Assessment of Knowledge and Perceptions of Climate Change Impacts on Public Health Among Key Stakeholders in Lusaka province, Zambia

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Abstract

Background: Climate change poses significant threats to public health, particularly in vulnerable regions like Sub-Saharan Africa. Zambia, and specifically Lusaka Province, faces unique challenges due to climate-induced health risks such as waterborne diseases, malnutrition, and heat stress. Despite growing awareness, there is a lack of consensus among stakeholders on the magnitude and urgency of these impacts, hindering effective policy implementation and resource allocation.

Methods: This qualitative study employed a cross-sectional design, conducting key informant interviews with 17 stakeholders, including policymakers, healthcare providers, environmental specialists, NGO representatives, and community leaders in Lusaka Province. Data were analyzed using thematic analysis to explore knowledge gaps, perceptions, and perceived risks related to climate change and public health.

Results: The study revealed varying levels of awareness among stakeholders, with environmental specialists and NGOs demonstrating more comprehensive knowledge compared to community leaders, policy makers and healthcare providers. Key findings highlighted significant gaps in understanding the indirect health impacts of climate change, such as mental health and non-communicable diseases. Stakeholders emphasized the need for localized research, comprehensive education, and improved data to inform policy and interventions. Vulnerable populations, including women, children, and the elderly, were identified as disproportionately affected by climate-induced health risks, particularly in informal settlements with poor infrastructure.

Conclusion: The study underscores the urgent need for targeted education, research, and policy integration to address the health impacts of climate change in Lusaka province. Strengthening stakeholder knowledge and fostering cross-sector collaboration are essential for building resilience and ensuring equitable health outcomes in the face of climate change.

Keywords: Climate Change, Public Health, Food security, Waterborne Diseases, Malnutrition

Introduction

Climate change has emerged as a global public health threat, exacerbating health challenges through extreme weather events like floods, strong winds, and wildfires. These climatic shifts increase the risk of infectious disease outbreaks and pandemics by altering disease transmission patterns. A World Bank assessment highlights five major climate-induced health hazards: extreme heat, stunted growth, diarrheal diseases, malaria, and dengue fever. These conditions could result in 21 million additional deaths by 2050 [1]. Furthermore, climate change may push 132 million people into extreme poverty by 2030, with over half in South Asia and Sub-Saharan Africa. By 2023, the World Bank projected that 44 million people would experience health issues due to climate change [2].

Sub-Saharan Africa faces heightened vulnerability due to its geographic, social, and developmental challenges. Prolonged droughts and heavy rains impact food security, water availability, and agriculture, leading to widespread malnutrition and increased waterborne and vector-borne diseases, including malaria and dengue fever. Poor healthcare infrastructure further worsens these challenges [3].

Zambia, particularly Lusaka Province, faces unique climate-related public health risks, including rising temperatures leading to heat stress, waterborne disease outbreaks, and food shortages. Climate-induced changes in disease vectors are of great concern, with over 4 million Zambians affected annually by vector-borne diseases. For instance, by February 12, 2024, Lusaka recorded 13,117 cases and 497 deaths from a disease outbreak, with a case fatality rate (CFR) of 3.8% [4]. Additionally, climate events threaten agricultural productivity, exacerbating food insecurity and malnutrition.

Despite awareness of climate change's health impacts among stakeholders, there is limited consensus on the urgency and scale of the crisis. This lack of agreement hampers collaboration and the implementation of effective interventions. Existing climate-health data in Zambia may be insufficient to guide targeted responses, and policies addressing climate-related health concerns remain inadequate. Limited knowledge among key stakeholders further constrains efforts to mitigate health risks associated with climate change [5].

This study examined stakeholders' knowledge and perceptions of climate change's health impacts to inform targeted interventions and policy decisions. It was conducted in both rural and urban areas of Lusaka Province to capture diverse perspectives. The target population included community leaders, environmental specialists, non-governmental representatives, policymakers, and healthcare providers. The findings provide valuable insights to guide future climate-health initiatives and policymaking.

