Climate Changes and Distribution of Water Borne Diseases in Eastern, Afghanistan

Salehi Shah Agha[1*], Rahimee Israrullah[1], and Azami Ahmadgul[1]

[1]Department of Microbiology, Faculty of Midical, Nangarhar University, Nangarhar, Afghanistan
*Corresponding author: salehinmf@gmail.com

ABSTRACT

Subject to a high burden of diarrheal disease, the east provinces of Afghansitan are also suceptable to climate changes. The most devastating consequences are the occurrence of flash floods and aridity. The climate changes trends will exacerbate the health risks associated with deficiencies in water, sanitation and hygiene. This study investigated the distribution of diarrheal disease in the east provinces and how linked with climate variables. Using monthly aggregated new cases of acute diarrhea reported between 2018 and 2023 by Health Management information system department, Ministry of public health of Afghanistan. We found seasonal variation and temperature are positively linked with diarrhea incidence. Initial analysis shows a seasonal trend in diarrhea cases, with peak incidence occurring in summer and reduced incidence during winter months. The recorded diarrhea cases show marked increment in the incidence of acute watery diarrhea in 2023 in eastern region. the incidence of diarrhea cases increased in 2023 (480/1000 population at risk) compared to 2019 (360/1000 population at risk) in eastern region. The impact of flash floods and Aridity as a consequences of climate change in Afghanistan cannot be underestimated. Increasing the incidence of water borne diseases like diarrhea and other infectious diseases outbreaks are important issues that could be assessed. Allowing for policymakers to account for potential impacts of climate change in their public health assessments, and provides a framework that could be extended to similar settings.

Keywords: Climate Change, Water Borne Disease, Communicable Diseases, East Afghanistan

INTRODUCTION

Climate change has the potential to influence the earth's biological systems, Afghanistan is a landlocked country located in the central Asia. Climate change has led to an overall increase in temperatures between 1906-2005 in the world (Change, 2013) and created serious threats to life and health. Currently, about 30% of the world's population is exposed to extreme weather that exceeds the human thermoregulatory capacity for at least 20 days a year (Mora et al., 2017). Based on ND-GAIN Country Index, South Asian countries are considered most vulnerable to climate change in the 2021 ranking of Afghanistan (175), Bangladesh (164), Pakistan (146), Nepal (126), India (111), Maldives (106), Sri Lanka (104) and Bhutan (94) (Initiative, 2021). Beside that World Bank classification suggest the eight countries of South Asia are at high risk for the vector born and communicable diseases such as India, Pakistan, Bangladesh, Sri Lanka, Nepal, Bhutan, Maldives and Afghanistan. (Khan, 2023).

The most devastating consequences are the occurrence of flash floods and droughts. These sudden and destructive floods and the more frequent droughts are the direct result of the changing climate patterns, posing significant threats to both human lives and the environment and exacerbating the country's already fragile socio-economic conditions. There are three common categories of infectious diseases sensitive to climate changes: water borne diseases, food borne disease and vector borne diseases(Dennis & Fisher, 2018). The climate changes trends will exacerbate the health risks associated with deficiencies in water, sanitation and hygiene (Cissé, 2019).The risk of acute watery diarrheas (AWDs) can potentially increase owing to heavy rainfall and high temperatures. (Jung et al., 2023) The climate changes influences the environment, at present many studies indicated that incidence of Water born disease will increase which is the main threats to human health especially in under developed countries. (Cann *et al*., 2013; Schijven *et al*., 2013)

Acute diarrhea is one of the conditions that has been shown to exhibit a spatial and temporal distribution linked with climatic variables, (Jepsen *et al*., 2009) diarrhea is a leading cause of morbidity and mortality, with more than 55 million per years of life lost among children under 5 years of age attributed to diarrhea in 2016

alone (Troeger *et al*., 2018). Afghanistan is situated in elevated risk regions with a less developed economy. Diarrhea is the second most prevalent disease (respiratory infections is the first) in a country that is home to numerous endemic infections, (Wallace *et al*., 2002) most with high mortality rates (Organization, 2017). Diarrhea is estimated to cause ~20% of morbidities reported among children under 5 years of age and 11% of morbidities in all age-groups attending health facilities in Afghanistan in 2013. (MY, 2016)

In this work, we investigate the distribution of acute diarrhea in eastern provinces of Afghanistan during 2018-2023. We quantify the role that climatic variables play in shaping the pattern of diarrhea across the east provinces. Such a model can be used to measure whether and how any change in climate could alter the distribution of acute diarrhea in the country, allowing for policymakers to account for potential impacts of climate change in their public health assessments, and provides a framework that could be extended to similar settings.

