Perception and knowledge about climate change and health problems: a study in Kolkata Metropolitan Region

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Abstract In the twenty-first century, land use changes, massive expansion of urbanization, population growth, economic crisis, environmental issues are the main challenges of developing countries. Climate change and its effects on human health are the major concerns for the different age groups of the population. The study delved into the causes associated with climate change and climate change-related myriad health impacts on the study population. This study has used a concurrent mixed-method research design. The quantitative and qualitative data were collected from the study area. Perception and knowledge about climate change and its consequences on health was based on a quantitative approach of Bi-variate analysis and Chi-Square test and Fisher's exact test; this study also used qualitative data analysis. Study results show that most respondents pointed out that temperature increases throughout the year and 90% of the respondents reported that rainfall pattern has also changed. Similarly, 65% of respondents agreed in their statements in favour of increased natural calamities in this region. The study findings show that more than 40% of population faces dengue fever and 10% of people also suffer from malaria. More than 60% of the urban population suffered from asthma. Similarly, more than 70% of the population also got affected by cold and cough due to weather variability. Focus Group Discussion (FGD) and In-depth interviews of the participants also affirmed the fact that climate variability induced diseases and health problems in Kolkata Metropolitan areas. Urban residents perceived that excessive urbanization contributes to the changes in regional climate and human health. The study will encourage the policy-makers and local government to mitigate adverse health effects driven by climate change in the Kolkata Metropolitan Region.

Keywords Urban residents · Perception · Knowledge · Climate change · Health problems · Kolkata · India

Introduction

Megacities in India now face a pressing challenge due to climate change, where the majority of people are experiencing health risks. Climate change is primarily caused by human activities; and its effects have already been seen across the globe in various forms (Rahman et al., 2008). India's Urbanization process is very rapid; many small, medium towns and cities have been growing without appropriate urban planning in recent decades (Anees et al., 2018). In general, the economic and socio-demographic