Study Objectives

General Objectives

To assess knowledge and perceptions of climate change impacts on public health among key stakeholders of Lusaka province.

Specific Objectives

1. To examine the gaps in knowledge on health impacts of climate change among key stakeholders.
2. To evaluate the knowledge and perceptions on the connection between climate change and public health.
3. To explore the perceived risks and vulnerabilities linked to climate change and health

Literature review

Knowledge gaps on the health impacts of climate change

The current studies highlight significant knowledge gaps among key stakeholders regarding the health impacts of climate change, with variations in understanding across different regions. While stakeholders in India recognize both direct and indirect effects of climate change on health, they exhibit insufficient knowledge and scepticism about its impact on non-communicable diseases [6]. This scepticism suggests a need for targeted awareness campaigns and stronger evidence linking climate change to chronic illnesses. Similarly, in England, local authorities have identified critical gaps in public understanding, the acceptability of climate actions, and the economic feasibility of interventions [7]. These gaps indicate a disconnect between climate policies and public perceptions, potentially hindering effective policy implementation.

In Australia, stakeholders stress the necessity of specific, spatially representative health-related climate indicators to monitor impacts, track trends, and identify vulnerable populations [8]. The emphasis on robust indicators reflects the challenge of translating climate-health linkages into actionable data, which is essential for targeted adaptation strategies. A common theme across all studies is the presence of financial constraints, resource limitations, and data deficiencies, which act as major barriers to closing these knowledge gaps [7,8]. These constraints highlight the need for increased investment in research, surveillance systems, and capacity-building initiatives.

To address these challenges, stakeholders across different contexts advocate for multi-level awareness programs, curriculum reforms, and region-specific research to inform evidence-based policies and improve adaptation strategies [6,7]. This underscores the importance of integrating climate change education into broader public health and governance frameworks. By bridging these knowledge gaps, stakeholders can enhance preparedness and resilience against climate-induced health threats, ensuring more effective and inclusive policy responses.

Knowledge and perceptions on the links between climate change and public health

The current studies have highlighted a global variation in awareness of climate change's health impacts, with significant knowledge gaps among both health professionals and the general public. While many health professionals acknowledge climate change as a threat to public health, they often report low self-assessed knowledge and express a strong need for further education [9]. This suggests that despite their role in addressing

climate-related health risks, they may lack the expertise to effectively integrate climate considerations into healthcare practice and advocacy.

Public perceptions of climate-related health risks also vary across regions. In North America, there is limited understanding of specific health consequences, whereas vulnerable populations in Asia and Africa demonstrate higher awareness due to direct exposure to climate-related hazards [9]. This disparity underscores the role of lived experiences in shaping climate change awareness. However, even in regions where awareness is higher, gaps remain in understanding complex health effects. For instance, medical students in China recognize direct health impacts such as air pollution and heat stress but struggle to identify broader and more complex consequences [10].

A major concern among public health officials is their limited engagement in climate policy discussions and lack of expertise to influence policymaking effectively [11]. This lack of involvement may weaken health-centred climate policies and hinder the integration of climate change mitigation and adaptation strategies into health systems. However, research suggests that framing climate change as a health issue can enhance public support for climate policies [11]. Strengthening climate-health education among health professionals and increasing their participation in policy discussions could play a crucial role in bridging knowledge gaps and driving effective climate action.

The perceived risks and vulnerabilities associated with climate change and health

The literature underscores the recognition of climate change as a major threat to human health, with various stakeholders perceiving it as a moderate to significant risk. While this awareness is widespread, there remain notable gaps in understanding the specific health impacts of climate change, particularly among policymakers and the general public [12]. This limited knowledge poses a barrier to effective adaptation and mitigation strategies, as a clear grasp of climate-related health vulnerabilities is essential for informed decision-making.

