



Actual health vulnerability vs perceived health vulnerability due to disaster at Amtali union, Bangladesh

Prome Debnath¹, Ayesha Siddiqua² and Avijit Biswas³

¹Department of Disaster Risk Management, Patuakhali Science and Technology University, Dumki, Patuakhali-8602, Bangladesh,

²Department of Disaster Resilience and Engineering, Patuakhali Science and Technology University, Dumki, Patuakhali-8602, Bangladesh,

³Dept. of Agriculture, Bangabandhu Sheikh Mujibar Rahman Science and Technology University, Gopalganj, Bangladesh

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For any information:

hritekaprome56@pstu.ac.bd

ABSTRACT

The coastal region of Bangladesh is highly vulnerable to climate induced disasters, so the study was carried out at Amtali union, Bangladesh. The aim of this study was to find out the existing health vulnerability and the perceived health vulnerability that will arise due to further disaster situations and investigate the relationship between respondents' socioeconomic characteristics with actual health vulnerability and perceived health vulnerability. The information was collected through face-to-face questionnaire survey and key informant interviews. To find out the health vulnerability of this area, the author used vulnerability index and perceived health vulnerability index that was measured through calculating indicators accumulative score divided by the obtainable score. After that, Coefficients of Correlation was used to find out the relationship between socioeconomic characteristics of respondent and actual vulnerability vs perceived health vulnerability. In the study area maximum respondents were male and middle aged with no literacy and low-level monthly income rate. The study revealed that according to respondents' opinion, the value of existing health vulnerability was 0.48, less than the perceived health vulnerability 0.67. The respondents of study area thought that their health conditions are deteriorating day by day for facing different kinds of disaster within a short period. So, it enhanced their unstable rate which may turn towards health risks for future adverse situations and made them more vulnerable to those disasters. Correlation analysis indicated that education (-0.268"), income (-0.312") and gender (-0.158") had a negative significant relationship with existing health vulnerability and only the marital status (0.211") had positive relationship with actual health vulnerability of study area. On the other hand, for perceived health vulnerability cases, education (0.346") and marital status (0.357") had positive relationship and age (-0.320"), income (-0.461") had negative relationship for triggering the health condition of victim people. Based on this analysis, in the study area, academic education and knowledge of disaster risk reduction and disaster risk management are the main focus so that they can extend their livelihood options to keep their income level stable and develop adaptability against any negative climatic change to disaster.

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I. Introduction

Climate change has been regarded as the largest global health challenge in the 21st century. Bangladesh is regarded as one of the nation's most severely impacted by climate-related calamities worldwide. This country is physically vulnerable to climate change due to its unfavourable geographic location and low, flat topography (Rahman, 2017). In addition, several socioeconomic factors, including high population density, extreme poverty, gender inequality, reliance on climate-vulnerable livelihoods sectors, particularly agriculture, fishing, and hunting and gathering, institutional insufficiency, and a lack of adaptation funds, are making people more susceptible to harm (Khan et al., 2011). The effects of climate change are complex, dynamic, and more acutely felt in underdeveloped countries and communities, which might influence people's health and natural systems. Due to its fragile geographic location, Bangladesh, one of the South Asian nations, has begun to experience significant public health effects of climate change (Hasib and Chathoth, 2016). The Interco relations between the potential consequences of a changing climate; the communities are exposed to both positive and negative variables. These include sensitivity to increasing prevalence of health concerns and the capacity to plan for responding to these threats (Ebi and Bowen, 2016). The biggest danger to public health in the twenty-first century was climate change, linked to environmental degradation and harmful health effects (Patrice et al., 2021). Changes in freshwater resources, food availability, and access to proper healthcare facilities are the climate change effects on human health that are most concerning (Few, 2007). Vulnerability is considered from the viewpoint of the health sector as the totality of all risk and protective variables that determine whether a person or group suffers negative health effects from exposure to an extreme event (Balbus and Malina, 2009). Four factors must be geographically integrated to measure the health susceptibility to climate change: the actual climatic change, any future ecological change, the presence of human disease, and human habitation (Sari et al., 2003).

