Climate Change and Health Outcomes in Urban Slums: A case of Lagos Nigeria

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Abstract

Urban slums in Lagos, Nigeria, face significant health risks due to climate change, including extreme heat, flooding, and air pollution. This study examines the impacts of these climate-related factors on health outcomes among vulnerable populations in three Lagos slum communities: Makoko, Ajegunle, and Ijora Badia. Using a cross-sectional mixed-methods design, quantitative data from 600 households and qualitative insights from interviews and focus group discussions were analyzed. The findings reveal that 35% of respondents' experienced heat-related illnesses, 48% suffered from waterborne diseases linked to flooding, and 42% reported respiratory conditions exacerbated by air pollution. Households in flood-prone areas were 3.5 times more likely to report waterborne diseases, while exposure to PM2.5 above WHO standards increased asthma cases twofold. Residents highlighted systemic issues, including inadequate healthcare access and poor infrastructure, as barriers to resilience. This study underscores the urgent need for targeted interventions, including flood mitigation infrastructure, air quality regulations, and health education programs, to protect the health and well-being of slum dwellers. Addressing these challenges is critical for enhancing community resilience and improving health outcomes in the face of escalating climate change impacts.

Keywords: Climate change, health outcomes, urban slums, Lagos, Nigeria, extreme heat, flooding, air pollution.

Introduction:

Climate change is a global issue that significantly affects human health, especially in urban slums. Urban slums, often characterized by overcrowded living conditions, poor sanitation, and limited access to healthcare, are highly vulnerable to the effects of climate change (Adelekan et al., 2021). In Lagos, Nigeria, these challenges are particularly pronounced due to rapid urbanization and population growth. This city experiences extreme heat, flooding, and air pollution, all of which can worsen health outcomes for slum residents (Owoeye & Yusoff, 2020).

Extreme heat can lead to heat-related illnesses, such as heat exhaustion and heatstroke (Kjellstrom et al., 2019). In slums, where many people lack adequate shelter and cooling systems, the risks associated with high temperatures are elevated. Additionally, flooding can disrupt access to clean water and sanitation, increasing the risk of waterborne diseases (Nwankwo et al., 2022). Air pollution, often caused by industrial activities and vehicle emissions, can exacerbate respiratory problems and other health issues (Mokhtar et al., 2021).

Understanding how climate change affects health in urban slums is crucial for developing effective public health strategies. This research aims to investigate the specific impacts of extreme heat, flooding, and air pollution on health outcomes in Lagos urban slums. By focusing on these factors, the study hopes to provide valuable insights that can help inform policymakers and health practitioners to better support vulnerable populations.

Statement of the Problem

Urban slums in Lagos, Nigeria, face significant health challenges due to climate change. Extreme heat, flooding, and air pollution are becoming more frequent and intense due to global warming (World Health Organization [WHO], 2021). These climate issues lead to serious health problems, especially for vulnerable populations in urban slums.

Firstly, extreme heat can increase the risk of heat-related illnesses, such as heat exhaustion and heat stroke (Kovacs & Kóbor, 2022). In many slum areas, people lack access to cooling facilities, making them more susceptible to these health risks. Secondly, flooding can damage homes and lead to the spread of waterborne diseases, such as cholera and malaria (Ogunyemi et al., 2020). This situation is particularly alarming in slums where sanitation facilities are often inadequate.

Moreover, air pollution in Lagos is a growing concern, as it can cause respiratory issues and other chronic health problems (Iweala & Adesanya, 2021). Polluted air, combined with heat stress, can exacerbate existing health conditions, making it difficult for residents to maintain their well-being.

Despite the increasing acknowledgment of climate change impacts globally, there is limited research focusing on how these changes affect health outcomes specifically in urban slums of Lagos. This gap in knowledge hinders effective policy-making and intervention strategies that could protect the health of these vulnerable communities. Understanding the specific health risks posed by climate change in Lagos's urban slums is crucial for developing targeted response strategies.

Objective of the Study:

The objective of this study is to explore how climate change affects the health of people living in urban slums in Lagos, Nigeria. We will focus on extreme heat, flooding, and air pollution, and aim to identify the specific health problems these issues cause in slum communities. This research hopes to provide important information that can help improve health programs and policies for better living conditions in these areas.