MATERIALS AND METHODS

Study Area and data collection

The data regarding diarrhea cases were provided by the directorate of Public Health in Nangarhar Afghanistan, based on the HMIS and DEWS reports from January 2018 to Dec 2023. The data includes reports from more than 260 health facilities covering particularly all parts of the east provinces (Nangarhar, Kunar, Laghman and Noristan) territory. All cases were included, regardless of whether sourced from public or private health facilities. Incident diarrhea cases diagnosed at designated health facilities are reported at monthly interval to the national database (DHIS2) under the supervision of health management information system, department of Ministry of Public Health. The re attendance of same individual within first week of diagnosis and chronic cases (persisting over 2 weeks from first diagnosis) were excluded in the reporting process. In this study diarrhea cases were aggregated to the provincial level indicating in last 5 years. Every data point in the study represents the total number of cases per year for a selected province. Even though no any census has been conducted since 1979,(Anwar et al., 2019) updated annual provincial data from the Afghanistan central Statistics Office (cso.org.af) were used as the closest available approximation of provincial population sizes.

Statistical Analysis

We initially analyzed the baseline distribution of diarrhea as well as climate variables to explore their trends, seasonality, and geographic characteristics. Beside that the burden of communicable diseases outbreaks described which is reported by disease early warning system (DEWS) department in Nangarhar province. Microsoft Excel (Office 2021, Microsoft Corp, SPSS 24, 2016) was used for initial data analysis.

RESULTS

Distribution of acute diarrhea cases

Initial analysis shows a seasonal trend in diarrhea cases, with peak incidence occurring in summer and reduced incidence during winter months. The recorded diarrhea cases show marked increment in the incidence of acute watery diarrhea in 2023 in eastern region. Temporally, the peak in diarrhea cases coincided with a rise in air temperature and rainfall.

Table 1. shows the distribution of Acute diarrhea cases in public health facilities in eastern provinces of Afghanistan

Diseases	Province	Year									
		2019		2020		2021		2022		2023	
		# of cases	incidence	# of cases	incidence	# of cases	incidence	# of cases	incidence	# of cases	incidence
Acute Diarrhea cases recorded in Public Health Facilities	Nangarhar	579904.	320	452154.	260	657198.	360	825672.	460	764789.	420
	Kunar	206457.	400	205663.	400	259818.	500	352914.	680	295156.	560
	Laghman	240479.	460	180330.	340	190529.	360	301386.	580	285922.	560
	Noristan	68779.	400	64759.	380	45657.	260	115047.	660	127176.	740
Incidence (new cases/population x1000)		1095619.	360	902906.	300	1153202.	380	1595019.	520	1473043.	480

The numerator is acute diarrhea new cases which are recorded in public health facilities and reported through online DHIS2 database to Health Management Information System (HMIS) department of MoPH. The denominator is the update Central Statistics Office population of each province.

