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Research article

Urbanization, climate change and health vulnerabilities in slum communities in Ghana

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ABSTRACT

Introduction: Rapid population growth, increased migration, surge urbanization and human settlement challenges have become defining features of most African cities. Accra, the capital of Ghana, is no exception as its fast-urbanizing processes and associated housing challenges have seen the emergence of slum communities in and around the city. While slum communities are not new in Accra nor in Ghana, what is worrying is the current pace of emergence, the state of such communities, population density and levels of vulnerability. Even more worrying are the observed impacts of climate-induced extreme weather events on such communities and attendant health consequences.

Methodology: Focusing on some slum communities in and around the city of Accra, this paper investigates the environmental health conditions of slum communities and how such conditions converge with climate change impact manifestations to increase disease burden. The paper employed a concurrent triangulation mixed method approach to simultaneously gather data from randomly selected slum communities in the Accra Metropolitan Assembly and La-Nkwantanang Madina municipality to explore possible correlations between current changes in climate and public health challenges.

Conclusion: The results affirm a correlation between observed climate change impacts and prevailing health conditions in the selected slum communities. There is ample evidence to signal both direct and indirect linkages between climate-induced weather events and increased prevalence of diseases such as malaria, diarrhea, cholera, skin disease, lung diseases, as well as the emergence of novel diseases in the target slum communities. The study, ultimately, succeeds in demonstrating the nexus of climate change, health, and urbanization.

1. Introduction

The urban age is manifesting quickly and forcefully in almost every part of the world. The continent of Africa, represented by its different countries, remains one of the fastest urbanizing regions in the world [1]. At current pace of urbanization, the general expectation is that urban populations in Africa could see an exponential surge from 395 million in 2010 to around 1,339 billion in 2050 [1–2]. Such growth rates are not only unusual, but they are alarming, with significant ramifications for the continent's sustainable development aspirations.

The consequential impacts of irreversible changes on urban socio-ecological, cultural, and economic systems, particularly as they relate to human settlement considerations, are dire and counter-productive to sustainable development processes [3]. The situation as is currently unfolding is even more worrying in Sub-Saharan Africa (SSA) where increased migration, population expansion and surge urbanization processes have become a defining character of most cities in ways that have brought most governments and their city planning authorities under tremendous pressures (Fig. 1).

The city of Accra, Ghana's capital, is no exception as it endures the negative impacts of unplanned urbanization with associated human settlement challenges. Prominent among these challenges is the pervasiveness of slum communities across the city and the socio-ecological and health threats that these communities face [4]. Even more concerning is the fact that climate change as an emergent reality is exacerbating existing challenges to make slum dwellers even more vulnerable. Increased and intense precipitation, rising temperatures and extreme hydro-metrological events such as floods and droughts [5] are some of the current manifestations of climate change impacts across Ghana and more specifically in urban communities, such as Accra, where slum settlements are nested.

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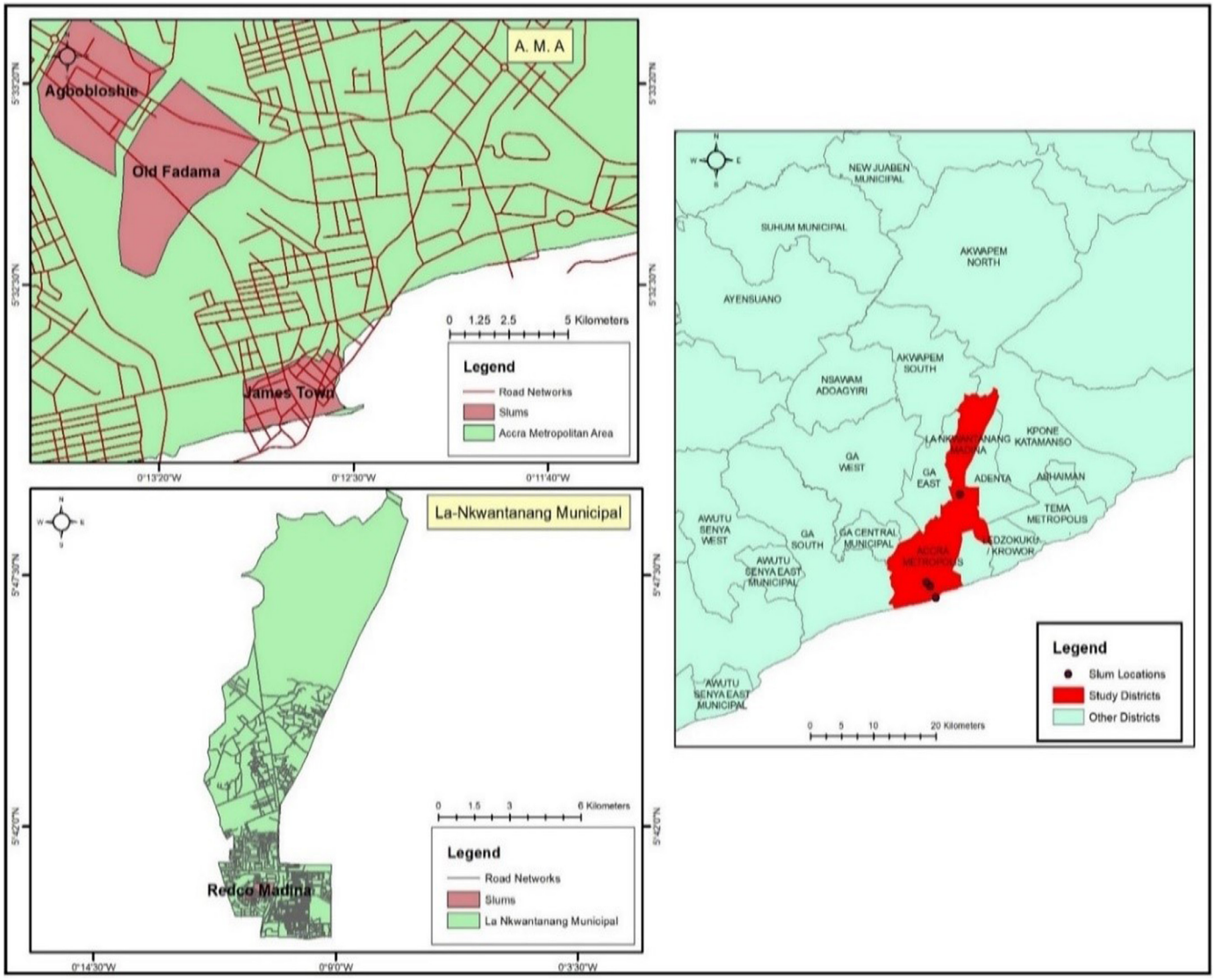