The IPCC's predicted changes to the global climate might indirectly or directly impact human health (Kim et al., 2014). Infectious disease outbreaks and transmission, thermal stress-related mortality from extremely high temperatures, and mortality and morbidity from extreme weather events like floods and storms are some of the direct effects on health. On the other hand, reproduction and spread of microorganisms and vectors, as well as harsh climatic conditions, indirectly impact health. The most vulnerable populations in affluent nations as well as low income countries, where the ability for adaptation is weakest, are anticipated to be affected by the majority of the negative consequences of climate change on health (Haines et al., 2006). Over 70% of respondents in the United States thought their jurisdiction (a county or city) would face severe adverse health consequences related to climate change during the following two decades (Akerlof et al., 2010). During severe occurrences, the risk of negative health outcomes was raised for the underprivileged, pregnant women, children, those with chronic illnesses, and people with mobility or cognitive impairments (Balbus and Malina, 2009). Additionally, vulnerability is influenced by the social determinants of health, including social capability, social norms, culture, healthcare services, access to and quality of education, transportation alternatives and most importantly, availability of resources (Braveman and Gottlieb, 2014). A disaster can have many different effects on a community, so the main goal of disaster management from a public health perspective is to evaluate the effectiveness of disaster relief programs, assess the needs of populations affected by disasters, match resources to those needs, prevent further negative health effects, implement disease control strategies for clearly defined problems, and improve contingency plans for various types of future disasters (Leppold et al., 2022). Although adaptation measures present practical challenges, especially in low-income nations, they should be prepared to mitigate some negative effects. In order to improve health, low-income countries should identify cost-effective intervention options in the health sector, such as early planning, which can help reduce future negative health impacts, and mitigation strategies, such as using a variety of renewable energy sources, which can both address climate change and improve health by reducing pollution. However, efficient emergency medical response depends on identifying these many medical and health issues before they occur and delivering the necessary interventions (relief supplies, equipment, and personnel) at the exact moments and locations where they are most required (Beyramijam et al., 2021).

The Bangladeshi government has acknowledged the difficulties in addressing the health-related risks brought on by the various disasters the nation has already experienced and has taken several good initiatives to reduce such risks. The 2008 Bangladesh Climate Change Strategy and Action Plan

emphasized the necessity of putting in place surveillance systems for potential disease outbreaks, both old and new, and made sure health services are ready to handle future demands. Bangladesh is among the first nations to create a Climate Change and Health Promotion Unit (CCHPU) under the Ministry of Health and Family Welfare. The CCHPU's mandate is to conduct research, assess health promotion and climate change programs, and monitor such programs. To close a critical knowledge gap in the health field in the context of climate change, the Ministry of Environment has determined the necessity of conducting extensive statewide research focusing on climate-sensitive illnesses (Limin and Muthukumara, 2014). But even so, Disaster-related health concerns in Bangladesh are frequently underappreciated and understudied. Most of the time, when dealing with other disaster-related effects, this sector is given the least amount of attention. In addition, there is a significant lack of understanding among coastal residents regarding the health risks associated with disasters and risk control strategies. It is crucial to evaluate current vulnerabilities, understand how coastal residents are affected by health risks, and comprehend how the current healthcare system responds to their demands. The aim of this study to find out the existing and the perceived health vulnerability of the Amtoli union those are arisen due to disaster situations and after that, analyze the relationship between respondents' socioeconomic characteristics with actual health vulnerability and perceived health vulnerability to highlight the triggering factor which may instigate the health vulnerability during disaster time towards the worst level.

II. Materials and Methods

Description of the study area

Barguna district lies on the bank of Payra river. This District has a total area of 1939.39 square kilometres. The area is located with latitude of 22.158°N and longitude of 90.1264°E. The study was conducted at Amtoli union of Amtoli upazila under Barguna district (Figure 01). Amtoli union has 50.59 square kilometres and literacy is 50.6%. Amtoli union was purposively selected for the study, as it is located near the Bay of Bengal and frequently affected by different kinds of disasters, especially water-related disasters. The average annual temperature was 26.0 °C and precipitation rate was 2516mm annually (BMD, 2015). Most common climatic events are floods, cyclones, heavy rainfall, river erosion, epidemic etc. CARE Bangladesh (2020) stated that Amtoli union was severely affected by the recent severe cyclone, known as super cyclone Amphan (2020). The lower part of Amtoli union was flooded, several houses, trees and schools collapsed due to strongest cyclonic storm. Some families were in waterlogged condition for several days due to high tide. It caused multiple health issues with massive damage and illness, potential disease outbreaks, disruption of healthcare facilities etc., along the study location. This was the reason for selecting the Amtoli Union for study area.