Research identifies multiple health-related vulnerabilities associated with climate change, including water quality and quantity issues, heat stress, food security risks, vector-borne diseases, and air pollution [12]. These impacts disproportionately affect vulnerable populations, such as individuals with preexisting medical conditions, low-income households, and racial/ethnic minorities, who perceive themselves at higher risk. However, vulnerability is not solely determined by health status but is also shaped by social, economic, and environmental factors, such as rapid population growth, aging demographics, and increased coastal development [13]. These compounding factors highlight the complex and multifaceted nature of climate-induced health risks.

Despite growing recognition of these risks, the response remains fragmented, with gaps in policy integration and public engagement. Experts emphasize the need for targeted education, inter-sectoral collaboration, strengthened emergency management, and enhanced social networks to improve climate adaptation strategies [13].

Without these efforts, existing vulnerabilities will persist, and health systems may struggle to cope with climate-induced challenges. Addressing these gaps through coordinated and proactive approaches is crucial to building resilience and ensuring equitable health outcomes in the face of climate change.

Social Cognitive Theory

The theoretical framework that guided this study was the Social Cognitive Theory, which examined various perceptions and understanding of key stakeholders on climate change influencing public health. SCT focuses on the interdependent relationships among persons, their actions, and their environment; it particularly emphasizes observational learning, self-efficacy, and outcome expectations. Through observational learning, stakeholders in Lusaka can acquire new knowledge about effective adaptive strategies if they witness people around them reacting to such health challenges from climate change. Increased levels of self-efficacy regarding actions such as water conservation, vector control, or supporting sustainable practices can enhance stakeholders' motivation to actively mitigate the impact of climate change on public health. Greater feelings of self-efficacy are likely to enhance motivation toward concrete action to reduce the potential impact of climate change on public health; for instance, water conservation, vector control, or other supportive activities for sustainable practices [14].

METHODOLOGY

Research Approach

This study employed a qualitative research approach that examines people's experiences, perspectives, and opinions [15]. Through taking this method, the study sought to obtain a thorough grasp of the perspectives held by key stakeholders regarding the ways in which Lusaka's public health is being impacted by climate change.

Research Design

The cross-sectional approach was used in the study because it allowed for systematic data collection within time and resource restrictions, which made it easier to achieve research aims. The cross-sectional design was used because it is an observational research technique that examines data from a representative sample or the population at a certain point in time. This approach provided a snapshot of opinions on health and climate change held by various parties during a specific time period.

Research Setting

The study was conducted in the province of Lusaka, which includes both urban and peri-urban areas. The choice of Lusaka as the research location was based on its susceptibility to extreme meteorological conditions including floods and droughts, which have a substantial influence on public health [16]. This study based in the capital city of Zambia (Lusaka), chosen for convenience to maximize human geographic development, policy and healthcare delivery along with its urbanization status. Lusaka province has an area size of 21,896 km2 and is made up Six districts namely Rufunsa, Kafue, Luangwa, Lusaka,

Chilanga & Chongwe with a population in upwards of three Million.

Study Population

The research population was composed of the primary individuals responsible for the administration of public health and environmental issues within Lusaka province. The individuals in question include policymakers, who are government officials responsible for the formulation and implementation of policies, and representatives from non-governmental organizations (NGOs) who participate in grassroots initiatives and advocate for policy changes. Health professionals who are at the forefront of identifying and diagnosing health issues influenced by environmental factors, environmental specialists who provide specialized knowledge on ecological dynamics and sustainability practices, and community leaders who serve as a liaison between local communities and decision-makers. The inclusion of these diverse stakeholders is essential for the acquisition of a comprehensive understanding of public health and climate change [17].

Sampling Techniques

Purposive sampling, was used to select participants who had information or experience that was directly connected to the study purpose. This technique ensured that the information gathered is sourced from the most experienced stakeholders. Those involved in climate change, public health, and environmental management in the province of Lusaka were selected based on their roles and level of involvement.

Sample Size

The sample size of 17 participants was determined through theoretical saturation. This approach involved conducting interviews until no new significant information or themes emerged from additional participants. While a specific sample size calculation was not used in this study, the decision to continue interviewing until saturation was reached helped to ensure that the data collected was sufficient to address the research objectives and provide a deep understanding of the stakeholders' perspectives on climate change and public health in Lusaka province.