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determinants are influencing urban expansion (You & Yang, 2017). Urbanized areas, land surface properties and other physical structures are influenced by regional climate (Gu et al., 2019). Urban growth is the main cause behind changes in temperature changes in urban areas (de Lima & Rueda, 2018). Climate change and urbanization both have influences on precipitation patterns (Gu et al., 2019). Cities significantly influence meteorology at local and regional scales (Morris et al., 2017). Climate change poses a serious threat to the coastal city region, which is characterized by uncertain rainfall, temperature variations, and poor urban infrastructure. In addition, the climate change-related major effects are inclusive of high temperature, humid weather, cyclones and floods (Ngwenya et al., 2018). At present, climate change is a significant challenge, and it is likely to bring devastating effects on human life and settlements (Balaban, 2012). As a result of climate change, people confronted the most profound health threats in this era (WHO, 2021). Although evidence shows that, climate change has an impact on human health (Acharibasam & Anuga, 2018). Temperature variations, excessive rainfall, and humidity all have impacts on health. A change in air quality is predicted to exacerbate respiratory and allergic diseases in many regions (Haque & Singh, 2017). Smoke inhalation and high temperatures cause respiratory problems in millions of Indians (McMichael et al., 2006; Nomani & Parveen, 2020). Dengue is a severe vector-borne infectious disease, particularly in Kolkata and its surrounding districts (Bal & Sodoudi, 2020). In Kolkata Metropolitan Region, Weather variation and regional climate have an impact on health; people are also faced malaria transmission. Consequently, this paper explored the perception and knowledge about climate change and major health problems of the people in Kolkata Metropolitan Region (Fig. 1).
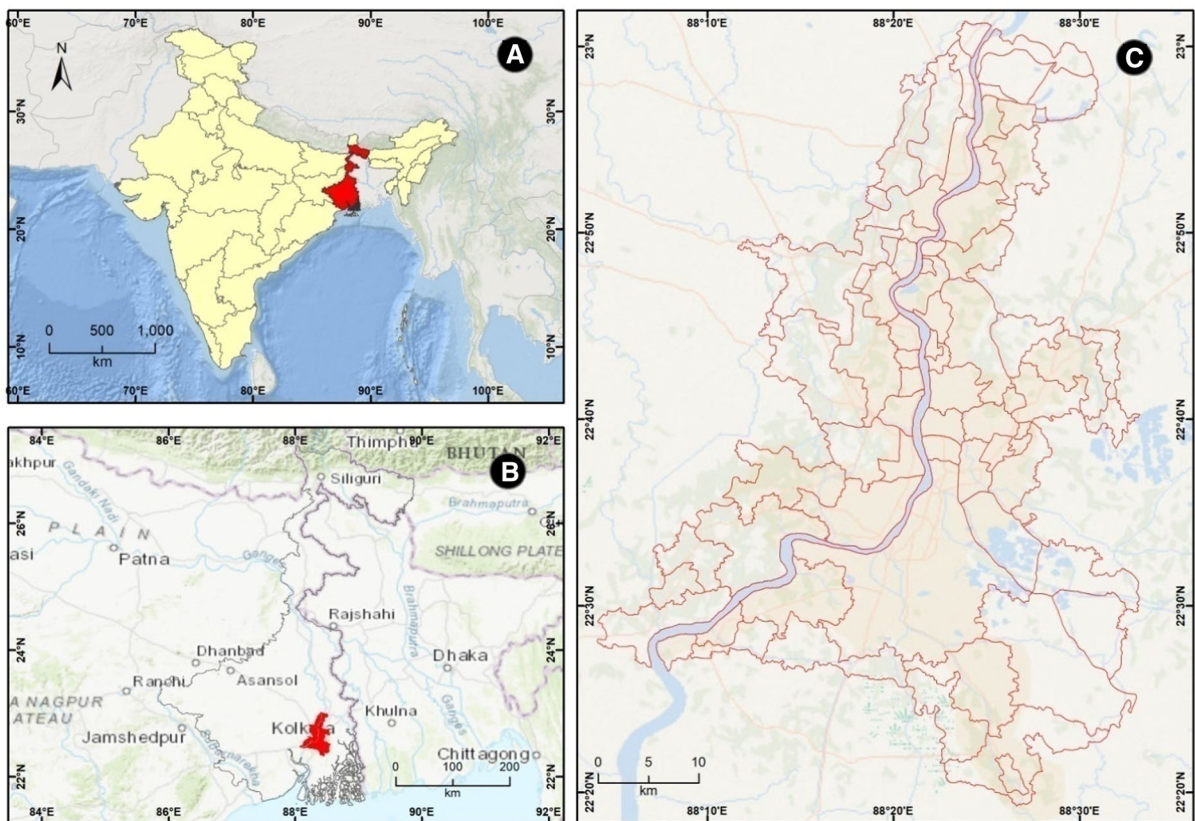

Fig. 1 Location of Kolkata Metropolitan Region: **A** shows the India, **B** shows the West Bengal and **C** shows the Kolkata Metropolitan Region

Database and methodology

The illustration of the urbanization, climate change-related exposure impact on human health cannot be explained through the quantitative data. For a better understanding of this issue, the data were collected with the help of the household interview schedule questionnaires, and a qualitative technique was used as In-depth Interviews and Focus Group Discussion (FGD). In-depth interviews were taken from head of the household, local administrative heads, health professionals, Government Officials, Municipal Councilors, and NGO professionals in Kolkata Metropolitan Region. The study is based on pilot Survey in the Kolkata Metropolitan Region through the semi-structured questionnaire. In this research, we consider the respondents those who are in the age group of 45 and more and permanent residents of the study region for at least 30 years. In this study, 70 (seventy) respondents were interviewed for the quantitative data purpose as well as 8 (eight) In-depth interviews and 4 (four) focus group discussions were conducted for the qualitative data. The study encompasses people's perceptions and knowledge about climate change and significant health problems. Data were analyzed with the help of Stata statistical software, version 13.

The quantitative data were analyzedusing Bi-variate analysis, Chi-Square test, and Fisher's exact test. The qualitative data helped to fact-check and validate the quantitative data.