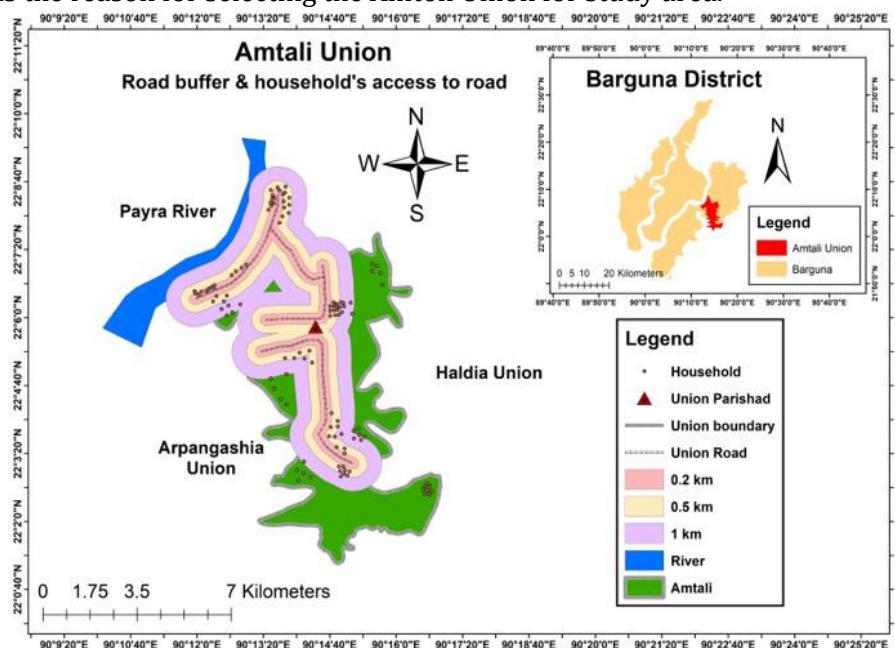


Figure 01. Study area map of Amtoli Union

Data collecting instrument

A structured interview schedule was used as the data-gathering instrument. The interview schedule was carefully prepared, considering the objectives of the study. Qualitative methods such as Key informant interviews and focus group discussions were implied to get a clear picture of this situation.

Measurement of Variables

Measurement of independent variables

Sl. No	Variable	Measurement technique
1	Age	Year
2	Education	Illiterate=1, only sign=2, primary=3, secondary=4, higher secondary=5, graduate=6
3	Gender	Male=1, Female=2
4	Marital status	Single=1, Married=2, Divorced=3, Widow=4
5	Religion	Muslim=1, Hindu=2, Christian=3, Buddhist=4
6.	Income	Taka

Measurement of Dependent variable

Actual Health Vulnerability Index: Actual health Vulnerability index was measured by computing an 'obtain score' and obtainable score based on total number of questionnaires. Here, used a formula to measure actual health vulnerability index.

$$AHVI = \frac{\sum \text{Score obtain per statement}}{\text{Obtainable score}}$$

There were 26 items were taken, which were calculated in an excel sheet. Some codes were used to measure VI (Vulnerability Index). They were 0 and 1. Then calculated as the summation of score obtained per statement (26 items) divided by obtainable score (26 items). Then the result of vulnerability index was made (Table 01).

Table 01. Actual Health Vulnerability Index

SI No.	Indicators	Classes	Weights	Interpretation	Reference
1	Have diseases suffered anyone in your family due to disaster in past 10 years?	Yes	1	Higher disease affected family member means more vulnerable to climate change effects.	Hahn et al., 2009
		No	0		
2	Has anyone in your family died from disaster in the past 10 years? If yes, please indicate in number.	Yes	1	Higher number of died people due to disaster indicates that they are more susceptible to changing climate.	Hahn et al., 2009
		No	0		
		1	0.25		
		2	0.50		
3	Is anyone in your family chronically ill very often?	3	0.75	Higher number of chronically ill people means more vulnerability to disaster	Birkmann, 2013; Flanagan et al., 2011; Ahsan and Warner, 2014; Balica, 2012
		4-more	1.00		
		1	0.25		
		2	0.50		
4	Has anyone in your family been so sick for 2 weeks after a disaster that they had to miss work or school?	3	0.75	More number of sick people in family indicates their sensitivity to disaster.	Birkmann, 2013; Flanagan et al., 2011; Ahsan and Warner, 2014; Balica, 2012
		4-more	1.00		
		1	0.25		
		2	0.50		
5	Has there enough medical facility after a disaster?	Available	1.00	Less medical facility means more vulnerability.	Hahn et al., 2009
		Little available	0.67		
		Not available	0.33		
6	How much time it take to reach nearest vehicle station?	<10min	0.25	Higher the distance of vehicle station from house increases the rate of	Flanagan et al., 2011; Kazmierczak and
		10-20min	0.50		
		20-30min	0.75		