Data Collection Techniques

Data was collected through the key informant interviews. The interview process was designed to ensure comprehensive data collection and meaningful engagement with participants. A total of 17 key stakeholders were interviewed, representing diverse perspectives relevant to the study. Prior to the interviews, an interview guide was developed to maintain consistency while allowing flexibility for in-depth discussions. This guide was shared with participants in advance, helping them familiarize themselves with the study objectives and question themes. Additionally, participants were informed about the study's purpose, confidentiality measures, and their right to withdraw at any stage.

The majority of the interviews were conducted virtually, which facilitated smooth scheduling and interactive engagement, allowing participants to join from their preferred locations. This approach enhanced accessibility and minimized

logistical constraints. Each interview lasted approximately 40 minutes, providing ample time for participants to articulate their thoughts. Open-ended questions were used to encourage participants to share their knowledge and experiences without restrictions, enabling a detailed exploration of the topic. Probing techniques were employed to clarify points, explore emerging themes, and gather nuanced insights.

A conducive and respectful environment was maintained throughout, ensuring that participants could freely express their views. Active listening and follow-up questions helped facilitate detailed responses. Data collection continued until the point of saturation, where no new significant insights emerged [18]. This rigorous process resulted in rich qualitative data, forming a solid foundation for analysis and interpretation.

Data Analysis

Thematic analysis which is a qualitative analytic method was utilized to analyze the Interview transcripts. This involved systematically Identifying, categorizing and analyzing patterns/themes in the data. The following codes were applied to the recording sessions and transcripts: environmental specialists (ES#), policy makers (PM#), healthcare providers (HP#), representatives of non-governmental organizations (NGO#) and community leaders (CL#). Further, version 14 of the NVivo package was used to finish the transcription and analysis. During the data analysis procedure, the inductive thematic analysis was used to find new themes that addressed the research topics, the codes were created inductively. Following transcript familiarization and coding processing, the codes were classified into their corresponding themes, concepts and other pertinent categories.

Ethical Considerations

The study is guided by explicit rules for ethical considerations at every stage, which makes them extremely important. Permission was voluntarily obtained and with full knowledge of the involvement, from each participant. To protect the participants' privacy, strict confidentiality procedures were put in place. Data was only used for research and is securely stored.

The study received ethical clearance from the University of Lusaka Research Review Committee (UNILUS-REC), and all necessary health research certifications and approvals were secured to ensure full compliance with applicable research standards and ethical guidelines from relevant oversight bodies.

Written and Verbal consent was obtained from the participants before the interview was conducted, which included the rights to withdraw from the study at any stage without further obligation. Further, the participants were assured that data to be collected was kept confidential and only used for research purposes.

The participants were also assured that their personal information and identities would not be disclosed or made public. In order to guarantee anonymity, the identities of organizations and participants were replaced with specific codes.

RESULTS

This section presents the viewpoints of significant stakeholders concerning climate change and its impact on public health. The section highlights the demographic characteristics of participants and the thematic key findings.

Demographic Characteristics of Participants

Table 1.0: Characteristics of participants

Characteristic	Frequency	Percent
Age Range (Years		
20-29	5	29%
30-39	7	41%
40+	5	29%
Gender		
Male	7	41%
Female	10	59%
Educational Level		
Diploma	1	6%
Bachelor's degree	9	53%
Master's degree	7	41%
Years of Experience		
2-5	8	47%
6-10	5	29%
11-20	3	18%
20+	1	6%

Table 1 displays the basic demographic characteristics of the participants; 17 participants were intentionally recruited. The majority of participants, accounting for 7 (41%) of the total, fell within the 30-39 age range, while both the 20-29 and 40+ age groups had an even distribution of 5 (29%) each. This study had more female participants 10 (59%) than males, who were 7 (41%). Besides, the majority of the participants had bachelor's degrees 9 (53%), while 7 (41%) possessed master's degrees, but only 1 participant had a diploma. Of these, most had a working experience of 3-5 years 8 (47%), followed by the one who had a working experience of 6-10 years 5 (29%), while 3 participants had a working experience of 11-20 and 1 member of the more than 20 years of working experience.