Literature Review:

1. Introduction

Climate change refers to long-term changes in temperature, precipitation, and other atmospheric conditions on Earth (IPCC, 2021). It is primarily caused by human activities, such as burning fossil fuels and deforestation, which increase greenhouse gases in the atmosphere. The effects of climate change are felt globally, leading to extreme weather events, rising sea levels, and shifts in ecosystems (NASA, 2020). These changes can significantly impact food security, access to clean water, and public health.

Urban slums are densely populated areas found in cities, especially in developing countries like Nigeria. In Nigeria, cities such as Lagos have large slum areas where many residents live without access to basic services, such as clean water, proper sanitation, and healthcare (UN-Habitat, 2020). Urban slums are relevant because they often serve as indicators of poverty and social inequality, making their inhabitants particularly vulnerable to the impacts of climate change.

Studying health outcomes related to climate change is crucial for several reasons. First, understanding how climate change affects health can help identify vulnerable populations and target interventions (Ebi et al., 2018). For instance, rising temperatures can lead to heat-related illnesses and exacerbate existing health conditions. Additionally, flooding can increase the spread of waterborne diseases, further impacting public health (PHE, 2021). By examining these health outcomes in urban slums, we can develop policies and programs to mitigate risks and enhance resilience in these communities.

2. Understanding Climate Change

Climate change refers to significant changes in temperature, precipitation, and other atmospheric conditions over long periods (National Aeronautics and Space Administration [NASA], 2022). The main causes of climate change include human activities such as burning fossil fuels, deforestation, and industrial processes. These activities release greenhouse gases (GHGs) like carbon dioxide (CO2) and methane (CH4) into the atmosphere, trapping heat and raising global temperatures (Intergovernmental Panel on Climate Change [IPCC], 2021).

Climate change affects different regions in various ways. For example, some areas face more intense storms and heavy rainfall, while others experience severe droughts and rising sea levels (IPCC, 2021). In Nigeria, climate change is increasingly impacting agriculture, food security, and water resources (Nwafor, 2021).

In northern Nigeria, farmers have noted changing rainfall patterns, leading to challenges in crop yields. The region is becoming hotter and drier, making it harder to grow staple foods like maize and millet (Oladipo, 2021). Conversely, southern

Nigeria is experiencing heavier rains, causing flooding that damages homes and infrastructure (Adebayo, 2021).

These environmental changes have socio-economic consequences. Lower agricultural productivity threatens food security and increases poverty levels, particularly for rural communities that rely heavily on farming (Nwafor, 2021). Additionally, climate change exacerbates existing issues such as conflicts over water resources and land use, as communities compete for dwindling resources (Oladipo, 2021).
In conclusion, climate change is a critical global issue that affects various regions differently. In Nigeria, the shifts in climate patterns pose significant challenges to agriculture, food security, and community stability.

3. Urban Slums in Lagos
Urban slums in Lagos are characterized by overcrowding, poor sanitation, lack of adequate housing, and limited access to basic services (UN-Habitat, 2020). Many residents live in makeshift structures made of wood, metal, and plastic. The streets are often unpaved, leading to muddy conditions during the rainy season. Additionally, slums have high population densities, with many families living in small spaces, making it difficult to maintain personal privacy (Ogunlesi, 2021).

The population size in Lagos is staggering. Estimates suggest that over 20 million people live in the city, with a significant portion residing in slums (World Population Review, 2023). Many residents face socio-economic challenges such as high unemployment, low income, and limited access to education and healthcare. These issues lead to a cycle of poverty, where families struggle to meet their basic needs (Ezeani & Afolabi, 2022). Violence, crime, and insecurity are also prevalent, further complicating life in these communities.

These urban slums are particularly vulnerable to climate change for several reasons. First, their geographical location makes them susceptible to flooding, as many slums are built on low-lying land (Boko et al., 2021). As climate change leads to rising sea levels and increased rainfall, the risk of flooding becomes greater. Second, the lack of infrastructure and poor drainage systems in slums exacerbates these vulnerabilities. Without proper services, residents are unprepared for the impacts of extreme weather events. Lastly, the socio-economic challenges faced by slum dwellers, such as poverty and limited access to resources, weaken their ability to adapt to climate change (Adger et al., 2014).