SI No.	Indicators	Classes	Weights	Interpretation	Reference
7	How long distance does it take to get a health facility (in kilometre)?	30min-more	1.00	vulnerability.	Cavan, 2011 Hahn et al., 2009
		<1km	0.25	Higher the distance of health facility from house increases the rate of vulnerability.	
		1-5km	0.50		
		5-10km	0.75		
8	What percentage of households in your family received treatment from government or private hospitals after a disaster?	10km-more	1.00	Less percentage of keeping treatment from health center means high vulnerability after disaster	
		10-20%	0.20		
		30-40%	0.40		
		50-60%	0.60		
9	What percentage of households in your family received proper facilities for child delivery and immunization?	70-80%	0.80	Less percentage of keeping treatment for child delivery and immunization means high vulnerability after delivery.	
		90-100%	1.00		
		10-20%	0.20		
		30-40%	0.40		
10	Households having health insurance?	50-60%	0.60	High vulnerability after delivery.	
		70-80%	0.80		
		90-100%	1.00		
11	Households having health insurance?	Yes	1	Having no insurance increase people's vulnerability in time of disaster	Nhuan et al., 2015; Browne and Hoyt, 2000; Birkmann, 2013
		No	0		
12	Households having family members who have first aid knowledge?	Yes	1	Having no knowledge of first aid may increase vulnerability of people during emergency situation	Wisner et al., 2004
		No	0		
13	Is there enough facility in the shelter?	Yes	1	Inadequate shelter facility may render vulnerability	Wisner et al., 2004; Hosseini et al., 2014
		No	0		
14	Do you think the shelter has great influence to create diseases from one people to another?	Yes	1		Wisner et al., 2004; Hosseini et al., 2014
		No	0		
15	After a disaster from which source did you get medical treatment?	MBBS doctor	1.00	Disqualified medical treatment may rise risk of vulnerability	Mahmud and Prowse, 2012
		Local rural doctor	0.75		
		Kabiraj	0.50		
		Jhar-fuk	0.25		
		Once a week	1.00		
16	Did you have any medical check-up in a monthly basis?	Twice a month	0.67	Having no monthly medical check-up may increase health vulnerability	
		Once a month	0.33		
17	Did you have stored food for using after a disaster?	Yes	1	Stored dry food may help victim to stay away from contaminated food	Sattar and Cheung, 2019
		No	0		
18	Did you have enough capacity to buy food and medicine during a disaster?	Sufficient capacity	1.00	Inadequate capacity to buy food and medicine during disaster increase vulnerability of people	Nhuan et al., 2015; Hahn et al., 2009
		Insufficient capacity	0.67		
		No capacity	0.33		
19	Did you have relief facility after a disaster?	Yes	1	Having no relief facility may enhance susceptibility of risk	Mwale, 2015
		No	0		
		Others			
20	Have there anyone in your family who has taken health related training?	1	0.33	Having no people trained in health treatment increase vulnerability	Wisner et al., 2004
		2	0.67		
		3-More	1.00		
21	Is there fresh water available every day?	Yes	1	Unavailability of fresh water may enhance health risk	Zhou et al., 2015; Hahn et al., 2009; Ahsan and Warner, 2014
		No	0		

SI No.	Indicators	Classes	Weights	Interpretation	Reference
21	What is your main source of water?	Tube-well		Households having access to safe drinking water indicates to less health risk.	Zhou et al., 2015; Hahn et al., 2009; Ahsan and Warner, 2014
		Deep tube-well			
		Pond			
		River			
		Others			
23	Do you have used any purification treatment process for drinking water?	No	0	Having no purification system for water after disaster may enhance health risk	Zhou et al., 2015; Hahn et al., 2009; Ahsan and Warner, 2014
		Yes	1		
		No	0		
24	What kind of toilet do you have?	Pucca	1.00	Well-structured toilet may reduce health risk	Ahsan and Warner, 2014
		Semi-pucca	0.75		
		Kacha	0.50		
		none	0.25		
		Antiseptic	1.00		
25	What kind of hand washing materials used after toilet?	Soap	0.75	Having no hand washing materials after toilet may increase health vulnerability	Ahsan and Warner, 2014
		Soil	0.50		
		None	0.25		
		No	0		
27	Households having any kind of saving?	Yes	1	Having no savings in house may increase risk in emergency.	Wisner et al., 2004; Browne and Hoyt, 2000
		No	0		
	If yes, what types of saving?	Money	1.00		
		Gold	0.80		
		Silver	0.60		
		Crops	0.40		
		Others	0.20		