Thematic Key Findings

The findings were presented based on the main three themes which are; *knowledge gaps on health impacts of climate change*, *Climate change and public health interconnection,* finally *the perceived risks and vulnerabilities*. The subthemes were also presented corresponding to the main themes.

Knowledge Gap on Health Impacts of Climate Change

Varying Levels of Awareness and Expertise

The knowledge regarding the health impacts of climate change among stakeholders in Lusaka Province varies significantly. While some environmental specialists and non-governmental organizations (NGOs) demonstrated a strong understanding of the issue, community leaders and healthcare providers were found to have a limited grasp, especially regarding non-communicable diseases and mental health. A participant, a community leader, expressed uncertainty about the connection between climate change and diseases like cardiovascular issues and mental health:

"I did not know that climate change can also contribute to such diseases" (Community leader CL03).

This discrepancy highlights the need for tailored awareness programs to bridge knowledge gaps and ensure that all sectors of society are well-informed on the health impacts of climate change.

Comprehensive Education

The need for comprehensive education on the links between climate change and health was a common theme. A majority of participants noted that both the general population and key stakeholders, including community leaders and healthcare providers, require more in-depth training. Healthcare providers, in particular, indicated that their medical training had not adequately addressed climate-sensitive diseases, resulting in gaps in their ability to diagnose and manage climate-related health issues. One healthcare provider highlighted the lack of climate-related training, emphasizing the need for comprehensive education on diseases caused or worsened by climate change:

"I believe that I would greatly benefit from a comprehensive training on the specific diseases that are caused or associated with climate change" (Healthcare provider HP02).

Additionally, participants pointed out that people with disabilities face challenges in accessing climate change information, further stressing the importance of inclusive communication strategies.

Research and Data Needs

The participants also raised the need for reliable data to understand the magnitude of climate change's impact on health. Policymakers and NGO representatives emphasized the need for better data to inform local interventions and policies. In particular, the gap in data on mental health and non-communicable diseases linked to climate change was a critical concern. As one healthcare provider stated, "We do not have enough data that is clearly highlighting how mental health is affected by the changing climate" (Healthcare provider HP02). The lack of localized, reliable data hinders the development of effective interventions, making it difficult to address the health implications of climate change in a timely and evidence-based manner.

Climate Change and Public Health Interconnection

Perceived Effects on Health

The rise in diseases like cholera and diarrhoea was frequently mentioned as a key health effect of climate change. Many participants identified inadequate sanitation infrastructure as a significant factor contributing to the spread of these diseases, particularly during extreme climate events like floods. One community leader observed;

"During floods, we see a rapid increase in cases of cholera and other waterborne diseases due to contaminated water sources and inadequate sanitation infrastructure" (Community leader CL02).

Additionally, climate change-induced poverty was recognized as a driver of social problems, such as forced early marriages and teenage pregnancies, which disproportionately affect adolescent girls. Participants also highlighted the potential increase in HIV infections, especially among marginalized groups like young people and women, due to the compounded effects of poverty and climate change.

Environmental Determinants of Health

Increasing temperatures and changing rainfall patterns were identified as key environmental determinants of health, particularly for vulnerable groups like the elderly and children, who are more susceptible to heat-related illnesses. Participants also noted the poor waste management systems in Lusaka, which worsen during climate events like floods. One participant mentioned;

> *"In Lusaka we do not have adequate waste management infrastructure to meet the ever-increasing population, which has likelihood of causing health risks associated with dangerous garbage materials" (NGO representative NGO03).*

These environmental factors, along with rapid urbanization and unplanned settlements, increase the vulnerability of urban populations to climate change and its health impacts. The intersection of climate vulnerability and urbanization calls for integrated solutions, such as improved urban planning and more robust disaster preparedness.