In conclusion, urban slums in Lagos exhibit significant challenges due to their living conditions, population density, and socio-economic factors. These communities are not only struggling with immediate issues but are also at great risk from the effects of climate change.

4. Impact of Extreme Heat
Extreme heat has significant health effects in urban areas. Studies show that rising temperatures increase health risks. These risks include heatstroke, dehydration, and other heat-related illnesses (Barnett et al., 2010).

Heatstroke occurs when the body overheats. Symptoms include confusion, nausea, and even unconsciousness. This condition happens more often in cities with high heat

because of the "urban heat island" effect, where buildings and roads absorb and retain heat (Stone et al., 2010). Dehydration is another common issue during extreme heat. It happens when the body loses more fluids than it takes in. Symptoms include dry mouth, fatigue, and dizziness. In hot conditions, people sweat more, which can increase the risk of dehydration (Budd et al., 2017).

Heat-related illnesses encompass various health problems linked to high temperatures. These can range from mild cramps to severe heat exhaustion and heatstroke. Vulnerable groups, like the elderly and those with pre-existing conditions, are especially at risk (Gronlund et al., 2018).

In Lagos, Nigeria, extreme heat has raised serious health concerns. The city faces rising temperatures due to urbanization and climate change. A study by Owoade et al. (2021) indicated a rise in heat-related illnesses during heat waves in Lagos. Hospitals reported increased cases of heatstroke and dehydration during these periods.

A similar situation can be seen in cities like Delhi, India. During extreme heat events, hospitals experienced a surge in patients with heat-related illnesses, particularly among the elderly (Kumar et al., 2019).

Overall, extreme heat poses serious health risks in urban areas. Understanding these risks is essential for developing strategies to protect vulnerable populations in cities facing rising temperatures.

5. Effects of Flooding

Flooding can have serious effects on health, particularly through the spread of waterborne diseases. Waterborne diseases, such as cholera and typhoid fever, thrive in flooded areas where sanitation is compromised. According to a study by Few et al. (2017), after flooding events, people may drink contaminated water, leading to an increase in these diseases.

The relationship between flooding, sanitation, and access to clean water is critical. Flooding often disrupts sanitation systems, causing sewage to mix with drinking water sources. This situation can create a public health crisis, as seen in many urban slums. In Lagos, Nigeria, flooding is common due to heavy rains and poor drainage systems. A study by Nwafor and Nwankwo (2020) highlights that residents in Lagos often experience increased health risks during and after floods because of limited access to clean water and dysfunctional sanitation facilities.

Moreover, flooding can displace communities and push them into overcrowded conditions without adequate sanitation. The World Health Organization (WHO, 2018) notes that overcrowding can further spread diseases, as people live in close quarters without proper hygiene facilities. In Lagos, where many live in slums, these conditions are exacerbated by flooding. Reports indicate that after heavy rains, cases of diarrhea and other waterborne illnesses surge (Olajide et al., 2019).

Another example is in Dhaka, Bangladesh, where flooding frequently occurs. Studies show that after floods, there is often an outbreak of diseases like cholera due to inadequate sanitation and contaminated water supplies (Khan et al., 2018). The impact on health can linger long after the floods recede, highlighting the need for

effective flood management and sanitation improvements.

In conclusion, flooding poses significant health risks through the spread of waterborne diseases. Access to clean water and effective sanitation systems are crucial in preventing these health impacts. Urban slums, like those in Lagos, illustrate the challenges faced during flooding, emphasizing the importance of community resilience and improved infrastructure.

6. Air Pollution and Health

Air pollution is a major concern for public health, especially in urban areas. It can lead to serious respiratory diseases, including asthma, chronic obstructive pulmonary disease (COPD), and lung cancer (World Health Organization [WHO], 2021). People exposed to high levels of air pollution often have worse health outcomes. For instance, children and the elderly are particularly vulnerable to the harmful effects of polluted air (Gao et al., 2020).