Perceived Health Vulnerability Index:

The household survey and KII questionnaires identified the perceived health vulnerability. The questionnaires collected future health problems, loss of life, physical capability, different contagious diseases, facilities of medical treatment, financial ability, Govt. health policies, etc. Here, used a formula to measure perceived health vulnerability index.

$$PHVI = \frac{\sum \text{Score obtain per statement}}{\text{Obtainable score}}$$

There were 10 items taken and these items were calculated in excel sheet. Some codes were used to measure PRI (Perceived Risk Index). They were 0 and 1. Then calculated the summation of score obtained per statement (10 items) and this was divided by obtainable score (10 items). Then the result of perceived risk index was made (Table 02).

Table 02. Perceived Health Vulnerability

SI No.	Indicators	Classes	Weights	Interpretation	Reference
01	Likelihood of future health problem due to disaster	Very high	1.00	Believing in possibility of more health risks due to disaster occurring in the future means higher risk perceptions.	Ho et al., 2008; Miceli et al., 2008
		High	0.80		
		Moderate	0.60		
		Low	0.40		
		Very low	0.20		
02	Chances of live loss due to disaster induced health problem	Very high	1.00	Having more died in disaster indicates higher risk perceptions.	Ho et al., 2008; Miceli et al., 2008
		High	0.80		
		Moderate	0.60		
		Low	0.40		
		Very low	0.20		
03	Physical capability to cope with natural disaster	Very low	1.00	Having no physical capability may indicate more health risk due to disaster.	Ho et al., 2008
		Low	0.80		
		Moderate	0.60		
		High	0.40		

SI No.	Indicators	Classes	Weights	Interpretation	Reference
04	Sensitivity to contagious diseases due to disaster	Very high	0.20	Having more sensitivity to contagious diseases in disaster means high health risk in disaster.	Ho et al., 2008; Miceli et al., 2008
		Very much sensitive	1.00		
		Sensitive	0.80		
		Neutral	0.60		
		Slightly sensitive	0.40		
05	Availability of medical facility to cope with disaster induced health risk	Not sensitive	0.20	Unavailability of medical facility during disaster may consider more health risks.	Alam and Collins, 2010; Ho et al., 2008; Bishawjit et al., 2017; Terpstra and Gutteling, 2008
		Very low	1.00		
		Low	0.80		
		Moderate	0.60		
		High	0.40		
06	Chances of medical facility interruption during disaster	Very high	1.00	Having more chances of interruption in medical facilities during disaster may increase possibility of health risk	Miceli et al., 2008
		High	0.80		
		Moderate	0.60		
		Low	0.40		
		Very low	0.20		
07	Chances of changing health condition by disaster	Worst	1.00	Retrograde of health condition by disaster may enhance health risk	Armas and Avram, 2009
		Bad	0.80		
		Neutral	0.60		
		Low	0.40		
		Very low	0.20		
08	Have there any disaster plan during disaster period? If yes, effectiveness of emergency health plan to fight against disaster induce health risk.	Yes		Having no effective emergency health plan against disaster means more health risk	Ho et al., 2008; Terpstra and Gutteling, 2008
		No			
		Very poor	1.00		
		Poor	0.80		
		Average	0.60		
09	Future financial facility to take treatment after disaster	Good	0.40	Inadequate financial facility may indicate more health risk.	Alam and Collins, 2010; Ho et al., 2008; Bishawjit et al., 2017; Terpstra and Gutteling, 2008
		Very good	0.20		
		Very low	1.00		
		Low	0.80		
		Moderate	0.60		
10	Agree with Govt. health related policies for DRR and CC	High	0.40	Agreeing with the government's health related policies to climate change and DRR reflects lower risk perception	Yu et al., 2013
		Very high	0.20		
		Strongly agree	1.00		
		Agree	0.80		
		Undecided	0.60		
		Disagree	0.40		
		Strongly disagree	0.20		

Statistical tests

Firstly the data were inputted into a master sheet which was obtained from the respondents then compiled, tabulated and analyzed by the objectives of the study. Mean, percentage distribution and standard deviation those statistical methods were used in describing the dependent variables. Tables were used to presenting the data. Pearson's Product Moment Coefficients of correlation (r) analysis was used for exploring the relationship between the selected characteristics of the respondents with their actual health vulnerability and perceived health vulnerability due to climate change induced disaster.