Equity and Social Justice

Participants expressed concerns about the disproportionate impact of climate change on marginalized populations, particularly women, children, and the elderly. Prolonged droughts have severely affected small-scale farmers, many of whom are women, leading to food insecurity and increased vulnerabilities. One participant emphasized;

> *"It is very evident that children, pregnant women and the elderly are disproportionately and more susceptible to the health impacts of climate change" (NGO representative NGO02).*

Additionally, the cascading effects of climate change, such as water scarcity, further exacerbate hygiene challenges, particularly for young girls during menstruation. This highlights the need for equitable climate change adaptation and mitigation strategies that prioritize the most vulnerable groups in society.

Perceived Risks and Vulnerabilities

Vulnerable Populations

The participants consistently highlighted the heightened vulnerability of communities living in slums and informal settlements, where lack of basic infrastructure—such as adequate sanitation and waste management—compounds the health risks during extreme weather events. As one environmental specialist noted;

> *"Changes in rainfall patterns and increasing extreme weather events affect crop yields and food security, leaving these communities more susceptible to malnutrition and related health challenges" (Environmental specialist ES01).*

Additionally, marginalized populations in both urban and rural areas were recognized as the most at risk, due to both environmental and socio-economic factors, including limited access to healthcare, education, and essential services. Targeted interventions addressing both environmental and social dimensions of vulnerability are critical to reducing these risks.

Concerns About Nutrition and Food Security

Food insecurity emerged as a primary concern among the participants, with prolonged droughts having a direct impact on crop yields and food availability. One community leader lamented,

> *"We lost our crop due to the long dry spell that we suffered, which has drastically reduced food production and availability in our households" (Community leader CL04).*

This issue is particularly dire for vulnerable groups, such as children and pregnant women, who are more dependent on consistent food supplies for their health and development. The reduced availability of basic commodities also exacerbates the nutrition challenges faced by these groups, underlining the need for integrated climate adaptation strategies that address both food security and health.

Discussion

Knowledge Gap on Health Impacts of Climate Change

The study revealed a significant knowledge gap regarding the health impacts of climate change among stakeholders, which highlights the varying levels of awareness and expertise. Respondents, such as policymakers and community leaders, displayed a basic understanding of climate change, but their knowledge of the link between climate change and health was minimal. On the other hand, representatives from NGOs, healthcare providers, and environmental experts exhibited a more comprehensive understanding. This disparity aligns with other studies that suggest differing levels of awareness among stakeholders regarding climate change's health impacts [19]. While community leaders and policymakers may possess general knowledge, a more specialized understanding is needed to effectively implement climate adaptation strategies.

To address this knowledge gap, it is crucial to emphasize climate and health education at multiple levels. A broader understanding is essential for grassroots interventions, but specialized knowledge is required to design effective adaptation strategies. Tailored educational programs should target policymakers and community leaders to provide them with deeper insights and practical skills to respond to the health impacts of climate change effectively.

Communications and Dissemination Gaps

Another major issue identified was the communication gap in informing marginalized populations about the health risks associated with climate change [21]. During in-depth interviews, participants emphasized the need for educational materials to be developed in local languages and formats accessible to people with disabilities. This underscores the importance of culturally

and linguistically appropriate climate change communication strategies. Research has also recommended that climate change education incorporate accessible formats for marginalized communities, ensuring that the message resonates and reaches those most affected by climate-related health issues [22].

Comprehensive education campaigns should not only raise awareness about climate change's health impacts but also focus on practical, adaptive measures. Educational resources should be designed to address the unique vulnerabilities of different sectors within the community, such as farmers, healthcare workers, and vulnerable groups. Collaborative efforts with local schools and community groups could help embed climate change education in the cultural fabric of affected areas, ensuring long-term effectiveness.