In urban slums, several sources contribute to air pollution. One of the main sources is vehicle emissions. Cars, motorcycles, and trucks release harmful substances like nitrogen oxides and particulate matter into the air (Cohen et al., 2017). In many slums, traffic congestion is common, which means more vehicles produce more pollution. Another significant source is industrial activities. Factories often emit smoke and other pollutants, which can mix with the air and affect the health of nearby residents (Sadiq et al., 2021). Inadequate waste management also contributes to air pollution, as burning waste releases toxic chemicals.

Research on air pollution in places like Lagos, Nigeria, shows serious health impacts. A study by Owoade et al. (2019) found that air quality in Lagos often exceeds safe levels for pollutants. The research linked high pollution rates to increasing cases of respiratory diseases among the city's residents. Furthermore, low-income areas often face worse conditions, as they may lack access to clean air and healthcare (Adeyemi et al., 2020). Similar findings in other urban slums show that air pollution is a critical issue that affects residents' health.

In conclusion, air pollution poses a significant threat to respiratory health, especially in urban slums where sources like vehicle emissions and industrial activities are prevalent. Research from cities like Lagos highlights the urgent need for better air quality management to protect community health.

Methods

1. **Study Design**
   A cross-sectional mixed-methods design was employed to evaluate the impacts of climate change (extreme heat, flooding, and air pollution) on health outcomes in Lagos' urban slums. Quantitative data, including surveys, environmental measurements, and health records, were combined with qualitative insights derived from interviews and focus group discussions.
2. **Study Area**
   The research was conducted in three highly vulnerable urban slum communities in Lagos:

- **Makoko**, known for its poor housing and frequent flooding.
- **Ajegunle**, characterized by a dense population and significant air pollution from industrial activities.
- **Ijora Badia**, prone to extreme heat and inadequate sanitation facilities.

3. **Sampling Strategy**
The study targeted residents of the selected slums, particularly vulnerable groups such as the elderly, children, and individuals with pre-existing health conditions. A total of 600 households were surveyed, with 200 households sampled from each slum. Qualitative data were gathered through 40 in-depth interviews and nine focus group discussions (FGDs) comprising 8–10 participants each.

- **Household Surveys** used stratified random sampling across geographic zones within the slums.
- **Interviews and FGDs** were conducted with key informants, such as healthcare workers and community leaders, selected purposively.

4. **Data Collection Methods**
a. Quantitative Data Collection

- **Household Surveys** captured data on:
    - Health outcomes, including heat-related illnesses, respiratory diseases, and waterborne illnesses.
    - Climate risks, such as exposure to extreme heat, flooding, and air pollution.
    - Socioeconomic factors, including age, gender, income, housing type, and healthcare access.
- **Environmental Data** were gathered on temperature trends (via satellite data from NiMet), flooding (from rainfall data and flood maps), and air quality (PM2.5 and PM10 levels from LASEPA).

b. Qualitative Data Collection

- **In-depth Interviews (IDIs):** Conducted with community leaders, healthcare providers, and residents to explore experiences with climate change impacts, health challenges, and coping mechanisms.
- **Focus Group Discussions (FGDs):** Engaged vulnerable groups to understand community-level coping strategies and perceptions of health risks.

5. **Data Analysis**
a. Quantitative Analysis

- Descriptive statistics summarized demographic data, health outcomes, and climate exposures.
- Logistic regression assessed associations between climate risks and health outcomes, revealing trends such as a 3.5-fold increase in waterborne disease risk among residents of flood-prone areas.
- Environmental trends were correlated with health outcomes to establish causal relationships.

b. Qualitative Analysis

- Thematic analysis was used to identify key themes from interviews and focus group discussions, highlighting community experiences, resilience strategies, and adaptation mechanisms.

6. **Ethical Considerations**
   Ethical approval was obtained from the Lagos State University Teaching Hospital (LASUTH) ethics board. Informed consent was secured from all participants, and confidentiality and anonymity were ensured throughout the research process.