Fig. 1. Map of the study area.Source: Authors' Construct (2020).

Climate change impacts have become rampant in most communities in Ghana and continue to turn fragility, disorganization, and the sheer density of slum communities into critical risk factors in urban environments. Typical instances are witnessed in most urban areas like Accra where climate extreme events like flooding have become an annual phenomenon in recent decades and hit hard on the poor and most vulnerable people in the city [10]. Climate risks, have become pervasive and are characterized by intense rains, frequent flooding, drought, heat trapping, water shortages and air quality deterioration [6]. Of particular concern is how climate-induced socio-ecological changes are introducing new health burdens [7]. Previously eradicated diseases are re-emerging in some instances and there is growing evidence of diseases such as smallpox, cholera from poor water safety, influenza, yellow fever and others which are worsening existing health burdens of slum dwellers [8].

As observed changes become more pronounced in some slum communities in Accra, it has also become a worrying concern that no focused attention has been given to urban slums to understand the impacts of climate change on these settlements and the health of the communities.

This study aims to bring the issue into focus by highlighting the link between climate change and urbanization. Specifically, the study investigates the problem of climate change in the context of unplanned urbanization in cities such as Accra and the consequential emergence of slum settlements. Focusing on Accra, the capital of Ghana, the study examines evidence of climate change to establish the extent and nature of impacts on health in selected slum communities. The paper then explores the extent and nature of vulnerabilities, especially as they relate to the health of slum dwellers, with a view to understanding how existing vulnerabilities are currently being exacerbated by changing climate conditions to cause changes in the health trends in informal human settlements such as slums in Accra.

2. Climate and health in Ghana

Ghana is faced with several climate-associated disasters and events which have had and continue to have significant adverse impacts on public health. In the past few years, several disasters have been witnessed in different parts of the country, mostly in the cities and urban areas [9]. These include floods, drought, and fire outbreaks. In most instances, when these disasters struck, the immediate concern has always been the provision of relief items and safe shelters to victims after which they are left to their respective fates [9]. This is particularly the case in urban Accra, where flood events have become recurring and disastrous during rainy seasons [10].

The frequency of flooding in Accra is believed to have increased over the last decade as rainfall trends have changed [11]. These changes have manifested in disruption in community lives and are believed to have increased the prevalence of disease burdens from malaria, diarrhea and other water-borne diseases in local communities. Mumuni [12] affirms such changes by observing that diarrhea has been one of the top ten public health concerns in Ghana in the last two decades. This is also true for cholera and other sanitation and hygiene-related diseases. While these have become critical public health concerns in urban poor settings [12], the situation does not seem to have attracted the needed attention.

As climate change impacts become more pronounced and verifiable in local communities, it has also become increasingly clear that excess moisture, thus flood events, are also causing extensive direct and indirect health challenges. Some effects that have become common across Ghana include food insecurity, water quality and scarcity, ecosystem disruption, mental health stresses and population displacement [13]. The situation is dire in some instances, but even more so is the disturbing fact that current projections signal even more ominous future conditions with more significant impacts if not proactively addressed.