Results

A total [22 (31.43%)] of the survey respondents were female, and [48 (68.57%)] were male (Table 1). About [46 (65.71%)] of the respondents fell into the 45–59 age group, [24 (34.29%)] of the respondents were into the 60 and above age group. About [49 (70.00%)] of the respondents were married, and [21 (30.00%)] of the respondents were widowed. In this study, [60 (85.71%)] of respondents were from the Hindu community and [10 (14.29%)] from the Muslim and Christian community.

Table 2 data shows, [63 (90%)] of the respondents reported that the rainfall pattern has changed, and most of them responded in agreed of increasing temperature over the period. On the other hand, [46 (65.7%)] of respondent's found increase in natural

Table 1 Socio-demographic characteristic of the adults aged ≥ 45 years in Kolkata Metropolitan Region

Respondent's characteristics	Frequency	Percentage
Gender		
Female	22	31.43
Male	48	68.57
Age		
45–59	46	65.71
60 and above	24	34.29
Marital status		
Married	49	70.00
Widowed	21	30.00
Education		
No formal education	15	21.43
Primary	35	50.00
Secondary and above	20	28.57
Occupation		
Business	31	44.29
Private job	12	17.14
Others	27	38.57
Type of family		
Nuclear	49	70.00
Joint	21	30.00
Religion		
Muslim and Christian	10	14.29
Hindu	60	85.71
Caste		
SC/ST/OBC	32	45.71
General	38	54.29
Type of house		
Semi pucca	48	68.57
Pucca	22	31.43
Separate kitchen		
Yes	37	52.86
No	33	47.14
Source of drinking waters		
Tap water	23	32.86
Packaged drinking water	47	67.14

Eligible respondents (n = 70)

calamities and most of the region confronted flood during the rainy season. [64 (91.4%)] of respondents pointed out the increasing pollution and dust in this region.

Urban residents observed climate change phenomena in the forms of storms, cyclones and floods. Consequently, weather attributes changed over the

Table 2 Urban resident responses about changes inclimatic phenomena in Kolkata Metropolitan Region

Climatic phenomena	Frequency	Percent of cases
Changing patterns of rainfall	63	90.0
Temperature increasing	70	100.0
Temperature variation in day and night time	31	44.3
Winter temperature increasing as compared to past years	35	50.0
Increasing natural calamities	46	65.7
Frequently flood	53	75.7
Increasing pollution and dust	64	91.4

Table 3 Urban resident responses/or perceptions about the main causes of climate change in the Kolkata Metropolitan Region

Reason of climate change	Frequency	Percent of cases
Urban expansion	44	62.86
Land use changes	63	90.00
Decrease in natural vegetation	55	78.57
Industrialization	10	14.29
Population growth	55	78.57
Increasing the motor vehicles	67	95.71
Increasing the pollution and dusts	68	97.14
Household energy consumption	28	40.00

last 30 years. They claimed that the growth rate of the urban settlement in the metropolitan area, small and medium towns, had been increased remarkably high in the past decades.

According to the responses of the urban residents, the leading causes of regional climate change are urban expansion, land-use changes, decrease in the natural vegetation, and increase in pollution and dust. Table 3 shows that [63 (90%)] of respondents said that land use is the responsible factor of climate change.

More than 75% of the people pointed out that population growth and decrease in natural vegetation directly influenced local meteorology. Similarly, [28 (40%)] of the respondents regarded the household energy consumption as an influencing determinant of regional climate and more than 10% [10 (14.29%)] of the respondent said that industrialization also played as an important factor for the climate change. Respondents also said that climate variability had changed as compared to previous years. The participants of Focus Group Discussion (FGD) and In-depth

interviews also asserted that summers were hot, and rainfall patterns have changed over the years. They also affirmed that they experienced the warm weather during the summer season and cold conditions amidst winter season had effects on health. Focus Group Discussion and In-depth interviews participants also reported climate variability-induced diseases and health problems in Kolkata Metropolitan areas. The respondent's possessed crystal clear consciousness about changes pertaining to climate and issues relates to their health. One of the indirect health impacts of climate change is the emergence of particular climate-sensitive infectious diseases (Wei et al., 2014). Studies have shown that climate changes such as humidity, temperature, radiation, and wind correlate with these extreme weather-related illnesses (Glaser et al., 2016; Matysiak & Roess, 2017).

