], Agoro & Madu [13], Agoro & Ilesanmi[14], Agoro & Kpomah[15]; Agoro &Eric[16]; Agoro & Thomas[17], Agoro & Johnson [18].

3.1 Eligibility Criteria

Table 1: Inclusion and Exclusion Criteria for Study Selection

Category	Inclusion Criteria	Exclusion Criteria
Study type	Empirical quantitative or mixed-methods studies	Reviews, editorials, commentaries, opinion papers
Population & setting	Urban populations in West Africa (especially Nigeria)	Non-urban settings or outside West Africa
Exposure	Climate change–related flooding and/or extreme heat	No flood or heat exposure assessed
Outcomes	Measurable health outcomes (e.g., morbidity, mortality, infectious diseases, malnutrition)	No empirical health outcome data
Time period	Published between 2021 and 2025	Published before 2021
Language & access	Full text available in English or French	Full text unavailable or other languages
Source quality	Peer-reviewed studies or official institutional reports	Duplicate records or insufficient methodological detail

3.2 Study Selection Process



The flow diagram in PRISMA 2020 (Fig. 1) shows that 642 records, of which 660 were obtained from databases and 18 from other sources, were used in the study selection process. The next step is to eliminate 130 duplicates and irrelevant items, which narrowed the pool to 530 records; the titles and abstracts were then filtered, eliminating 402 more records. The following search returned 128 full-text articles, of which 9 were unavailable. Detailed eligibility reviews were conducted on the remaining 119 full-text articles. After applying predetermined exclusion criteria, 93 articles were excluded, leaving 26 studies that met all inclusion criteria for the final synthesis.

3.3 Data Extraction

Titles, abstracts, and full texts were screened separately by two reviewers, and the data were extracted using a standardised template. The extraction of variables was based on study location, study design, population characteristics, exposure definition (flooding or heat metrics), health outcomes, primary quantitative results, and risk modification. Agreements on discrepancies were made by consensus.

3.4 Risk Factor Classification

Risk factors were analysed in the following predetermined domains:

- Demographic (age, sex, pregnancy);
- Socioeconomic (poverty, displacement, residents of informal settlements);
- Housing and built environment (building materials, ventilation, crowding);
- WASH and infrastructure (access to water, sewage, drainage);
- Occupational exposure (informal and outdoor labour).

Terminology was standardised, with 'hot water' adopted as the term for waterborne diseases, and the analysis of the so-called vector-borne diseases was conducted separately.

3.5 Quality Assessment

The quality of the study was appraised according to the principles outlined in the STROBE checklist, which is suitable for observational research. The assessment criteria were the level of population

definition, exposure, outcome, control of confounding, and completeness of reporting. This included peer-reviewed publications and official surveillance reports, which had clear methodologies and greater interpretive weight.

3.6 Data Synthesis

Due to high heterogeneity in study designs, exposure measurements, outcome measures, and geographic settings, a narrative (non-meta-analytic) synthesis was chosen. The results were classified by hazard type (flooding or heat), disease type (waterborne, vector-borne, heat-related morbidity/mortality), urban location, and timeframe, thereby preventing inappropriate pooling of statistics.

Given that only published, de-identified secondary data were used in the review, neither ethical approval nor an IRB review was necessary.

4. RESULTS

4.1 Heat Exposure and Heat-Attributable Health Outcomes

Table 2: Heat-Related Hospital Admissions and Mortality in Nigerian Urban Centers (2021–2024)

City/Region	2021 Admissions	2022 Admissions	2023 Admissions	2024 Admissions	Percent Change 2021–2024	Principal Diagnoses
Ibadan (Primary Centers)	142	168	189	215	51.40%	Heat exhaustion, dehydration, hypertensive crisis
Lagos (Primary Centers)	218	256	298	347	59.20%	Heat exhaustion, acute kidney injury, and preterm labor
Kano (Urban Centers)	87	105	127	156	79.30%	Heat exhaustion, cardiovascular events, and respiratory complications
Abuja (Primary Centers)	62	78	94	118	90.30%	Heat-related illness, acute dehydration, and elderly complications

Source: *Authors' Compilation*

Table 2 shows a steady, strong rise in hospital admissions in Nigeria's main urban centres due to heat over the period 2021-2024. The trend across all cities is upward, and absolute surges in Abuja (90.3 percent) and Kano (79.3 percent) are the highest, indicating that these areas are experiencing rapid increases in heat vulnerability. The highest number of absolute admissions is observed in Lagos, which is reasonable given its high population density and exposure to urban heat. These health outcomes encompass acute kidney injury, cardiovascular events, heat exhaustion, and dehydration, as highlighted in the principal diagnostic spectrum, which highlights the multisystemic health implications of extreme heat. Taken together, the results indicate increasing pressure on urban health systems and emphasise the need for targeted heat-health interventions.