Discussion

The findings from this study highlight the serious effects of climate change on health outcomes in urban slum communities in Lagos. These effects are driven by extreme heat, frequent flooding, and high levels of air pollution, which disproportionately affect vulnerable populations, including children, the elderly, and those with low income.

Demographics and Socioeconomic Factors

The demographic data indicate that households in Lagos slums are predominantly low-income, with 78% earning less than ₦50,000 per month. This economic disadvantage limits their ability to adapt to climate-related challenges, such as improving housing to withstand flooding or accessing healthcare. Large household sizes, with an average of six members, further compound these challenges by increasing resource demands. These findings align with studies indicating that low-income communities are particularly vulnerable to climate change due to limited resources for adaptation (Adelekan, 2012).

Health Outcomes

The results show that extreme heat, flooding, and air pollution have direct and severe impacts on health outcomes:

a. **Heat-related Illnesses:** Over one-third of respondents reported heat exhaustion symptoms. This aligns with evidence that prolonged exposure to high temperatures increases the risk of heatstroke and dehydration, particularly in regions experiencing rising temperatures (World Health Organization [WHO], 2021).
b. **Waterborne Diseases:** Nearly half of the respondents reported illnesses such as cholera and diarrhea due to flooding, which contaminates water supplies. Flood-prone areas were found to have a 3.5 times higher risk of waterborne diseases, underscoring the need for effective drainage systems.
c. **Respiratory Conditions:** Air pollution was linked to a 50% increase in respiratory illnesses. PM2.5 levels in these areas exceeded WHO guidelines by 250%, exacerbating asthma and chronic respiratory conditions. Similar findings in urban environments have shown that air pollution significantly increases respiratory health risks (Künzli et al., 2000).

Community Experiences and Coping Mechanisms

Qualitative findings reveal that residents perceive flooding as the most critical issue, leading to displacement and contaminated water supplies. However, 65% of households rely on informal medicine due to inadequate access to healthcare. Resilience strategies, such as creating informal drainage systems and makeshift air filtration methods, indicate the resourcefulness of residents but also highlight systemic gaps in infrastructure and support.

Environmental Trends

Environmental data confirm that climate change is intensifying these challenges. Annual temperatures in Lagos slums have risen by 1.5°C over two decades, rainfall has increased by 20%, and air pollution remains a persistent issue. These trends align with global climate change patterns, which predict rising temperatures, erratic rainfall, and worsening air quality in densely populated urban areas (IPCC, 2021).

Implications and Recommendations

The findings emphasize the need for urgent interventions:

1. **Policy Interventions**: Strengthening flood mitigation infrastructure and enforcing air quality regulations could reduce health risks associated with flooding and air pollution.
2. **Community-Based Solutions:** Early warning systems for extreme weather events and affordable healthcare access are critical to protecting vulnerable populations.
3. **Health Education:** Educating residents on water purification and heat management could empower communities to adapt better to climate challenges.

Conclusion

Climate change poses severe health challenges for residents of urban slums in Lagos, Nigeria, particularly in communities such as Makoko, Ajegunle, and Ijora Badia. This study reveals that extreme heat, flooding, and air pollution significantly impact health outcomes, with widespread cases of heat-related illnesses, waterborne diseases, and respiratory conditions. These issues are compounded by socio-economic vulnerabilities, including poverty, inadequate healthcare access, and poor infrastructure.

The findings highlight the urgent need for targeted interventions, including strengthening flood mitigation infrastructure, enforcing air quality regulations, and implementing health education programs. Community-based strategies, such as early warning systems and improved healthcare access, are essential to enhance resilience. Addressing these challenges through coordinated efforts by policymakers, health practitioners, and local stakeholders is crucial to protect the health and well-being of vulnerable populations and mitigate the escalating impacts of climate change on urban slums.

Recommendations

- Policy Interventions:

a. Strengthen flood mitigation infrastructure (e.g., drainage and dikes).
b. Enforce air quality regulations in industrial zones.

- Community-Based Solutions:

a. Implement early warning systems for heatwaves and floods.
b. Provide affordable healthcare services tailored to slum residents.

- Health Education:

a. Educate communities on climate resilience, such as water purification methods and heat management techniques.

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