Changes in climate variables are expected to cause increased incidences of diseases such as malaria, measles, skin and other respiratory diseases [14]. Temperature, for instance, is projected to increase with concomitant increases in heat waves which will affect people who are at risk of heat-related health disease conditions. Honda et al. [15] observe that current conditions converge ominously with projected climate changes to make Ghana susceptible to several climate-related health effects based on annual increases in temperature and precipitation trends.

3. Study context

The study was conducted in the Greater Accra region which is currently the most populous region according to the 2021 Population and Housing Census (PHC) and doubles as the region in which Ghana's capital, Accra, is situated. It focuses specifically on the Greater Accra Metropolitan Area (GAMA), which constitutes approximately 33% of the Greater Accra region's total land surface and is the most densely populated area, serving as a home to about 3.7 million inhabitants. The GAMA region covers approximately 96% of the Greater Accra region's total population [16].

GAMA is positioned in the dry coastal equatorial climatic zone with two rainy seasons. The first season starts in March and ends in July, whilst the second season starts in September and ends in November [10]. Rainfall is mostly intensive with short storms which normally cause flooding in most parts of the region. Mean monthly temperature ranges from 24.7°C in August to 33°C in March, with an annual average of 26.8°C [17].

The city of Accra, located within the borders of GAMA, has dry periods in January, February, and December. Most rainfall (rainy season) is seen in May and June; on average June is the wettest month with average monthly values between 152 and 254 mm [18]. Coastal savannah shrubs scattered with thickets mainly cover the region. However, it is believed that much of the area was once covered with dense forest which has been lost due to climate change and other human activities [19].

By 2012, GAMA had metamorphosed into twelve (12) autonomous but physically and functionally integrated administrative divisions [18]. Two administrative areas, Accra Metropolitan Assembly (AMA) and La-Nkwantanang Municipal Assembly, were selected for study out of the twelve. Four slum communities were considered for the study within the GAMA region.

The selection of the various slum communities was guided by Paller's [20] classification of slums, where slums were classified according to their indigeneity, extra-legality and purchasing power. The selected communities for this study also meet the description of slum areas giving by UN-Habitat [21] and, indeed, this provided a best fit description considering dynamism in character, settlements, impacts and economic activities.

4. Methodology

4.1. Study design

This paper employed the concurrent triangulation mixed-method strategy and was performed between February and March 2020. Data collection activities included administering of questionnaires, interview guides and focus group discussions that were carried out simultaneously, to validate the adverse effect of climate change on health among slum dwellers in Accra.

4.2. Sampling

A simple random sampling was used to select the studied districts (Accra Metropolitan Assembly and La-Nkwantanang Madina Municipality). Ablekuma South and Ashiedu Keteke were the 2 sub-metros the study considered within AMA. Two slum communities, Agbogbloshie and Old Fadama, were selected from Ablekuma South sub-metro, and Jamestown was selected from Ashiedu Keteke sub-metro. Madina Redco Point 5 slum area was also chosen from La Nkwantanang Municipality.

Study participants, comprising dwellers from all the selected communities, were sampled utilizing convenience sampling methods. A convenience sampling technique was used because it was quick, easy and convenient, utilizing participants that were readily available at the moment of the data collection exercise. Health practitioners including nurses, pharmacists, and medical doctors within the two districts also were sampled using purposive sampling and snow-balling methods. This was necessary to ascertain the influence that climate change has on health from their perspective.

4.3. Data collection

Surveys, in-depth interviews, and focus group discussions constituted our data collection mechanisms. Structured questionnaires were used as the only quantitative instrument to investigate the impacts of climate change on health among slum dwellers of various communities. These structured questionnaires considered rainfall, temperature, wind and humidity as the common climate variables for the study. A total of 120 questionnaires were administered to the sampled population for the study.

As noted, to achieve the objectives of a concurrent triangulation mixed-method approach, a well-organized in-depth interview and focus group discussions (FGDs) also were deployed to complement, confirm, and corroborate quantitative analysis of the study. There were 2 sessions of FGDs conducted with between 7 and 9 members in each. The two separate discussions were organized for adult males and females of 30 years and above at Agbogbloshie. These discussions were significant and advantageous in consolidating respective experiences, opinions, and worldviews of climate change impacts on health among slum dwellers. Additionally, 8 in-depth interviews were held with health practitioners in the studied districts to explore issues pertaining to knowledge on climate change including climate change impacts and health-related challenges of climate change, among others.

All interviews and discussions were tape-recorded with permission of participants. The themes for the FGDs and in-depth interviews included, but were not limited to, knowledge and perception of climate change, observed climate extreme events in the various communities, climate induced health impacts, and recommendations. Focus Group Discussions were conducted in local languages (Ga and

Twi, which are the two most common languages spoken). The in-depth interviews were conducted in English because this category of participants included medical doctors, nurses, pharmacists, and other health practitioners who have obtained high levels of education.

4.4. Data analysis

Data were coded and processed with the aid of Statistical Package for Social Sciences (SPSS) Version 22. Descriptive statistical formats including pie charts and bar graphs were generated and the results were transformed and presented using frequency distribution and percentage cross tabulation tables.