A Fisher's exact test was calculated to assess the association between socio-demographic variables and the participants' knowledge of climate change. Gender, Age, and marital status were significantly associated with participants' knowledge. Males [48 (100%)] had more knowledge on climate change compared to 86.4% of females (n = 19). Individuals in the age group 45–59 years [46 (100%)], had more knowledge on climate change than the older adults which is more significant than 60 years [21 (87.5%)]. The knowledge on climate change is higher in the married respondents [49 (100%)] than the widowed [18 (85.71%)] (Table 4).

In-depth interviews and Focus Group Discussions (FGD) revealed that most people know about hazards related to climate change. They stated that the rainfall pattern has changed, the temperature has been increasing, and they are getting cyclones every year in the months of May, June, and November. Participants also stated that human activities are also responsible

Table 4 Association between socio-demographic variables and knowledge of climate change in adults aged ≥ 45 years in Kolkata Metropolitan Region

Respondent's characteristics	Knowledge (no)	Knowledge (yes)	Chi square value	Fisher's exact P-value
Gender				
Female	3 (13.64)	19 (86.36)	6.84	0.028
Male	0 (0.0)	48 (100.00)		
Age				
45–59	0 (0.00)	46 (100.00)	6.01	0.037
60 and above	3 (12.50)	21 (87.50)		
Marital status				
Married	0 (0.00)	49 (100.00)	7.31	0.02
Widowed	3 (14.29)	18 (85.71)		
Education				
No formal education	2 (13.33)	13 (86.67)	4.06	0.18
Primary	1 (2.86)	34 (97.14)		
Secondary and above	0 (0.00)	20 (100.00)		
Occupation				
Business	1 (3.23)	30 (96.77)	1.26	0.77
Private Job	0 (0.00)	12 (100.00)		
Others	2 (7.41)	25 (92.59)		
Type of family				
Nuclear	3 (6.12)	46 (93.88)	1.34	0.55
Joint	0 (0.00)	21 (100.00)		
Religion				
Muslim and Christian	0 (0.00)	10 (100.00)	0.52	1.00
Hindu	3 (5.00)	57 (95.00)		
Caste				
SC/ST/OBC	0 (0.00)	32 (100.00)	2.64	0.25
General	3 (7.89)	35 (92.11)		
Type of house				
Semi pucca	3 (6.25)	45 (93.75)	1.44	0.55
Pucca	0 (0.00)	22 (100.00)		
Separate kitchen				
Yes	0 (0.00)	37 (100.00)	3.51	0.10
No	3 (9.09)	30 (90.91)		
Source of drinking water				
Tap water	2 (8.70)	21 (91.30)	1.62	0.25
Packaged drinking water	1 (2.13)	46 (97.87)		

for climate change, while others mentioned that it is the cause of urbanization and natural changes.

Table 5 shows that, climate change gave rise to detrimental health effects in the inhabitants of the urban area. Due to increase in temperature, more than 50% of the population faced eye irritation, and 30% faced diarrhea. While in the Kolkata metropolitan region, more than 15% people have suffered from typhoid. More than 10% people also get suffered from malaria. Dengue and Malaria fevers are increasing in Kolkata Metropolitan Region; these diseases occur periodically throughout the year. Forty-seven percent people got affected from dengue and more than 60% of respondents have perceived asthma.