Research and Data Needs

The study also highlighted the need for more context-specific research to improve preparedness for the health effects of climate change. Participants called for research that examines seasonal variations in disease trends, evaluates public health systems' readiness to tackle climate-related health risks, and investigates the local health impacts of climate change. These findings align with recommendations from other studies that call for more localized climate-health research to develop strategies tailored to the specific challenges different communities face [25, 26].

Moreover, the importance of incorporating traditional ecological knowledge into climate adaptation strategies was also emphasized. Indigenous knowledge, based on a deep understanding of local ecosystems and weather patterns, provides invaluable insights into climate change adaptation. Other studies have similarly pointed out that indigenous communities have survived for centuries by relying on this knowledge, which could be crucial in shaping adaptive policies [27].

Climate Change and Public Health Interconnections

Perceived Health Effects

Respondents demonstrated a solid understanding of the various health effects associated with climate change, with a particular focus on waterborne diseases, such as cholera epidemics. This perception aligns with international studies that highlight the interconnectedness of water-related health risks and climate change [28]. Additionally, participants identified malnutrition as a key concern, which is consistent with literature linking climate-induced changes in agricultural productivity to nutritional outcomes [29].

Mental health risks, including anxiety, depression, and trauma, were also recognized as significant health concerns arising from climate change. The growing awareness of mental health in climate change adaptation strategies is supported by studies showing the psychological effects of climate change on vulnerable populations [30]. Furthermore, respiratory illnesses, exacerbated by air pollution and climate change, were also identified, mirroring findings in other research on the health impacts of climate change [31].

Participants also expressed concern about the potential rise in teenage pregnancies and early marriages among adolescent girls due to climate-induced poverty. In rural areas, families facing economic hardship may marry off their daughters to cope with the financial strain of prolonged droughts. This concern echoes advocacy efforts by organizations such as UNICEF, which emphasize the need for interventions to support adolescent girls and young women in the context of climate change [32].

To address these health concerns, a multifaceted approach is necessary. Improved access to clean water and sanitation facilities, resilient water infrastructure, and mental health support services should be prioritized. Additionally, strategies to improve food security and promote sustainable agricultural practices are essential to protect communities from climate-induced health risks.

Environmental Determinants of Health

The study also explored environmental determinants of health, with participants recognizing the complex relationship between climate change and health. Respondents identified extreme temperatures, water quality, rainfall patterns, air pollution, food security, and waste management as key environmental factors influencing health. These findings align with previous studies, which have noted the significant health risks associated with climate change, particularly in relation to extreme weather events and environmental degradation [33].

Concerns were also raised about the impact of urbanization, automobile emissions, and industrial activities on respiratory and cardiovascular health. Research has shown that climate change is exacerbating the effects of air pollution, which has significant implications for public health [34]. Participants also highlighted the role of poor waste management in urban areas, which contributes to environmental pollution and poses serious health risks, particularly in densely populated cities. This issue is consistent with current research on the relationship between climate change, urbanization, and health [35].

Flooding, which destroys infrastructure and increases the risk of waterborne diseases, was identified as another major environmental health concern. The lack of adequate sanitation and clean water supplies exacerbates the health risks associated with floods. Integrated environmental health assessments that consider both local environmental conditions and social factors, such as waste management and urbanization, are necessary to address these interconnected issues.

Equity and Social Justice

The study also reinforced the finding that climate change disproportionately affects marginalized communities, particularly pregnant women, children, and the elderly. These groups are more vulnerable to the health impacts of climate change due to their physiological characteristics and limited access to resources. Pregnant women, for example, face higher risks of malnutrition and health service disruption, while children are particularly susceptible to heat stress and vector-borne diseases [6]. These findings align with previous research on the increased vulnerability of specific groups to climate change [33].

Gender inequalities further exacerbate the challenges faced by women and girls in the context of climate change. Women are primarily responsible for household water and food security, which makes them more vulnerable to climate-induced disruptions. In addition, women are at higher risk of violence and exploitation in the aftermath of climate-related disasters. Gender-sensitive adaptation strategies are therefore crucial to ensure that women are empowered to cope with climate change and contribute to decision-making processes in affected communities [37].