Interviews and Focus Group Discussions were transcribed into scripts and analyzed using thematic content technique in line with the themes of the survey findings to support, confirm and strengthen the results of the study. Audio recordings in the local languages were transcribed directly into English and then read multiple times to correct errors. This activity became imperative to check and ensure consistency, accuracy and quality of the data. Narratives and direct quotations were also used as part of the analyses to support and validate results of the survey [22–23].

4.5. Limitation of the Study

The sampling technique (convenience sampling method) used in obtaining data for the study made use of the respondents and participants readily available at the time of data collection. However, this may not be a true reflection of the intended sample with first-hand information about the topic. Future studies should utilize probability sampling methods which carefully select and give equal representation to different members of the studied population. Also, this paper focused on low income high density areas in the city of Accra; therefore, future studies should focus on areas that are not slums for a comparative assessment.

5. Results

The outcome of the data analyses is presented chronologically. The first set of findings displays the demographic characteristics of participants. The second aspect of the findings establishes and describes extreme climate change consequences that are commonly experienced in slum communities in Accra, including the frequency of flood and drought occurrences. The study then assesses the causal factors underlying the effects of extreme climate change events that affect slum dwellers. The final set of results explores climate-induced health impacts in slums in Accra.

As shown in Table 1, 120 respondents from four slum communities in Accra were included in the quantitative data collection. This was comprised of 39 people (32.5%) from Agbogbloshie, 35 people (29.2%) from Jamestown, 26 respondents (21.7%) from Madina Redco, and 20 respondents (16.7%) from Old Fadama.

Out of the 120 respondents, 57.5% (69) were male slum dwellers while 42.5% (51) were female. In terms of age groups, 35% were above the age of 40 years, 22.5% were 26-30 years, 20% were 31-35 years, 17.5% were 20-25 years, and 5% were 36-40 years of age.

According to field data obtained from slum communities, 55 respondents (45.8%) had only attained Junior High School (JHS) education. Twenty-one (17.5%) have had their education up to Senior High School level, 21 (17.5%) had attained primary education, 14 (11.7%) have had no formal education, and 9 respondents (7.5%) had attained tertiary education. Fifty-nine of the total respondents (49.2%) were married whilst 53 (44.2%) were single.

Table 1
Socio-demographic characteristics.

Socio-Demographic Variables	Frequency	Percentage (%)
Communities		
Madina Redco	26	21.7
James Town	35	29.2
Old Fadama	20	16.7
Agbobloshie	39	32.5
Gender		
Male	69	57.5
Female	51	42.5
Age Group		
20-25 years	21	17.5
26-30 years	27	22.5
31-35 years	24	20.0
36-40 years	6	5.0
>40years	42	35.0
Level of Education		
No Formal Education	14	11.7
Primary	21	17.5
JHS	55	45.8
SHS	21	17.5
Tertiary	9	7.5
Marital Status		
Single	53	44.2
Married	59	49.2
Divorced	4	3.3
Widowed	4	3.3

Source: Field data, (2020)

5.1. Climate extreme events in slum areas of Accra

Extreme climate events which were reported in the study included periods of high temperature, torrential rains and floods, and droughts. Respondents and participants in the study identified and expressed much distress over these extreme events (floods, droughts and dry spells) as the major life-threatening climate occurrences in their communities.

5.1.1. Frequency of extreme climate events in slum communities

In analyzing extreme climate events, three key descriptive variables regarding frequency were used in this study and defined as follows: Frequent (the event occurred many times within a year or was experienced more than three times in year); Occasional (the event did not occur regularly or two or three times in a year); and Uncommon (the event occurred rarely or only once in a year).

Table 2 shows the frequency of occurrence of climate extreme events (flooding and drought and dry spells) among slum communities in Accra. As flooding in Accra has been one of the major climate associated problems faced by residents, with records indicating that about 83 lives were lost directly from floods, and 178,750 people were displaced between 2000 and 2012 in Accra [10], it was important to establish the rate of its occurrence in order to understand the situation. Responses were varied; however, the majority of slum dwellers interviewed (69.2%) reported an occasional occurrence of flooding; 19.2% indicated that their experience of flood events was frequent; whilst 11.7% of slum dwellers reported rare incidents of flooding. reflecting topographical differences within the communities.

fFndings from the various slum communities in Accra suggest that flooding is one of the most common weather events bedeviling slum residents. It is also clear from observation and local history that impacts of floods on these communities tend to be severe and disastrous, mostly due to overcrowding and lack of access to basic services such as water and proper sanitation [26]. These findings were confirmed in different ways by some residents during focus group discussions. For instance, a male respondent from Agbogbloshie reported during the focus group discussion that flooding always occurs in the community following heavy rainfall. Similarly, a female resident in Agbogloshie explained that floods occur in that

Table 2
Frequency of flood occurrence in slum communities in Accra.

