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RESEARCH ARTICLE

Household survey on climate change and human health in a low-income country: Associations between increased health emergencies and extreme changes in climate in Liberia

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Abstract

Liberia and other low and middle-income countries (LMICs) are particularly vulnerable to climate change. Yet, data on perceived risks of climate change among community residents in these countries are little known. We performed a cross-sectional survey of 800 households selected randomly through multistage cluster sampling from two regionally distinct areas of Liberia. A 91-item English survey was administered by trained research assistants verbally in the respondent's preferred spoken language. Univariable comparison of climate related questions between the two regions was made by chi-squared analysis. Univariable and multivariable logistic regression modeling was performed to assess the association between known risks and the primary outcome of interest: a self-reported increase in health emergencies due to extreme heat, drought, flooding, wildfires, or other extreme weather events by climate change. Survey respondents were majority male (n = 461, 57.8%) with a mean age of 40.6 years (SD 14.7). Over 65% of households lived on less than 100 USD per month. A majority of respondents reported increased intensity of heat during the dry season (n = 408, 51.0%); increased intensity of rainfall during the rainy season (n = 433, 54.1%), and increased severity in endemic diseases (n = 401, 50.1%) over the past 5–10 years. In multivariable modeling, perceived water and food impacts (OR: 6.79, 95%CI 4.26–10.81; OR: 3.97, 95%CI 2.25–7.03, respectively), unemployment (OR: 3.52, 95%CI 1.89–6.56), and lack of electricity (OR: 2.04, 95%CI: 1.23–3.38) were the strongest predictors of perceived increased health emergencies due to climate change. A significant proportion of households across multiple Liberian communities have already felt the health effects of climate change. Focused efforts on mitigating individual and household risks associated with the increased health effects of climate change is essential.

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Introduction

Climate change disproportionately affects vulnerable groups, particularly lower-income communities and people of color. While high-income countries are the leading contributors of greenhouse emissions, low- and middle-income countries (LMICs, as classified by the World Bank) will face the brunt of climate change [1–3]. Increases in hazards due to anthropogenic climate change, including extreme heat, droughts, and floods will continue to increase across large parts of Africa [4]. While climate change will lead to lasting change in all countries, there are significantly more studies on climate impacts in high-income countries than in low-income countries. The 'attribution gap' reveals that evidence for climate impacts are twice as prevalent in high-income countries (HIC) than in low-income countries (LICs) [5, 6].

Liberia, a low-income country in West Africa, is particularly vulnerable to climate variability and change—including changes in rainfall, higher temperatures, and rising sea levels [7, 8]. Liberia suffers from high rates of infectious cholera, diarrheal illness, yellow fever, schistosomiasis, and malaria. Malaria, in particular, remains a leading cause of both morbidity and mortality in the country. Regional changes in climate will likely make these disease processes worse over coming years [9]. The health effects of climate change are also exacerbated by pre-existing infrastructure—road quality is poor throughout the country—and agricultural challenges [10]. Twenty percent of Liberians are food insecure, with some of the lowest agricultural yields in the region [11].

Liberia is one of 55 African countries that are signatories of the Programme of Action (POA) for the Implementation of the Sendai Framework for Disaster Risk Reduction [12]. The POA outlines 12 targets for regional disaster risk reduction (DRR), including the integration of DRR processes with climate change adaptation (CCA) [13]. These frameworks, as well as the Intergovernmental Panel on Climate Change (IPCC), support efforts at the community level to develop and understand adaptive strategies to climate change [14].

While several large regional reviews of climate change exist, data from Liberia specifically remains limited [15, 16]. A search of climate change, health, and Liberia resulted in no published peer reviewed literature at the national or subnational level. Additional data on community-based actions geared towards resilience building in Africa also remains limited [17, 18]. Furthermore, data specific to the emergency care health effects of climate change in Africa is also minimal, though several studies provide a roadmap for future progress on the continent [19–21].

The objective of this study is to survey community understandings of the effects of climate change on health emergencies and access to medical care. Results may help to guide community efforts at building responses to climate change leading to improved health benefits.

Methods

Study design

A community-based, cross-sectional survey was conducted in collaboration with the Emergency Medical Response-EMS/Respiratory Division of the Ministry of Health, Monrovia, Liberia, the University of Colorado, and Restore Hope, Liberia.