Similarly, 60% of the people faced skin diseases, and more than 70% of the population also got

Table 5 Climate change-related major health problems of the study population

Health problems	No	Yes
Eye irritation	31 (44.29)	39 (55.71)
Diarrhea	49 (70.00)	21 (30.00)
Typhoid	59 (84.29)	11 (15.71)
Malaria	62 (88.57)	8 (11.43)
Dengue	37 (52.86)	33 (47.14)
Asthma	27 (38.57)	43 (61.43)
Skin disease	28 (40.00)	42 (60.00)
Cold and cough	20 (28.57)	50 (71.43)

affected with cold and cough. The symptoms most often mentioned concerning cold weather were cough and fever, while emerging infectious diseases are dengue fever and malaria. Many of those who were interviewed remarked that their family members, especially children, women and old age people are more susceptible to get illness in the recent time.

Respondents reported their perceptions and knowledge of the effects of climate change on their health directly and indirectly. During the In-depth interview and Focus Group Discussion, people mentioned their health issues related to climate change.

After 1990, rapidly developed settlements in our locality and land-use changes rapidly and declined the vegetation cover over time. The concrete houses and roads highly contribute to the temperature increase in the Kolkata region (A 45 year's old man from Rajarhat Newtown Area).

In this metropolitan region, people observed day and night time temperature variations. The winter season was warmer as compared to the previous year. Day by day the temperature is increasing in Kolkata Metropolitan Region (A 55 year's old men from the Kolkata Municipal Corporation area).

In recent years, we observed temperature variation at day and night times and season to season. Due to temperature variation, child and old age people face cold and cough problems (A 57 year's old woman from Rajarhat Gopalpur Municipality Area).

Particularly, in this region, people are faced with temperature-related health problems like headaches, feeling of irritability, eye irritation, and skin diseases in recent years. My child faced rashes on the skin; similarly, in the summer season, I felt headache

many times (A 49 year's old man from the Salt Lake region).

Cyclonic activity is increasing in recent years; Cyclone Bulbul destroyed our area, thousands of people were affected, and trees, houses, and electric posts were destroyed in our locality. Similarly, the Fani cyclone in 2019 triggered heavy rainfall in the Kolkata Metropolitan region. Most of the low line area was water logged, and people have faced hardship in their daily lives. And every year, we face cyclones in May and June months. (A 63 years old woman from Rajarhat Gopalpur Municipality Area).

Due to building construction and rise in the numbers of motor vehicles, pollution levels in Kolkata Metropolitan Region are shot up, which directly affect our health. I have been suffering from Asthma for 5 years. And my father also faced respiratory problems due to pollution and dust (A 48 year's old man from Howrah Municipal Corporation Area).

We observed Rainfall patterns have changed over the period in Kolkata Metropolitan Region; basically, winter is a dry season. In recent years, we got few cyclones and rainfall in the winter season. The changing patterns of rainfall, directly and indirectly, affect our health. My parents became victims of dengue fever in the last year (A 51 year's old man from Newtown Area).

In Bauiati, Kestopur, and the Salt Lake area number of dengue cases have risen in recent years. Specially, from 2017 onwards here several thousand people were affected by Dengue. Last year, 20 people died due to dengue cases in this area (A 55 years old woman from Rajarhat Gopalpur Municipality area). Focus Group Discussion respondents have also reported experiences with regard to climate change and same health related maladies in Kolkata Metropolitan Area.

Discussion

This study highlighted the knowledge and perception of climate change and crucial health ailments stirred by climate change in Kolkata Metropolitan Region. The survey respondents were from urban metropolitan region. Nevertheless, they have a clear perception of the changes in rainfall, heat, cold, and natural disasters. Respondents reported that rainfall pattern has been altered, and temperature has increased over time.

Overall, study people have experienced winter session warmer as compared to the previous year. They have experienced catastrophic natural events like floods and cyclones in increased frequency in recent years. Weather variation has affected their health and livelihood. In the context of global climate change, it is a growing concern of environmental change effects on health (Cooper et al., 2019). Respondents reported headaches, eye irritation, skin diseases, and fever as the most common symptoms of hot weather. Higher temperatures and increased precipitation resulted in intensification or spreading of many infectious diseases (Shahid, 2010). As a consequence of climate change, the poor are most likely to suffer from its impacts, especially poor women (Stott, 2010).Climate change afflicted children, women, and old age people to the same extent in this urban area.