Climate Extreme Events	Frequency of Occurrence (%)			Total Percentage of Occurrence	Total Number of Responses
	Frequent	*Occasional*	*Uncommon*		
Flood	19%, (23)	69%, (83)	12%, (14)	100	120
Drought and Dry Spells	33%, (39)	58%, (70)	9%, (11)	100	120

Source: Field data, (2020).

community as a result of heavy rains and poor drainage systems in the community.

The views expressed by the respondents were summed up by one male respondent as follows:

> *"...Indeed! the change in climate brings about flood; for instance, when the rain falls for about an hour or two, most parts of the community if not all get flooded, restricting movements and ceasing economic activities... you take a look at this area, we do not work in offices [white collar jobs], we engage in trading, so such floods directly affect our livelihoods."*
>
> (Adult-Male FGD).

This view validates observations made by other respondents in all the slum communities studied, Agbogbloshie, Old Fadama, Jamestown and Madina Redco. In all these communities, while floods follow heavy and intense downpours, some of their impacts are exacerbated by the lack of proper drains and the pervasiveness of choked drains as a result of improperly disposed solid waste. The general view is that when rainfall is less intense many of the slum communities do not experience flooding, which implies the intensity of rain and obstructions to running rainwater are the main causes of flooding in these communities

In addition to floods, droughts and dry spells were other climate events experienced by residents in these slum communities. As seen in Table 1, 58% of respondents mentioned that they occasionally experienced droughts and dry spells, 33% experienced these events more frequently and 11.9% reported that droughts and dry spells are not common events to them. Droughts and dry spells are either regularly or sporadically experienced in these communities and are perceived as indications of climate change impacts. Most residents have noticed the current warm and harsh weather conditions and they interpret this condition from the perspective of increased temperatures as witnessed through the heat of the scorching sun.

Other participants observed that droughts and dry spells are observed realities in their environment, and these have significant impacts on individuals and the entire community. For instance, a male participant during FGD noted the significant changes as follows:

> *"... even as we are seated here we are experiencing the heat; we are sweating and do not need anyone to convince us that there are changes going on in the environment. It is not even 12:00 noon, so imagine what will happen after 1:00 pm. It is a very serious situation.... the dry spells are prolonged, and it makes the atmosphere very dry with less moisture. It also brings about poor air quality which affects our breathing."*
>
> (Adult-Male FGD)

Similarly, a female participant affirmed her experiences and observations of droughts and dry spells in her community as follows:

> *"...as for the drought and dry spells, it is frequent in this area and is causing us to sweat profusely and have other heat related problems."*
>
> (Adult-Female FGD)

5.2. Factors causing extreme climate event effects in slum communities of Accra

After respondents and stakeholders reported floods, droughts and dry spells as the major climate extreme events they experienced and observed, the study sought to investigate the key causes of their effects. Results showed that factors such as heavy rainfall, storm surges, poor drainage systems, and lack of vegetation cover were perceived as the main causes of flooding events.

The survey revealed that about 66.7% of participants attributed flooding events in slum communities to poor drainage systems and choked drains. Unconventional waste management practices in slum areas in Accra and incidence of flooding are correlated; most parts of Accra lack proper waste management practices and as a result, volumes of solid waste are not collected, with a good part of the waste ending up in community drains [27]. This causes blockages during rains and impedes runoff. About 20% of respondents attributed floods to heavy rains because many parts of Accra experience extreme flooding events following heavy rainfall. This situation has been corroborated by Ludlow [28], who observed that excessive water from rainfall usually overflows the boundaries of the drainage channel systems in Accra which causes flooding in local communities.

From authors' observations and interactions with slum dwellers, it became clear that most slum dwellers have concerns about prolonged dry spells and associated pollution and air quality issues. While most of them could not explain the causes of such incidents in any scientific terms, a few were of the view that industrial production processes and vehicular emissions may have a part to play. Most importantly, most of them believed that the constant burning of waste, especially electronic wastes and scrap metals, at nearby dump sites and all over the city of Accra, were major contributory factors to their predicament.

5.3. Climate-induced health impacts in slums in Accra

Health effects of climate change are not evenly distributed [29]. The distribution of the greatest health burden is almost opposite to the contribution of greenhouse gas emissions [30], and deleterious health outcomes are likely to be greatest in low-income countries and among vulnerable people living in urban areas [31]. Not surprisingly, therefore, many slum communities, including those in this study, seem to be suffering from impacts of climate change in ways that have significant implications for dwellers' health, as reflected in the responses from the study communities.