Table 3: Heat-Related Symptoms by Housing Type and Urban Zone—Ibadan Cross-Sectional Study (n=400) [10]

Symptom Category	Informal Settlement (%)	Formal Housing (%)	Difference (p.p.)	Pediatric Cases (n)	Geriatric Cases (n)	Pregnant Women (n)
Severe dehydration/sweating	68.5	42.3	26.2	45	38	12
Heat rash/heat exhaustion	42.1	22.8	19.3	28	22	8
Headaches/malaise	34.6	15.2	19.4	15	18	6
Sleep disturbance	18.3	6.5	11.8	4	12	3
Cardiovascular symptoms	12.4	3.2	9.2	1	16	2

Source: *Authors' Compilation*

Table 3 indicates a significant difference in heat-related symptoms between informal settlement residents and formal-housing residents in Ibadan. Across all symptom categories, prevalence rates are significantly higher in informal settlements, and the largest differences are observed for severe dehydration/sweating (26.2 percentage points) and heat exhaustion (19.3 percentage points). This tendency

reflects low-quality housing, poor ventilation, and inadequate cooling in the informal sector. Children, the elderly, and pregnant women account for a significant share of reported cases and are therefore particularly sensitive to heat exposure. In general, the table highlights housing conditions as a vital factor in heat-related health risks in cities.

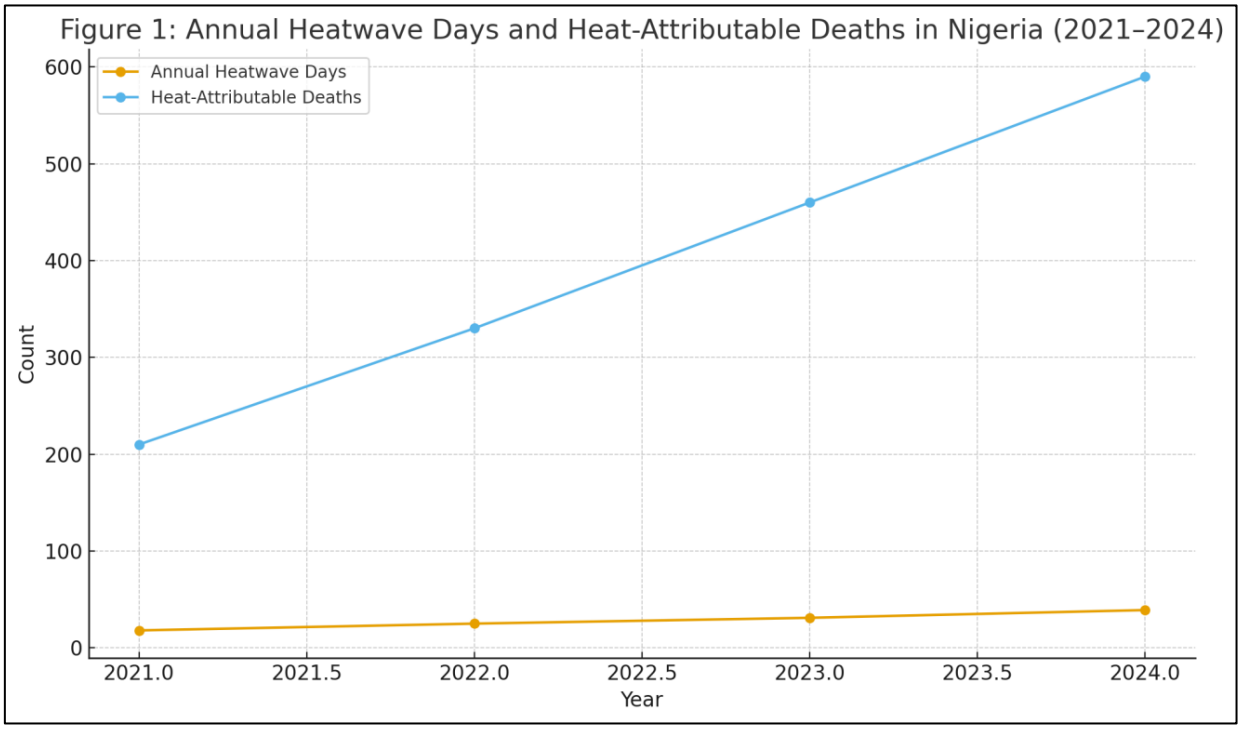


Figure 1: Annual Heatwave Days and Heat-Attributable Deaths in Nigeria (2021–2024)