Focus Group Discussions (FGD) and In-depth interviews revealed that most people have clear knowledge of climate change as a change in rainfall patterns, temperature and natural hazards. The respondents said that recently they have faced more infectious diseases such as dengue fever and malaria. These diseases occur periodically throughout the year. Health education programs for managing heat-related illnesses should be developed for health workers and the urban population (Ngwenya et al., 2018). In the public health sector, risk reduction and management should be the decisive points considered by the health experts (Orimoloye et al., 2019). The knowledge of climate variability is important scientific information, playing a significant role in reducing human health risks (Landauer et al., 2019; Rosenzweig, 2007). Moreover, knowledge of climate change can facilitate setting health policies and planning norms. Urban government will focus on the development with more effective infrastructure, urban management, and empowerment of urban governance. This research will be precious to policymakers in India and other nations who seek to create and implement effective and long-term adaptation strategies.

Conclusion

Study participants of the Kolkata Metropolitan Region had clear perceptions and knowledge of the weather changes over the last 30 years. Participants mentioned climate variability, rainfall, temperature changes over the period. People observed warmer winter, heavy rainfall, flood, and cyclone. They perceived that excessive urbanization affects the changes in climate and human health. Our study divulged that most surveyed respondent's know about climate change and climate change-related major health problems. The findings of this study are also pertinent to urban health policy frameworks and programmers. The results have shown that urban residents face health hazards due to climate change. The analysis also highlighted that more people are affected by asthma, skin diseases, cold and cough. The central and state governments should take a climate change policy to address the urban population's negative health impact and improve the quality of life and well-being. The most influential factors, such as awareness, government campaigns, will combat climate change and its impact. Understanding the climate change perceptions and knowledge will assist policymakers in developing effective development strategies in the Kolkata Metropolitan Region.

References

Acharibasam, W. J., & Anuga, S. W. (2018). Psychological distance of climate change and mental health risks assessment of smallholder farmers in Northern Ghana: Is habituation a threat to climate change? *Climate Risk Management, 21*, 16–25. https://doi.org/10.1016/j.crm.2018.04.002

Anees, M. M., Sajjad, S., & Joshi, P. K. (2018). Characterizing urban area dynamics in historic city of Kurukshetra, India, using remote sensing and spatial metric tools. *Geocarto International* 34(14), 1584–1607. https://doi.org/10.1080/10106049.2018.1499819

Bal, S., & Sodoudi, S. (2020). Modeling and prediction of dengue occurrences in Kolkata, India, based on climate factors. *International Journal of Biometeorology, 64*(8), 1379–1391. https://doi.org/10.1007/s00484-020-01918-9

Balaban, O. (2012). Climate change and cities: A review on the impacts and policy responses. *METU Journal 29*(1), 21–44. https://doi.org/10.4305/METU.JFA.2012.1.2

Cooper, S., Hutchings, P., Butterworth, J., Joseph, S., Kebede, A., Parker, A., et al. (2019). Environmental associated emotional distress and the dangers of climate change for pastoralist mental health. *Global Environmental Change, 59*, 101994. https://doi.org/10.1016/j.gloenvcha.2019.101994

de Lima, G. N., & Rueda, V. O. M. (2018). The urban growth of the metropolitan area of Sao Paulo and its impact on the climate. *Weather and Climate Extremes, 21*, 17–26. https://doi.org/10.1016/j.wace.2018.05.002

Glaser, J., Lemery, J., Rajagopalan, B., Diaz, H. F., García-Trabanino, R., Taduri, G., et al. (2016). Climate change and the emergent epidemic of CKD from heat stress in rural communities: The case for heat stress nephropathy. *Clinical Journal of the American Society of Nephrology, 11*(8), 1472–1483. https://doi.org/10.2215/CJN.13841215

Gu, X., Zhang, Q., Singh, V. P., Song, C., Sun, P., & Li, J. (2019). Potential contributions of climate change and urbanization to precipitation trends across China at national, regional and local scales. *International Journal of Climatology*, 39(6), 2998–3012. https://doi.org/10.1002/joc.5997