5.3.1. Perceived health effects of climate change

Through interviews and discussions, participants were asked to identify and explain how climate change variables (temperature and rainfall) and climate extreme events (floods and droughts) affect their health. Diverse views were solicited with emphasis on what they believe are causes of some of the health challenges they experience in their communities. Many respondents identified frequent and heavy rainfall patterns as well as increasing day and nighttime temperatures as the two main climate elements that affect their health. For instance, some participants shared their experiences which

ranged from excessive sweating, dehydration, body rashes to headaches as explained by a male participant during the FGD:

> "When the weather is hot, I become dehydrated; it weakens the body system. Also changes in temperature bring about body rashes, headaches, and malaria. Even just 3 days ago my small boy told me about rashes on his back and I had to get him medication"
>
> (Adult-Male FGD)

Similarly, a female participant indicated the adverse impact of intense heat as follows:

> *"High temperature does not help us to grow well because the heat drains all the water from us (dehydration). It also causes heat rashes, and we do not breathe well because of poor air quality. Most of us have constant colds and coughs."*
>
> (Adult-Female FGD).

Rainfall was also stated to be one of the variables impacting the health of slum residents in Accra. Participants were of the view that in as much as excess rainfall results in floods, they also have observed that infrequent rainfall or the lack of rainfall has been a major concern since these conditions also come with significant health implications for them as noted by a male respondent:

> *"First of all, the water we drink here is tap water and the source is from the Weija river, so if we don't receive rainfall as expected to increase the volume of our source of water, we look for alternative sources of water for drinking and other domestic uses. These alternatives are purchased and they are expensive considering my income. I can't afford them for my household. We therefore use any water we get, irrespective of source and quality, and that tends to cause diarrhea as well as other diseases for us."*
>
> (Adult-Male FGD).

It was also clear from interactions that residents observed that variable weather, especially very intense rainfall which results in flooding, spreads both solid and liquid waste materials in the community that contributes significantly to some of their health challenges. The situation is further worsened by the poor drainage systems in the communities coupled with indiscriminant disposal of waste and fecal matter as explained by a male respondent:

> *"...Our gutters are small and mostly choked with refuse and plastic bags, so when rain falls the water cannot flow freely. In some cases, they become stagnant and breeding places for mosquitoes to cause malaria... the rains carry and spread fecal material and refuse in the environment because we have sanitation problems and poor drainage systems. This makes the quality of water very poor causing diarrhea and cholera."*
>
> (Adult-Male FGD).

5.3.2. The impacts of climate extreme events on health

Apart from climate variables impacting the health of slum dwellers directly, the manifestation of these climate variables also brings about other health consequences.

Several health impacts of flooding events were described through questionnaires, interviews and discussions conducted on the field. As shown in Table 2, about 58.3% of subjects stated that flooding affected them through depression from loss and damage of property. People who have experienced flooding may suffer from sustained increases in common mental disorders [37]. 26.7% also faced challenges of infectious diseases such as malaria, cholera, and diarrhea. The reality remains that the vulnerability of the urban poor, and in this context slum dwellers, increases their exposure to extreme climate events and climate-induced disease in their communities [38]. A small percentage (5%) stated that they knew of people who have lost their lives directly or indirectly related to floods. Focus group discussions validated some of the findings from questionnaires obtained from the field. They supported the fact that flooding events cause diseases and put pressure on socio-economic activities. For instance, a female participant described the situation in her community as follows:

> *"When a flood event occurs in my area, the remaining water from the flood mostly breeds mosquitoes and my observation is that there is always an increase in mosquitoes and the number of malaria incidences in households. Also, flooding restricts our movements because the whole area becomes muddy and dirty causing the easy spread of diseases in our overcrowded communities."*
>
> (Adult-Female FGD)

In the same community, a male participant also explained the situation as follows:

> *"...yes, flooding in this area cause malaria, typhoid, diarrhea and others in my family and even the entire community because after flooding, it leaves behind stagnant waters and my children are mostly found playing in those waters and the next thing is facing health problems."*
>
> (Adult-Male FGD).

As shown in Table 3 participants reported several effects of droughts and dry spells on slum health. Heat-related diseases (heat strokes, heat rashes and skin disease) had the highest impacts among slum dwellers, followed by depression from loss and damage of property (fire outbreaks). Infectious disease was the next health consequence of droughts and dry spells on slum residents. Heart disease and loss of life were reported least frequently. About 46% of the respondents indicated heat-related problems as their major climate-induced problem whilst 30.5% also experienced depression. Infectious diseases accounted for 16.7%. About 4.3% respondents indicated loss of life in relatives whilst 1.5% indicated heart disease.

Other slum dwellers expressed their opinions to support and validate the findings on the implications of drought and dry spells on their health through FGDs. Both male and female participants in the FGDs highlighted how the dry weather conditions impacts on their health as follows:

> *"...the absence of rain and dry weather bring about dust and dirt causing respiratory diseases like catarrh cold, flu, asthma and body weakness. I for example, when I am exposed to dust, I catch cold easily. These events can also result in rashes and boils and sometimes I suffer from rashes like boils"*
>
> (Adult-Male FGD)

> *"... due to the frequent occurrence of drought and dry spells, I do not sleep well and when I walk for a short distance I feel very tired and weak and sweat profusely. It sometimes causes heat stroke, rashes and boils to my body."*
>
> (Adult-Female FGD)

The experiences of these slum dwellers to climate risks have become pervasive and are characterized by drought and heat trapping, water shortages and air quality deterioration, with its consequent impact on the health of slum dwellers. Some respondents also indicated going through depression as a result of loss and damage of properties from floods and fire. Many of the slum dwellers had experienced these incidents or knew of someone who had created a sense of mental burden due to loss or the threat of future such occurrence.