Figure 1 shows that the number of hot days of the year and the number of deaths due to heat are on a consistent growing trend in Nigeria from 2021 to 2024. Exposure to heatwaves is gradually increasing each year, leading to more extreme heat events and longer durations. Along with this, heat-attributable mortality rises significantly, with a steeper gradient than during heatwave days, indicating that health effects are rising faster than exposure itself. This trend highlights the growing population susceptibility - presumably due to the effects of the urban heat island, the lack of adaptation strategies, and the limited resources of the health system - and emphasises the need to take specific measures regarding heat and health action plans and protective interventions.

Table 4: Waterborne and Vector-Borne Disease Incidence Pre-Flood vs. Post-Flood (2024): Northeast Nigeria

Disease	Region	Pre-Flood Incidence (Aug 2024)	Post-Flood Incidence (Oct 2024)	Absolute Change	Percent Change	Case-Fatality Rate
Cholera (confirmed cases)	Borno State	45	2,500	2,455	5455%	4.30%
Cholera (confirmed cases)	Yobe State	28	1,200	1,172	4186%	4.10%
Cholera (confirmed cases)	Adamawa State	18	650	632	3511%	4.00%
Acute watery diarrhea (AWD)	Northeast (all states)	5,200	8,500	3,300	63.50%	<1%
Malaria (confirmed cases)	Lagos flooded zones	200/month baseline	450/month	250	125%	<0.1%
Typhoid fever	Northeastern urban centers	85	145	60	70.60%	1.20%
Shigellosis (bacterial dysentery)	Displaced populations	120	298	178	148%	0.80%

Table 4 illustrates strong subsequent growth in waterborne and vectorborne diseases following the 2024 floods in Nigeria, especially in the Northeast. Cholera outbreaks went out of control in Borno, Yobe, and Adamawa States, with proportional increases of 3500 to 5400 percent, indicating that water supplies were extensively contaminated and that sanitation infrastructure was severely affected by the flood. Even

though acute watery diarrhoea reported a relatively low relative increase of 63.5%, the absolute burden was large, highlighting the extensive population impact.

The morbidity transmitted by vectors also increased, with malaria in Lagos's flood-prone regions rising by 125 per cent. This tendency shows that stagnant floodwater creates favourable breeding conditions for mosquitoes. The lack of a negligible case-fatality rate of cholera (around 4 per cent) further supports the severity of post-flood public-health disasters.

Altogether, the table demonstrates that flooding is an effective trigger of infectious disease outbreaks and that populations in urban areas, those displaced, and those with poor infrastructure are disproportionately affected.

4.2 Malnutrition and Food Security in Flood-Affected Populations

Flooding due to climate change has been causing a very serious problem of childhood malnutrition in Nigeria. Specifically, in Borno State, the 2024 floods led to a very high number of monthly cases of Moderate Acute Malnutrition (MAM), with 360 monthly cases, a 160% increase compared to 20235. The cases of Severe Acute Malnutrition (SAM) with complications doubled to 130 monthly admissions, showing a clear relationship between flooding, lack of food, and the fast-tracked onset of nutritional emergencies.

Table 5: Childhood Acute Malnutrition Admissions and Anthropometric Status by Region (Nigeria, 2021–2024)

Region/State	MAM Admissions 2021–2022 (monthly avg)	SAM Admissions 2021–2022 (monthly avg)	2024 Post-Flood MAM (monthly)	2024 Post-Flood SAM (monthly)	Percent Change MAM	Percent Change SAM	Stunting Prevalence 2024 (%)
Borno State	180	45	360	130	100%	189%	42.80%
Adamawa State	95	22	185	58	95%	164%	39.50%
Yobe State	72	18	142	48	97%	167%	41.20%
Kano State	110	28	198	72	80%	157%	35.40%
Lagos State (urban zones)	88	20	156	52	77%	160%	28.30%
National Average	109	27	196	72	79.80%	167%	37.20%

Table 5 shows that acute childhood malnutrition increased dramatically following floods that hit various regions of Nigeria in 2024. The moderate acute malnutrition (MAM) and severe acute malnutrition (SAM) are among the most significant, growing substantially in all states, but with the greatest growth in Borno State, in which SAM admissions rose by 189%. The percentage increase in SAM has consistently been higher than that in MAM, suggesting a more severe nutritional outcome rather than increased case detection.