Study setting

Two counties of fifteen total counties in Liberia were studied. The rural county of Lofa in northwestern Liberia has an estimated population of approximately 277,000 persons, while Montserrado county encompasses urban and peri-urban administrative areas in and

surrounding the capital city of Monrovia with an estimated population of approximately 1.12 million persons [22].

Multistage cluster sampling was performed in order to select households in both geographic areas. Using known county, district, and administrative mapping from previous 2008 National Population and Housing Census (NPHC) and data from the 2019–20 Liberia Demographic and Health Survey (LDHS), an initial sampling frame was created [22, 23]. A total sample size of 800 households, 400 households in Lofa County and 400 in the greater Monrovia area, was generated with 5% absolute precision and 95% CI, and an assumed 4% non-response rate based on previous sampling in Liberia [23].

A two-stage sampling frame was utilized in Lofa County: 40 random clusters, proportional to district size and based on known enumeration area and village town names, were chosen in the first stage followed by systematic random sampling of 10 households within each cluster.

A more complex sampling frame was utilized in Montserrado County, as we initially purposively sampled only high density urban or peri-urban districts from within the county. Again, proportional to known population size, townships in the greater Monrovia region were randomly selected. Next, enumeration areas, roughly equated with individual villages or clans, were randomized from the townships. Finally, systematic random sampling of 10 households per administrative cluster was performed.

Verbal informed consent from a representative adult (18 years old and older) of each household, not dependent of sex or home ownership, was obtained and documented on the survey form by research assistants prior to each survey administration. The verbal consent was obtained in each participant's preferred language. All participants were recruited and surveyed in November of 2022.

Survey tool

The results from a 91-item questionnaire specific to emergency care access and utilization are reported separately [24]. The eleven questions specific to climate change were based on previously validated studies in other LICs [25]. The survey tool was designed with the input of key informant community members, ministry of health representatives, and emergency care providers then piloted among research assistants and sample households prior to implementation. All surveys were administered orally by trained research assistants in each respondent's preferred language.

Data analysis

Collected data was de-identified and cleaned prior to initial analysis in Excel. Further data analysis was performed via Stata (Version 14.2, College Station, TX). Demography is presented as number and percents for categorical data or averages and standard deviations for continuous data.

Univariable comparison of climate related questions between the two regions were made by Pearson's chi-squared analysis. Univariable logistic regression was used to assess individual predictor variables with the primary outcome of interest: a self-reported increase in health emergencies due to extreme heat, drought, flooding, wildfires, or other extreme weather events by climate change. Multiple multivariable logistic regression models were also performed. In all models, predictor variables were based on prior methodologic theory, including variables from univariable analysis if the p-value was <0.10, variables thought to be known historical risk factors, and confounders of increased health effects from climate change [26].

The number of variables used in the final models differed between the two regions under study owing to differences in the number of reported outcomes in each area, the number of

variables significantly associated with the outcome, and the models goodness of fit. In each model we report the total number of households in the model, the calculated area under the curve (AUC) to assess for discrimination, Hosmer-Lemeshow (H-L) statistics for goodness of fit, and Pseudo R2. We report the unadjusted and adjusted odds ratios (aORs) and 95% confidence intervals (CI) for predictor variables to the outcome variable stratified by geographic area. A p-value of <0.05 was considered statistically significant in the models.

Data was accessed for input, cleaning, analysis and interpretation between November of 2022 and May of 2023.

Ethical approval was obtained from both the University of Colorado Institutional Review Board and Atlantic Center for Research and Evaluation, University of Liberia (ACRE-IRB, Protocol number: 22-11-350).

Results

A total of 800 respondents were surveyed (Table 1)–with 399 participants in the greater Monrovia region and 401 participants in Lofa County. Over half of all respondents were male (N = 461, 57.6%), and the mean age was 40.62 (SD 14.72). The primary language of respondents, the language most spoken at home, levels of education, literacy, occupation, and access to phones were grossly different, as expected, in the two regions sampled.

Household demography was also largely different between the two areas sampled (Table 2). The average number of occupants living in homes in Monrovia was larger as compared to those numbers in Lofa. Over 65% of those who answered questions on income, lived on less than 100 USD per month. Homes in Lofa were less likely to be made of durable materials, have personal/family latrine access, and electricity. Overall, access to water and mechanisms of cooking in the two regions were somewhat similar, while individual households in Lofa were less likely to have access to adequate soap.