Health professionals from the study communities were asked if climate change and the extreme events have resulted in any health complications. Even though most of them were not very familiar with the science of climate change, they were able to provide some

Table 3
Impacts of climate extreme events (flood, drought and spells) on slum health.

Climate Extreme Events	Impacts of flooding on health of slum residents (%)					
Flood events	Loss of lives	Depression from loss or damage of properties	Infectious Diseases	others	Missing responses	
	5%, (6)	58%, (69)	26.7%, (32)	6.3%, (8)	4%, (5)	
Total			**100%, (120)**			
	Impacts of drought and dry spells (%)					
Drought and Dry Spells	Loss of lives	Depression from loss or damage properties	Infectious diseases	Heat related diseases	Heart diseases	Missing responses
	4.3%, (5)	30.5%, (37)	16.7%, (20)	45.8%, (55)	1.5%, (2)	1-2%, (1)
Total			**100%, (120)**			

Source: Field data, (2020).

insights which indicated their awareness of how sudden and extreme "weather" changes or variations are deepening health burdens. For instance, links were made between increase in temperature and skin rashes as well as respiratory challenges as described by a health professional as follows:

> *"...yes, increased pollution leads to air pollution and water contamination which also brings about different diseases such as cholera and asthma, Again, frequent incidents of high temperatures, flooding and drought also reduce human immunity to make it easier for some harmful organisms to survive and cause diseases."*
>
> (Health Professional-Pharmacist)

Thus even though the residents and the health professionals could not proffer direct scientific explanations for the current changes that they observe in their environments, they were certain that temperature and rainfall variability have some impacts on the health of slum dwellers. Common climate-related (temperature and precipitation) diseases or health effects mentioned were dehydration, body weakness, skin disorders, heat rashes, frequent headaches, malaria, cholera, asthma and other respiratory problems. The lack of proper sanitation and drainage infrastructure also were mentioned as underlying factors that contribute to both the emergence and spread of diseases in slum communities (Table 4).

5.4. Climate-related diseases diagnosed in the past 2 years (2018-2020)

In exploring the effects of climate change on health, it was observed that climate change can contribute to disease outbreaks that compound existing health challenges. To further validate and make a case that people who live in slum communities are more vulnerable or susceptible to climate related health risks, respondents were asked to indicate some of the climate-related diseases they have suffered or been diagnosed with in the past two years (2018-2020). This was necessary to allow deeper explorations of participants' awareness and understanding levels, and also confirm with disease records obtained from the Health Directorate. Table 4 shows responses of various diseases diagnosed in slum dwellers in the past 2 years (2018-2020). The table also provides information on health records compiled from the La-Nkwantanang Municipal Health Directorate data sheet.

Within the past two years, most slum dwellers (70%) noted that they have suffered or been diagnosed with some infectious or parasitic diseases such as malaria, cholera, and diarrhea. A little over half (54.2%) of the total population were diagnosed with respiratory conditions and about 66% were diagnosed with heat strokes and skin rashes. 35% of respondents suffered from physical injuries. These data indicate how changing climatic conditions are affecting

Table 4
Disease slum dwellers were diagnosed of and health records.

Disease Conditions Diagnosed in the Past 2 Years (2018-2020)		
Various Diseases	**Frequency**	**Percentage (%) (N=120)**
Diagnosed with Infectious Disease (Malaria, Cholera, Diarrhea)		
Yes	84	70.0
No	36	30.0
Total	**120**	**100**
Diagnosed with respiratory Disease (Asthma, Pneumonia, Lung Disease		
Yes	65	54.2
No	55	45.8
Total	**120**	**100**
Diagnosed with Heat Strokes and Skin Rashes		
Yes	79	65.8
No	41	34.2
Total	**120**	**100**
Diagnosed with Physical injury		
Yes	42	35.0
No	78	65.0
Total	**120**	**100**
Source: Field data, (2020)		

Disease Data Obtained from Two Health Facilities in La-Nkwantanang Madina
(Source: compiled from La-Nkwantanang Municipal Health Directorate data sheet)

Health Facility	Disease	Year 2018	Year 2019
Kekele Polyclinic	Malaria (Infectious)	1682	1468
	Skin disease	1261	1482
	Respiratory	2683	3146
Madina Polyclinic (Rawlings Circle)	Malaria (Infectious)	1101	2011
	Skin disease	183	272
	Respiratory disease	613	830

vulnerable people in the slum communities where they live. While all their health ailments may not be attributed to climate change impacts, there are clear interlinkages, especially as they relate to frequent and intense rainfall and increasing temperatures.