Table 1 shows the distribution of acute diarrhea cases in east four provinces, the overall trend of diarrhea cases is increasing in 2022 and 2023, which has a relation with multiple flash floods that occurred in last two years in the eastern provinces.
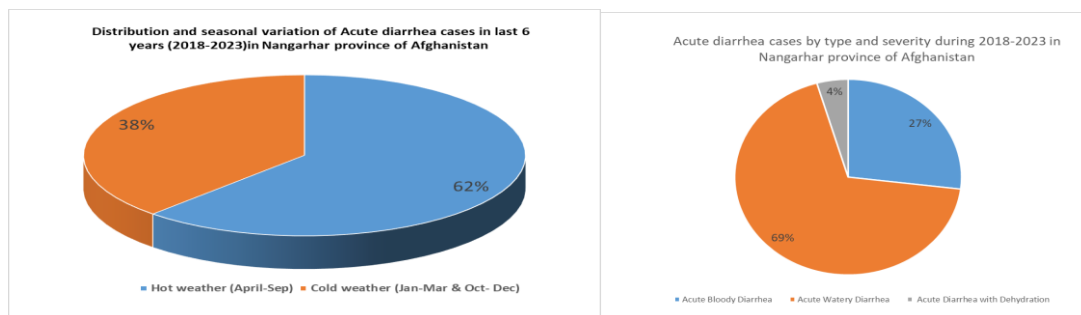
The pie charts indicate the seasonal trend of diarrhea cases in Nangarhar province, only 38 % of diarrhea cases recorded in relatively cold weather (Jan-Mar and Oct-Dec in last 6 years). Most of the cases (62%) recorded in the months of April to Sep in which the temperature is relatively high and the weather is hard. The 2nd pie chart shows the diarrhea cases by type and severity in last 6 years in Nangarhar province. Most of the diarrhea cases are acute watery (69%), 31% are severe diarrhea cases in which 27% are acute bloody diarrhea cases and 4% cases were present with some or severe dehydration.

According to the DHIS2 DEWS reports 33 outbreaks of acute watery diarrhea/cholera recorded and reported through disease early warning system in 2023. Beside that 156 outbreaks with 8352 cases of other communicable disease recorded by DEWS in eastern provinces of Afghanistan. The recent DEWS report indicates increment of different communicable diseases outbreaks in the eastern provinces of Afghanistan.

DISCUSSION

The Basic analysis of our study shows an annual seasonal pattern starting in early summer, peaking around June-Sep, and dropping after October. This period corresponds with the rise in daily mean temperature and drop in relative humidity rainfall levels. On the other hand, the incidence of diarrhea cases increased in 2023 (480/1000 population at risk) compared to 2019 (360/1000 population at risk) in eastern region. The Highest incidence of acute diarrhea cases recorded in Noristan province in 2023 (740/1000) which is affected by massive floods recently, and low incidence reported in Nangarhar province (420/1000). Kunar and Laghman provinces were relatively in middle range (560/1000). The high variability in reported diarrhea incidence for province close to each other reflects perhaps the heterogeneous map and divers seasonal climate.

The positive association we identified between temperature and diarrhea incidence reflects similar results reported by comparative studies(Checkley et al., 2000; Konno et al., 1983) and likely reflects increased growth and survival of bacterial pathogens at warmer temperatures. (Zhou et al., 2013) Despite significant associations with climatic variables, deciphering the process underlying the link is challenging, given the multiplicity of pathways by which climate factors can shape infectious disease transmission,(Metcalf et al., 2017) including diarrheal infections. In the absence of information about the specific etiologic agents of diarrhea in our dataset, we can only suggest hypotheses about possible driving mechanisms. Traditionally, elevated diarrhea rates in warmer seasons are suggested to be mediated through factors such as enhanced pathogen survival in the environment,(Zhou et al., 2013) elevated exposure to contaminated food,(Bentham & Langford, 2001) increased water intake in hotter conditions,(Black & Lanata, 1995) or more frequent contact among individuals. Concurrence of aridity and hotter temperature was found to be strongly associated with the elevated rate of diarrheal incidences in settings similar to Afghanistan(Alexander et al., 2013) and has been suggested to facilitate communicability of other infections.

CONCLUSION

In conclusion, the impact of flash floods and droughts as a consequences of climate change in Afghanistan cannot be underestimated. These devastating floods and droughts, triggered by increased temperature and erratic rainfall patterns which created a disastrous situation for both human lives and the environment. Increasing the incidence of water borne diseases like diarrhea and other infectious diseases

outbreaks are important issues that could be assessed. Allowing for policymakers to account for potential impacts of climate change in their public health assessments, and provides a framework that could be extended to similar settings.

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