Differences in responses to climate related questions were also explored between subgroups (Table 3). A majority of all respondents reported increased intensity of heat during the dry season (n = 408, 51.0%); increased intensity of rainfall during the rainy season (n = 433, 54.1%), and increased severity in endemic diseases (n = 401, 50.1%) over the past 5–10 years. Individual respondents in the urban and peri-urban communities around Monrovia were much more likely to have perceived increases in the intensity of heat, cold and rainfall over the last 5–10 years (60.9% vs 41.4%, p value <0.001; 47.1% vs 36.7%, p-value <0.001; 68.4% vs 39.9%, p-value<0.001, respectively). Similarly, the severity of all disease and frequency of disease during the rainy season of disease was thought to be more intense among those from areas around Monrovia as compared to those from Lofa (58.1 vs 42.1, p-value<0.001 and 56.4% vs 41.4%, p-value <0.001). While differences in perceived frequency of diseases during the dry season were different between the two regions, overall respondents were more mixed in the directional rating.

A significant proportion of individuals in both regions reported climate impacts to food (N = 491, 61.4%) and water supplies (N = 383, 47.9%) with over one third of individuals reporting impacts to their place of residence or workplace (N = 12, 39.0%), though there were no significant differences between subgroups. Increases in health emergencies (N = 272, 34.0%) and climate impacts on accessing emergency care (N = 241, 30.1%) were also noted among a sizeable proportion of all respondents.

Multiple demographic, social, and economic variables were associated with a perceived increase in health emergencies due to climate change in univariable analysis (Table 4). Non-English speakers (OR = 1.64, 95% CI: 1.22–2.21), illiteracy (OR = 1.52 95% CI: 1.13–2.05), unemployment (OR = 1.92, 95% CI: 1.18–2.24), low income status (OR = 1.83, 95% CI: 1.13–

Table 1. Baseline demographic characteristics among household respondents in two geographic regions of Liberia.

Characteristic	Total	Monrovia Area	Lofa County	P-Value*
	N = 800	N = 399	N = 401	
Sex (%)				<0.001
Female	337 (42.1)	123 (30.8)	214 (53.4)	
Male	461 (57.6)	276 (69.2)	185 (46.1)	
Mean Age (SD)	40.62 (14.72)	39.34 (14.35)	41.96 (14.99)	0.015
Age (%)				0.134
18-29	181 (22.6)	107 (26.8)	74 (18.5)	
30-39	235 (29.4)	120 (30.1)	115 (28.7)	
40-49	141 (17.6)	66 (16.5)	75 (18.7)	
50-59	95 (11.9)	46 (11.5)	49 (12.2)	
60+	94 (11.8)	43 (10.8)	51 (12.7)	
Primary language (%)				<0.001
English	422 (52.8)	325 (81.5)	119 (29.7)	
Other	377 (47.1)	74 (18.5)	282 (70.3)	
Primary household language (%)				<0.001
English	396 (49.5)	370 (92.7)	26 (6.5)	
Other	404 (50.5)	29 (7.3)	375 (93.5)	
Education (%)				<0.001
None	311 (38.9)	86 (21.6)	225 (56.1)	
Primary	90 (22.5)	45 (11.3)	45 (11.2)	
Secondary	213 (26.6)	148 (37.1)	65 (16.2)	
College/University	90 (22.5)	70 (17.5)	20 (5.0)	
Graduate	84 (10.5)	47 (11.8)	37 (9.2)	
Literacy (%)				<0.001
No	320 (40.0)	79 (19.8)	241 (60.1)	
Yes	476 (59.5)	318 (79.7)	158 (39.4)	
Occupation (%)				<0.001
Unemployed	93 (11.6)	84 (21.1)	9 (2.2)	
Farmer	269 (33.6)	3 (0.8)	266 (66.3)	
Business	178 (22.3)	158 (39.6)	20 (5.0)	
Other	194 (24.3)	142 (35.6)	52 (13.0)	
Phone Access (%)				<0.001
No	287 (35.9)	50 (12.5)	237 (59.1)	
Yes	513 (64.1)	349 (87.5)	164 (40.9)	

* As assessed by Pearson's chi-squared and t-tests for categorical and continuous variables, respectively.