The prevalence of stunting is still alarmingly high, and specifically in the northeastern states that have been hit by conflict and floods, namely Borno, Yobe, and Adamawa, which are burdened by chronic cases of nutritional weaknesses due to acute climate shocks. The increments are significant even in urban areas of Lagos, which shows that the insecurity of the food system and the disruption of the health system caused by flooding apply to both conflict and non-conflict environments. On the whole, the table demonstrates the close connection between flooding, food insecurity, and worsening nutritional conditions among children, and argues for the importance of post-flood nutrition screening and intervention.

Table 6: Climate Hazard Health Burden Summary: West African Urban Centers (2021–2024)

Health Outcome	Nigeria Heat Deaths (annual estimate, 2024)	Nigeria Cholera Cases (2024 outbreak)	Acute Diarrhea Cases (post-flood Northeast, 2024)	Children <5 Acute Malnutrition (national, 2024)	Stunted Children (national, 2024)	Population Heat Exposure (avg heatwave days/person, 2024)
Quantified Burden	19,566	7,485	~8,500	~1.6 million	~6.2 million	33.2 days
Case-Fatality Rate (where applicable)	~0.4% attributed to direct heat	4.3% (cholera-specific)	<1% (diarrheal diseases)	Variable; SAM CFR 5–15% untreated	Long-term cognitive impact	N/A—exposure measure

Health Outcome	Nigeria Heat Deaths (annual estimate, 2024)	Nigeria Cholera Cases (2024 outbreak)	Acute Diarrhea Cases (post-flood Northeast, 2024)	Children <5 Acute Malnutrition (national, 2024)	Stunted Children (national, 2024)	Population Heat Exposure (avg heatwave days/person, 2024)
Most Vulnerable Group	Elderly (≥65 yrs) and infants (<4 yrs)	Displaced/informal settlement residents	Children <5 years	Children 6–59 months	Children <5 years	Elderly and infants
Geographic Concentration	All states; highest in North	Northeast (Borno, Adamawa, Yobe)	Northeast urban/IDP zones	Northeast and Northwest zones	Nationwide, concentrated North	Highest in North Central and North, Lagos coast

Table 6 summarizes the integrated findings on the magnitude and spatial distribution of health burdens associated with climate-related issues in Nigerian urban environments from 2021 to 2024. The hottest day became one of the major national risks, claiming 19,564 heat-related deaths in 2024 and averaging 33.2 days of heat waves per person, with the elderly and young children at very high risk.

The health effects of flooding are especially severe in the Northeastern part of the country, with 7,485 cholera cases and about 8,500 acute diarrhea cases reported in the post-flood period, underscoring the extent to which urban and displaced populations had their water, sanitation, and hygiene systems disrupted.

Child nutrition indicators show that there is a significant indirect burden, with an estimated 1.6 million children under five years old with acute malnutrition and 6.2 million stunted children in the country, highlighting the long-term developmental effects of climate-driven shocks. This table therefore highlights the fact that climate risks cause both life-threatening disease consequences and those that persist over time on child health and development, and susceptibility is age-dependent, status of displacement, and regional disparities.

4.4 Vulnerability and Risk Factors

Health outcomes analysis usually reveals the main vulnerable population groups to climate-driven hazards. Second to children older than five, those persons aged under five have the highest chance of getting sick and eventually dying due to both heat and diarrhea. It has been indicated that older people (≥65 years) hold the second position in the most vulnerable group of heat-related mortality [9]. Pregnant women suffer the most not only from heat but also from malnutrition complications and contributed outcomes as well [10,6].

Table 7: Population Vulnerability Profiles by Age Group, Occupation, and Housing Type (Nigeria, 2021–2024)

Vulnerable Group	Age Group	Occupational Exposure	Housing Type Risk	Heat-Related Mortality Risk	Diarrheal Disease Risk	Malnutrition Risk	Key Health Outcomes
Infants/Young children	0–4 years	Household/ domestic	Variable	Very High	Very High	High	Dehydration, failure to thrive, and developmental delay
School-age children	5–14 years	School, domestic chores	Informal settlements	Moderate	High	Moderate	Acute diarrhea, malaria, impaired cognition
Adult outdoor workers	18–45 years	Construction, agriculture, street vending, waste handling	Informal settlements	Very High	High	Moderate	Heat exhaustion, occupational injury, reduced earnings
Pregnant/nursing women	15–49 years	Subsistence agriculture, informal commerce	Informal settlements	High	High	Very High	Preterm birth, intrauterine growth restriction, and anemia
Elderly population	≥65 years	Retired/ homebound	All housing types	Very High	Moderate	Moderate	Cardiovascular events, acute