Disease data from two (2) hospitals within La-Nkwantanang Madina municipality were obtained to ascertain how hospital records confirm observations and responses from participants from the study communities. As shown in Table 4, diseases recorded in the health facilities that provide health assistance to urban dwellers living in and around the study communities correspond with what participants reported. .

6. Discussion

The paper examined the reported impacts of climate change on health in selected slum communities in and around the city of Accra. Two dimensions of climate-induced health impacts emerged, namely, direct and indirect impacts. Direct effects of climate change on health among both male and female slum dwellers have been established, through direct impacts of climate variables (temperature and rainfall) on the health of individuals [40]. As direct consequences of either increased moisture or temperature, it was also observed that these variables influence the incidence of malaria [41], diarrhea, cholera, and sanitation -related health problems. A lot of these problems are a consequence of choked gutters, poor drainage and hygiene problems which are exacerbated by climate variables. These observations are very much in line with the claim that occasional intense rainfall after extended period of droughts can result in pathogen increases and disease outbreaks such as malaria and cholera [36].

The findings in this study showed that climate elements including torrential rainfall and periods of high temperatures give rise to floods and drought which most slum dwellers reported as the major life-threatening climate impacts in the study area. These challenges also were evident in a similar study by Haines et. al. [24] showing that climate change threatens health especially for people living in dismal areas. They noted increased floods, droughts and changes in distribution of vector-borne and water-borne diseases as means through which climate change endangers health.

Similarly, Mastrangelo et. al. [32] stressed that high temperatures and resultant heatwaves are becoming dangerous, especially among urban poor with limited access to immediate medical attention. A study by Bouma [33] showed a direct link between temperature and some climate-sensitive diseases such as malaria transmission and cholera, as increasing temperatures affect the life-cycle of disease-causing pathogens and bacteria. Malaria-transmitting mosquitoes thrive in temperatures that exceed 33°C−39°C, and in the setting of floods which promote mosquito breeding sites [34,39]. Extreme variations in temperatures also affect the reproduction and incubation period of pathogens [35]. Respondents in most of the communities surveyed in the current study confirmed these observations as a common reality.

Accra has been declared as the most populous among regions according to the Population and Housing Census (PHC) 2021. The catastrophic nature of flooding events observed in slum communities, along with population increases and a surge in urbanization, are likely to continue to contribute to poor sanitation, destruction of property, and even more deaths. The occurrence of extreme climate events, such as floods and droughts, are expected to increase with the progression of climate change, with severe effects on the vulnerable urban poor [25]. Our observations also indicated that infectious, respiratory, and skin diseases were the most common diseases slum dwellers have experienced over the past two years, which was confirmed with disease-rate data obtained from health centers through the Municipal Health Directorate in the La-Nkwantanang Madina Municipality.

The reality in Ghana, as in many African countries, is that climate change presents many health challenges which affect various regions at different levels [43], especially the poor living in over-crowded slum conditions in urban settings. These communities are vulnerable and face high risks of exposure to climate-relataed hazards and contracting various diseases and other health challenges. Addititonally, decrease in water availability and deteriorating water quality reduces access to drinking water in ways that negatively affect the health of the urban poor [45]. Further, because of women's roles in procuring the household water supply and their responsibililty for domestic chores and other care-giving roles, they may be at particular risk of water-related diseases including diarrhea and cholera in urban slum areas, with pregnant women and children being most susceptible [45- 46].

7. Conclusions

Ghana and Africa's surging urbanization makes addressing climate change-related health effects imperative as increasing migration, population expansion and the lack of adequate and affordable housing are turning cities into slums which increases the risk of disease emergence. Most city authorities have struggled to cope with the demands of safe urbanization [42]. Housing, sanitation, infrastructure, and health reflect critical urban development issues. Health effects, however, can remain silent as they are typically under-reported. Healthcare also is inadequate or absent for the urban poor. The challenge of providing healthcare is enormous without agreement on best practice, given that people in slum communities are at constant risk of eviction and relocation [44].

This study aimed to bring attention not only to the implications of climate impacts on the health of slum dwellers, but also on the larger implications of climate change on the health, safety, and well-being of whole communities. The study reveals the diversity of impacts of climate change on the health of slum dwellers in urban Accra, including direct and indirect impacts and their relationship to climate sensitive conditions such as dehydration, weakness, skin and heat rashes, headache, malaria, respiratory diseases, and diarrhea [32]. These impacts present urgent challenges at the nexus of climate change, health, and urbanization. Addressing them should include upgrading the living conditions of slum communities to promote proper health conditions and health-influencing behaviors for slum dwellers.

Author Agreement Statement

We the undersigned declare that this manuscript is original, has not been published before and is not currently being considered for publication elsewhere.

We confirm that the manuscript has been read and approved by all named authors and that there are no other persons who satisfied the criteria for authorship but are not listed. We further confirm that the order of authors listed in the manuscript has been approved by all of us. We understand that the Corresponding Author is the sole contact for the Editorial process. He/she is responsible for communicating with the other authors about progress, submissions of revisions and final approval of proofs.

Declaration of interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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