The study emphasized the importance of including marginalized communities in climate adaptation efforts, with a focus on reducing socio-economic inequalities and empowering vulnerable groups. Gender-responsive strategies should be prioritized to ensure that women, especially in rural areas, are not disproportionately affected by climate change's impacts on agriculture and water access.

Perceived Risks and Vulnerabilities

The study also highlighted the vulnerabilities of pregnant women, children, and marginalized populations to climate-induced health risks. These groups are more susceptible to malnutrition, impaired development, and restricted access to healthcare. Integrating nutrition-sensitive strategies with climate resilience efforts is essential to reduce these vulnerabilities and ensure sustainable food systems [6].

The study's findings are consistent with other research that identifies pregnant women, children, and the elderly as particularly vulnerable to the health impacts of climate change [38]. Additionally, the challenges faced by rapidly urbanizing regions in adapting to climate change are highlighted by the increased health risks associated with extreme weather events and the intersection of social vulnerability and climate risk.

Concerns About Nutrition and Food Security

Participants in the study expressed concerns about the risks to food security and nutrition posed by climate change. Dryland agriculture, which is highly sensitive to climatic variability, faces significant challenges due to erratic rainfall and prolonged droughts. These conditions exacerbate food insecurity, particularly in rural areas where smallholder farmers rely on seasonal rainfall for crop production [39]. Climate-induced stresses on livestock, such as heat stress and water scarcity, further exacerbate food security challenges in pastoralist communities.

Adaptation strategies to minimize the impacts of climate change on food systems should focus on increasing livestock resilience, improving water management techniques, and diversifying livelihoods. These strategies will help ensure that communities can adapt to changing climatic conditions and maintain food security in the face of climate change.

Study Limitation

One limitation of this study was the lack of sufficient existing literature on the impact of

climate change on public health in Lusaka province and Zambia as a whole. This gap in available research made it challenging to compare findings with broader, established knowledge. Additionally, the study relied solely on self-reported knowledge and perceptions from stakeholders, which could introduce bias or inaccuracies. Another limitation was the scarcity of studies focusing specifically on the understanding and perceptions of key stakeholders regarding the intersection of climate change and public health, which further constrained the context for analysis and comparison.

Conclusion

The study has provided valuable insights into the understanding of climate change and its health impacts among key stakeholders in Lusaka province. While there is a relatively high level of awareness regarding the direct impacts of climate change, significant disparities remain in the comprehension and articulation of these issues across different stakeholder groups. Notably, there is limited recognition of the indirect health impacts, such as mental health concerns, cardiovascular diseases, and shifts in seasonal disease patterns. These gaps highlight the urgent need for targeted education and training, particularly for healthcare providers, policymakers, and community leaders, to enhance their capacity to address these challenges effectively. Moving forward, there is a critical need for further studies across Zambia and beyond to deepen our understanding of how climate change is perceived and its broader health implications. Such studies will be instrumental in guiding the development of tailored interventions that can more effectively address the diverse needs of communities in the face of climate change.

Recommendations

The following recommendations are suggested to fill the identified gaps and promote increased adaptation and resilience within key stakeholder groups;

1. Develop localized climate health education programs that consider cultural and linguistic factors. Empower local leaders and healthcare workers with climate change knowledge and resources to respond to health crises.

2. Employ diverse communication channels, including local languages, accessible formats for people with disabilities, and digital platforms, to reach marginalized communities.

3. Invest in research that explores the health impacts of climate change, particularly in low-resource settings. Include both scientific and indigenous knowledge in research to build adaptive strategies that are culturally appropriate and locally relevant.

4. Strengthen the capacity of healthcare systems to address climate-related health impacts, such as the increased burden of vector-borne diseases and mental health issues, through training, resource allocation, and infrastructural improvements.

5. Policy Integration through promoting cross-sectoral collaboration between environmental, health, and urban planning sectors to address the complex links between climate change and public health.

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