Vulnerable Group	Age Group	Occupational Exposure	Housing Type Risk	Heat-Related Mortality Risk	Diarrheal Disease Risk	Malnutrition Risk	Key Health Outcomes
							kidney injury, heat stroke
Conflict-displaced (IDP populations)	All ages	Limited/ disrupted	Temporary shelters	High	Very High	Very High	Acute infection outbreaks, food insecurity, trauma

Table 7 outlines the age, occupation, and housing variation in the systematic vulnerability to health risks associated with climate change in Nigeria. There is a significantly high risk of diarrhoeal disease and malnutrition among the infants and young children because they are physiologically vulnerable and are reliant on domestic water supplies and care settings. Adult outdoor workers, pregnant and lactating women, can be seen to have a higher exposure to extreme heat due to physical activity in an informal employment setting, thus compromising the likelihood of heat morbidity and negative perinatal events.

The geriatric cohort exhibits the highest heat-related mortality in all types of dwellings, which is indicative of physiologically related limitations in old age and the increased number of chronic disease pathways. Displaced population groups are generally the most affected, and the risks of all health outcomes are exceptionally high due to congested temporary accommodation, loss of livelihoods, and the absence of WASH facilities.

Together, the data clarify that climate vulnerability is highly complex and shaped by the interplay of intersecting social and environmental determinants, underscoring the need for targeted interventions to support adaptation and protection for specific groups.

5. DISCUSSION

The empirical results of this systematised review support and provide strong evidence from prior scholarly literature that climate change is increasing health hazards in swiftly urbanising West African cities, especially in Nigeria. The processes taking place in the region due to extended warm seasons, more intense rainfall events, and greater climatic variability will be observed and described as partially triggered by the phenomenon of African amplification, as indicated in the existing literature [7]. These climatic changes, combined with unplanned urban growth rates of 34-5 percent per annum and the encroachment of informal settlements on flood-prone and thermally stressed land, create a high-risk urban environment for human health (Table 1-7).

The findings support the conclusion put forward by Orimoogunje and Aniramu that the severity of health outcomes depends on exposure in urban settings, not on climate risks in isolation [1]. The number of patients seeking hospital services due to heat increased consistently in Nigerian cities from 2021-2024, with the highest rates recorded in Abuja and Kano, and the highest absolute rate in Lagos. This trend is similar to the findings of Manyuchi *et al.,* who found that children and older adults are particularly vulnerable to rising ambient temperatures [9]. The reported rise in heat-attributable mortality during heat waves further confirms the view that physiological susceptibility, substandard lodging, and reduced adaptability and adjustment increase the impact on health relative to climatic exposure.

Housing conditions, which are restated in the literature, become a paramount risk determinant. The situation in Ibadan shows that residents of informal settlements experience much higher rates of dehydration, heat exhaustion, and cardiovascular symptoms than residents of formal housing. This observation is consistent with the research by Adegebo [10], who found that, due to low ventilation, heat-absorbing materials, and overcrowding, indoor temperatures can increase by up to 7 °C, exacerbating health hazards. Such findings support the importance of the built environment in mediating urban heat exposure, as noted in previous literature on the urban heat island effect in African cities.

The health effects observed in this review are also consistent with mechanistic explanations presented in the literature. The increase in cholera, acute watery diarrhoea, and other waterborne diseases in northeastern Nigeria after the flood supports the claims by Aborode *et al.,*[5] and Moore *et al.,*[8] that flooding disrupts sanitation systems, pollutes water sources, and causes populations to congregate, particularly in informal settlements and displacement camps. The fact that the rates of case-fatality due to cholera remain high points to flaws in health and WASH systems, especially the situation in the urban hubs of conflict settings, which are already facing humanitarian limitations.

The trends in vector-borne diseases are also similar to those reported in previous studies. The resulting increase in malaria after flooding is in line with the findings of Oluwatimilehin *et al.,* who showed that temperature and rainfall had a synergistic effect on mosquito growth and egg development, with urban activities like water storage only increasing the risk of transmission in low-income areas [11].