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2.97), perceived concerns in rendering first aid to others (OR = 2.69, 95% CI:1.52–4.75), and perceived decreases in access to food (OR = 11.61, 95% CI: 7.37–18.26) and water (OR = 11.23, 95% CI: 7.78–16.21) due to changing climate were all significantly associated with perceived increases in health emergencies from extreme heat, drought, flooding, wildfires, or other extreme weather events.

In multivariable modeling (Table 4), perceived water and food impacts (OR: 6.79, 95% CI = 4.26–10.81; OR: 3.97, 95% CI = 2.25–7.03, respectively), unemployment (OR: 3.52, 95% CI = 1.89–6.56), and lack of electricity (OR: 2.04, 95% CI: 1.23–3.38) were the strongest predictors of increased health emergencies due to climate change.

Table 2. Household characteristics among households in two geographic regions of Liberia.

Characteristic	Total	Monrovia Area	Lofa County	P-Value*
	N = 800	N = 399	N = 401	
Mean occupants (SD)	6.93 (4.55)	7.82 (5.66)	6.06 (2.80)	<0.0001
Mean occupants <18 (SD)	2.91 (2.23)	3.02 (2.61)	2.79 (1.74)	0.158
Mean occupants with income (SD)	1.54 (1.35)	1.76 (1.28)	1.24 (1.38)	<0.0001
Household monthly income (%)				<0.001
<100 USD	215 (26.9)	94 (23.6)	121 (30.2)	
>100 USD	115 (14.4)	83 (20.8)	32 (8.0)	
Dwelling standards (%)				<0.001
Durable walls	452 (56.5)	351 (88.0)	101 (25.2)	
Durable roof	690 (86.3)	394 (98.7)	296 (73.8)	
Durable floor	456 (57.0)	353 (88.5)	103 (25.7)	
Latrine access (%)				<0.001
No	211 (26.4)	7 (1.8)	204 (50.9)	
Yes	586 (73.3)	391 (98.0)	195 (48.6)	
Adequate water access for drinking (%)				<0.001
No	46 (5.8)	11 (2.8)	35 (8.7)	
Yes: community pump	428 (53.5)	213 (53.4)	215 (53.6)	
Yes: purchase	139 (17.4)	121 (30.3)	18 (4.5)	
Yes: running water/tap	184 (23.0)	54 (13.5)	130 (32.4)	
Treatment of drinking water (%)				<0.001
No	493 (61.6)	171 (42.9)	322 (80.3)	
Yes**	284 (35.5)	217 (54.4)	67 (16.7)	
Adequate water for cleaning (%)				0.001
No	216 (27.0)	88 (22.1)	128 (31.9)	
Yes	574 (71.8)	309 (77.4)	265 (66.1)	
Water access for agriculture (%)				<0.001
No	462 (57.8)	300 (75.2)	162 (40.4)	
Yes	334 (41.8)	97 (24.3)	237 (59.1)	
Soap access for hygiene (%)				<0.001
No	322 (40.2)	135 (33.8)	187 (46.6)	
Yes	471 (58.9)	263 (65.9)	208 (51.9)	
Household electricity (%)				<0.001
No	417 (52.1)	70 (17.5)	347 (86.5)	
Yes	379 (47.4)	327 (82.0)	52 (13.0)	
Cooking location (%)				<0.001
Outdoor	584 (73.0)	227 (56.9)	357 (89.0)	
Indoor	207 (25.9)	167 (41.9)	40 (10.0)	
Cooking fuel source (%)				0.001
Charcoal or wood	767 (95.9)	376 (94.2)	391 (97.5)	
Gas or electric	29 (3.6)	23 (5.8)	6 (1.5)	

* As assessed by Pearson's chi-squared and t-tests for categorical and continuous variables, respectively.

**chlorine, boil or filter

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Stratified multivariable modeling (included as S1 and S2 Tables) revealed perceived food and water impacts and lack of electricity to remain significantly associated with increased health emergencies due to climate change in both groups despite their demographic differences. Based on the Hosmer-Lemeshow statistic there is no evidence to suggest a lack of fit in

Table 3. Perceptions of climate change and impacts on human health in two regions of Liberia.