Haque, M. S., & Singh, R. B. (2017). Air pollution and human health in Kolkata, India: A case study. *Climate, 5*(4), 1–16. https://doi.org/10.3390/cli5040077

Landauer, M., Juhola, S., & Klein, J. (2019). The role of scale in integrating climate change adaptation and mitigation in cities. *Journal of Environmental Planning and Management, 62*(5), 741–765. https://doi.org/10.1080/09640568.2018.1430022

Matysiak, A., & Roess, A. (2017). Interrelationship between climatic, ecologic, social, and cultural determinants affecting dengue emergence and transmission in Puerto Rico and their implications for Zika response. *Journal of Tropical Medicine*. https://doi.org/10.1155/2017/8947067

McMichael, A. J., Woodruff, R. E., & Hales, S. (2006). Climate change and human health: Present and future risks. *Lancet, 367*(9513), 859–869. https://doi.org/10.1016/S0140-6736(06)68079-3

Morris, K. I., Chan, A., Morris, K. J. K., Ooi, M. C. G., Oozeer, M. Y., Abakr, Y. A., et al. (2017). Urbanisation and urban climate of a tropicalconurbation, Klang Valley, Malaysia. *Urban Climate, 19*, 54–71. https://doi.org/10.1016/j.uclim.2016.12.002

Ngwenya, B., Oosthuizen, J., Cross, M., & Frimpong, K. (2018). Emerging heat-related climate change influences; a public health challenge to health care practitioners and policy makers: Insight from Bulawayo, Zimbabwe. *International Journal of Disaster Risk Reduction, 27*, 596–601. https://doi.org/10.1016/j.ijdrr.2017.10.012

Nomani, M. Z. M., & Parveen, R. (2020). Prevention of chronic diseases in climate change scenario in India. *Environmental Justice, 13*(4), 97–100. https://doi.org/10.1089/env.2019.0032

Orimoloye, I. R., Mazinyo, S. P., Kalumba, A. M., Ekundayo, O. Y., & Nel, W. (2019). Implications of climate variability and change on urban and human health: A review. *Cities, 91*, 213–223. https://doi.org/10.1016/j.cities.2019.01.009

Rahman, A. A., Alam, M., Alam, S. S., Uzzaman, M. R., Rashid, M., & Rabbani, G. (2008). UNDP human development report 2007: Background paper on risks, vulnerability and adaptation in Bangladesh. In *UNDP*. Retrieved December 14, 2021, from http://hdr.undp.org/sites/default/files/rahman_alam_alam_uzzaman_rashid_rabbani.pdf

Rosenzweig, C. (2007). Climate change and cities. *Built Environment, 33*(1), 5–9. https://doi.org/10.2148/benv.33.1.5

Shahid, S. (2010). Probable impacts of climate change on public health in Bangladesh. *Asia-Pacific Journal of Public Health, 22*(3), 310–319. https://doi.org/10.1177/1010539509335499

Stott, R. (2010). Population and climate change: Moving toward gender equality is the key. *Journal of Public Health, 32*(2), 159–160. https://doi.org/10.1093/pubmed/fdq040

Wei, J., Hansen, A., Zhang, Y., Li, H., Liu, Q., Sun, Y., & Bi, P. (2014). Perception, attitude and behavior in relation to climate change: A survey among CDC health professionals in Shanxi province, China. *Environmental Research, 134*, 301–308. https://doi.org/10.1016/j.envres.2014.08.006

WHO. (2021). *Fast facts on climate and health*. Retrieved December 14, 2021, from https://cdn.who.int/media/docs/default-source/climate-change/fast-facts-on-climate-and-health.pdf?sfvrsn=157ecd81_5&download=true

You, H., & Yang, X. (2017). Urban expansion in 30 megacities of China: Categorizing the driving force profiles to inform the urbanization policy. *Land Use Policy, 68*, 531–551. https://doi.org/10.1016/j.landusepol.2017.06.020