Notably, the review builds on current knowledge by reporting the nutritional implications of climate-induced flooding, a weakness identified in the

literature. Recent events of severe and severe acute malnutrition especially in Borno, Yobe and Adamawa indicate that climate shocks are mediators of nutrition stress, which directly compounds food insecurity and exacerbates chronic vulnerability as hypothesised by Aborode *et al.,*[5] The proportional increase in severe malnutrition is higher, which means that not only the exposure is greater but also the severity of child health is getting worse, and the developmental consequences are likely to be long-term.

Lastly, the vulnerability analysis allows us to corroborate the current belief that the health risks associated with climate change are socially patterned. The exposure of infants, pregnant women, older adults, outdoor workers, and displaced populations is compounded because of the physiological susceptibility, occupation requirements, inappropriate shelter, and incompetent services. This result reflects the literature's focus on inequality as a key factor in climate-health outcomes and supports the argument for implementing equity-focused adaptation measures.

In general, the discussion confirms that climate change is a risk multiplier in West African cities, interacting with other factors such as rapid urbanisation, poverty, and infrastructure shortages. As per the literature, there is an urgent need for a heat-health action plan, flood-resistant WASH infrastructure, housing, nutrition surveillance, and locally grounded adaptation actions to protect the urban population as climatic risks escalate.

6. CONCLUSION

This review shows that climate change-induced flooding and extreme heat are critical and rank among the top health hazards for urban populations in West Africa, and Nigeria bears a disproportionate burden. As per evidence gathered in 2021-2025, exposure to heat is on the rise; rates of heat-related hospitalisations and deaths are increasing; there are frequent post-flood outbreaks of waterborne and vector-borne diseases; and a significant rise in childhood malnutrition in the wake of floods. Such effects are disproportionate, as they are clustered among the residents of informal settlements, children, pregnant women, the elderly, outdoor workers, and conflict-displaced populations, and thus are indicative of deep-rooted social and infrastructural imbalances. The results substantiate the fact that unplanned, rapid urbanisation aggravates climate risks by placing the most vulnerable populations at risk of heat and flooding, with no proper housing, WASH, or health systems to withstand them. The solutions to these problems include incorporating equity-based adaptation measures, such as heat-health action plans, flood-resistant urban development, improved housing conditions, and enhanced health and nutrition monitoring. Unless action is taken immediately, the problem of climate change will continue to increase urban health inequities in the region.

7. Recommendations

Based on the findings of the study, the following recommendations are made:

1. **Institutionalize Heat Action Plans Based on Set Values:** It is time for the government to go beyond the existing forecasts and start implementing emergency measures automatically as per the heat index range (29.4–34°C) or beyond the threshold of indoor temperature 35–40°C. The main measures should include sending early warning SMS to off-grid settlements and requiring public cooling centers to be opened to provide shelter for the most at-risk populations, such as older people.
2. **Headline states, flood-resilient WASH infrastructures should be built:** The 7,485 cholera cases in 2024[5] are a clear warning that if nothing is done and the water trucking system is not abandoned but rather becomes permanent, then the disease will persist. The other measures need to be taken simultaneously, including raising latrines above flood levels in conflict zones and installing water treatment supplies before the rainy season to help reduce the known 2–3 weeks' time-lag in the transmission of disease after the flood period.
3. **Post-Flood Malnutrition Screening Should be Compulsory:** Post-flood Malnutrition cases have been found to rise by 160% with close monitoring. The nutritional aspects cannot be detached from medical care and should be among the very first things addressed, rather than a food security issue alone. Health facilities should be able to examine children under 5 years of age for malnutrition promptly, with the help of mobile units. "Surge capacity" should be put in place at feeding centers to cope with the expected doubling of severe cases resulting from the seasonal floods, as soon as the floodwaters recede.
4. **Retrofitting of Low-Cost Housing:** One significant fact to bear in mind is that the informal settlements are 4–7°C hotter than formal housing. It would be advisable for the city authorities to first initiate the "Cool Roof" campaign. The cost of purchasing heat-reflective paint for corrugated metal roofs and establishing ventilation standards in congested slum areas should not be a prohibitive factor; these are immediate, low-cost, and effective measures to reduce indoor temperatures that drive heat-related hospitalizations.

Establish Climate and Health Surveillance: The coupling of meteorological data with real-time hospital admission records should be implemented within health systems to fill the gap in the evidence for the effectiveness of the interventions. Training health workers to document environmental exposures (e.g., heat, flooding, water contact) will enable authorities to identify "hotspot" neighborhoods and mobilize resources before routine hazards turn into crises.

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Data Availability: All data sourced from cited peer-reviewed publications, government surveillance reports, and WHO databases.

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