Characteristic	Total	Monrovia	Lofa	P-value*
	N = 800	N = 399	N = 401	
Compared to five to ten years ago, do you feel the intensity of heat during the dry season has changed? (%)				<0.001
Less	188 (23.5)	45 (11.3)	143 (35.7)	
Neutral	196 (24.5)	110 (27.6)	86 (21.4)	
More	408 (51.0)	243 (60.9)	165 (41.4)	
Compared to five to ten years ago, do you feel the intensity of cold during the rainy season has changed? (%)				<0.001
Less	239 (29.9)	90 (22.6)	149 (37.2)	
Neutral	216 (27.0)	121 (30.3)	95 (23.7)	
More	335 (41.9)	188 (47.1)	147 (36.7)	
Compared to five to ten years ago, do you feel the intensity of rainfall during the rainy season has changed? (%)				<0.001
Less	161 (20.1)	33 (8.3)	128 (31.9)	
Neutral	195 (24.4)	91 (22.8)	104 (25.9)	
More	433 (54.1)	273 (68.4)	160 (39.9)	
Compared to five to ten years ago, do you feel certain diseases (such as malaria) are changing in severity (eg. more people are getting sick)? (%)				<0.001
Less	211 (26.4)	72 (18.0)	139 (34.7)	
Neutral	176 (22.0)	94 (23.6)	82 (20.4)	
More	401 (50.1)	232 (58.1)	169 (42.1)	
Compared to five to ten years ago, do you feel the frequency of diseases during the dry season are changing (eg. people sick more often)? (%)				<0.001
Less	311 (38.9)	146 (36.6)	165 (41.1)	
Neutral	166 (20.8)	110 (27.6)	56 (14.0)	
More	316 (39.5)	142 (35.6)	174 (43.4)	
Compared to five to ten years ago, do you feel the frequency of diseases during the rainy season are changing (eg. people sick more often)? (%)				<0.001
Less	223 (27.9)	73 (18.2)	150 (37.4)	
Neutral	181 (22.6)	100 (25.1)	81 (20.2)	
More	391 (48.9)	225 (56.4)	166 (41.4)	
Has your water supply been impacted by shortages or higher prices in the last five years due to drought, flooding, wildfires, or other extreme weather events? (%)				0.452
No	408 (51.0)	200 (50.1)	208 (51.9)	
Yes	383 (47.9)	198 (49.6)	185 (46.1)	
Has your food supply been impacted by shortages or higher prices in the last five years from warmer temperatures, drought, flooding, wildfires, or other extreme weather events? (%)				0.221
No	301 (37.6)	160 (40.1)	141 (35.2)	
Yes	491 (61.4)	239 (59.6)	252 (62.8)	
Have extreme weather events in the past 5 years, such as extreme heat, drought, flooding, wildfires, or severe storms made it more challenging to access medical care? (%)				0.770
No	549 (68.6)	274 (68.7)	275 (68.6)	
Yes	241 (30.1)	123 (30.8)	118 (29.4)	
Has your place of residence or workplace been impacted by flooding, drought, extreme heat, or other climate-related extreme weather event? (%)				0.081
No	481 (60.1)	254 (63.7)	227 (56.6)	
Yes	312 (39.0)	145 (36.3)	167 (41.6)	
Have you or your household members experienced an increase in health emergencies due to extreme heat, drought, flooding, wildfires, or other extreme weather events? (%)				0.012
No	516 (64.5)	276 (69.2)	240 (59.9)	
Yes	272 (34.0)	120 (30.1)	152 (37.9)	

*As assessed by Pearson's chi-squared test.

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Table 4. Characteristics associated with perceived increase in health emergencies due to extreme heat, drought, flooding, wildfires, or other extreme weather events by climate change.

Characteristic	Unadjusted OR (95% CI)	Adjusted OR (95% CI)*
Recent food impacts	11.61 (7.37–18.26)	3.97 (2.25–7.03)*
Recent water impacts	11.23 (7.78–16.21)	6.79 (4.26–10.81)*
Perceived concerns in rendering first aid	2.69 (1.52–4.75)	–
No electricity in home	2.30 (1.69–3.12)	2.04 (1.23–3.38)*
Floor not cement	2.19 (1.63–2.96)	1.50 (0.90–2.50)
Unemployment	1.92 (1.18–2.24)	3.52 (1.89–6.56)
Low income (<100 USD)	1.83 (1.13–2.97)	–
Outside cooking	1.61 (1.13–2.29)	–
Death in home in last 12 months	1.58 (1.04–2.39)	–
Illiteracy	1.52 (1.13–2.05)	–
Non-English speaking	1.64 (1.22–2.21)	–
Lofa county	1.46 (1.08–1.96)	–

*Statistically significant predictors in multivariable analysis ($p<0.05$).

**N = 710, AUROC = 0.8438, H-L chi2 = 5.32 (p value 0.5041), Psuedo R2 = 0.2879

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either of the stratified models (Monrovia H-L $\chi 2 = 1.84$, p-value 0.8702; Lofa H-L $\chi 2 = 3.08$, p-value 0.3791). This is further supported through the area under the curve and pseudo R2 results for each of the reported models.

Discussion

This is the first large scale study to assess the perceived impacts of climate change among community households in Liberia. A significant proportion of community members surveyed in this study were from rural and poor communities. Household demographics are representative both of the country of Liberia as a whole, as well as those most at risk from the effects of a changing climate [27]. Again, while a large number of study participants had little to no formal education and were illiterate, all were able to confidently understand research assistant questions on climate change and comprehend the potentially relevant impacts on individual and household health. This data adds to, and is consistent with, several studies on the public perceptions of climate change and health in LMICs [28–30].

The study indicates that a significant proportion of community members have already felt the impacts of a changing climate in the past 10 years. A majority of household respondents felt that the intensity of heat and rainfall had increased or substantively changed as compared to 5–10 years ago. Community perceptions of climate change in Liberia are consistent with known changes in heat and rainfall. Over the last several decades average temperatures have increased 0.8 degrees [9]. In the future, mean average temperatures in Liberia are projected to continue to increase by 1.8 degrees Celsius between 2040 and 2059 [31].

Perceptions of change were not universal however—with notable geographic variability. Stratified by county, those living in peri-urban and urban areas in Monrovia were more likely to experience the effects of a changing climate—including more severe heat, cold, and rainfall—as compared to those in rural Lofa county. Those in urban areas were also more likely to have felt an increase in the severity of diseases and frequency of diseases in the rainy season. Existing data supports the overall trend seen here, that urban environments do and will experience the effects of climate change disproportionately than rural environments, especially among those living in so called urban heat islands [32, 33].

Perceived increases in health emergencies due to a changing climate were also associated with economics. Those without electricity or unemployed were both more likely to perceive increases in health emergencies in multivariable modeling. Additional variables suggestive of a lower socioeconomic status were also significant in univariable modeling and included income less than 100 USD per month, illiteracy, and cooking outside. In stratified multivariable analysis of responses, a non-durable, unpaved floor was also significantly associated with increased health emergencies in Lofa County, while being non-English speaking demonstrated higher odds of reporting increased health emergencies in the Monrovia Area. The effects of climate change are currently known to, and will in the future, disproportionately affect those who are poor, marginalized, and vulnerable [14, 34]. Similar to other social determinants of health, climate change leads to the widening of known structural inequities and worsened health outcomes [35]. That the health effects of climate change appeared to be significantly associated with those that perceived recent impacts to food and water supply is further evidence of this fact.

Limitations include the interaction of recall bias and possible interpretation errors, as the research assistants were not formally certified in interpretation services.

This study provides a first step in understanding perceptions of climate change and health and supports the role that communities should play in adapting to climate change regionally.

Conclusions

The effects of a changing climate are already being felt in Liberia with those effects most felt in urban environments. Additionally, health emergencies from climate change are disproportionately associated with those that have experienced food and water insecurities and who are economically marginalized and poor. Though the Republic of Liberia has recently recommitted to combating climate change through a national action plan to lower greenhouse emissions across sectors [36], this study underlines the crucial need for simultaneous attention toward mitigation strategies of current and future health impacts. These findings can help to inform the development of effective approaches to emergency care access and delivery in a changing climate.

Supporting information

S1 Checklist. Inclusivity in global research.
(DOCX)

S2 Checklist. STROBE statement—checklist of items that should be included in reports of observational studies.
(DOCX)

S1 Table. Characteristics associated with perceived increase in health emergencies due to extreme heat, drought, flooding, wildfires, or other extreme weather events by climate change in the Monrovia Area.
(DOCX)

S2 Table. Characteristics associated with perceived increase in health emergencies due to extreme heat, drought, flooding, wildfires, or other extreme weather events by climate change in Lofa County.
(DOCX)

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