III. Results and Discussion

Socio-economic profile of respondents

A total of 61 per cent of the survey respondents were male and 39 percent were female. Now in Bangladesh, the ratio of men and women is same, but still, the male dominated society doesn't want to permit women for their freedom. Additionally, climate variability has pushed women into a vulnerable

and marginalized position in Bangladesh. Especially natural disasters and man-made disasters like socially constructed systems had made the situation possible where climate change plays a key role in instigating the vulnerabilities of woman (Rahman, 2013).

In Table 03 It was found that 28.5 percent of respondents were category -2 aged, 37.5 percent were category -3 aged, and the rest 21.5 percent respondent's age were upper 50 years. Most of the respondents in the study area age were between 36 to 50 or middle aged. Climate related injury and illness were mostly felt by children and elderly (UNICEF, 2021). Older people, especially those already in poor health, are particularly vulnerable to climate-related events and it will be severed over the next 20-30 years (Oven et al., 2012). Furthermore, the health of older adults can be disproportionately affected by environmental hazards associated with climate change and air pollution (e.g., increasing temperatures, extreme events and poor air quality (Benivoljenj and Deregni, 2019)

Educational background of the farmers was classified into six categories: illiterate 51.5% can sign only 19%, primary level 3%, 10.5% of respondents have completed high school/secondary school, Higher secondary School percentage 11.5% and only 4.5% respondents appeared to university. Data showed that half of the respondent (51.5 percent) in this study area had no education. People with higher education levels were more likely to make efforts to health response, as they had higher perceived benefits and perceived severity when facing climate change (Li et al., 2021). Societies can improve the most effective long-term defense against the dangers by strengthening human capacity, primarily through education about risk perception, skills and knowledge, indirectly reducing poverty and improving health and resources (Muttarak and Lutz, 2014). Educational programs and policies are crucial public health interventions (Han and Truma, 2015).

In the study area, maximum respondents were married (80%). As the respondents were between 36 to 50 or middle-aged, it was natural that according to Bangladesh culture, middle-aged people must be married or widowed. On the other hand, most of the respondents in study area were Muslim (95.5%) (Table 03).

Table 03. Socioeconomic characteristics of respondent

SI. No.	Variable	Categories	Percentage	Mean	Standard Deviation
01	Age	Category-1(18-25)	12.5	2.68	0.94
		Category-2(26-35)	28.5		
		Category-3(36-50)	37.5		
		Category-4(>50)	21.5		
02	Gender	Male	61	1.61	0.48
		Female	39		
03	Education	Illiterate	51.5	0.25	0.32
		Only sign	19		
		Primary	3		
		Secondary	10.5		
		Higher secondary	11.5		
04	Marital status	Graduate	4.5	2.02	0.61
		Single	12		
		Married	80		
		Divorced	6		
05	Religion	Widow	2	1.05	0.21
		Muslim	95.5		
		Hindu	4.5		
06	Income	1200-7000	68	7.00	3.24
		7000-13000	22.5		
		Above>13000	9.5		

In analyses, stratified information given that the respondent's monthly household income (BDT) was collected to know their socio-economic status. The people were categorized into three income groups and their response has been recorded: 'low income' (Taka 1200-7000 thousand), 'medium income' (Taka 7000-13000 thousands) and 'high income' (above Taka 13000 thousands). Highest portion of farmers (90.5 percent) were in low to medium income category. Due to low social and economic status,

the respondents of study area could not properly fight against health problems raised from different kinds of adverse situations. People with low incomes could not invest large amounts of money in healthcare issues. The higher economic group was reported to have more resources to respond to climate change than the lower economic group (Li et al., 2021). Balasubramanian (2018) express that Climate change had not affected the world equally and people of lower socioeconomic status had experienced more negative effects than others. The overall balance of climate change is likely to affect the populations in low-income countries and particularly vulnerable to the adverse effects (Moreno, 2006; Hanies, 2006).

Actual health vulnerability index

Vulnerability is the fundamental underlying risk factor. It indicates the negative set of conditions of something or someone. From this analysis, it was shown that in this study area, people suffered from diseases due to disaster and following fewer shelter facilities, less medical facilities, no savings and unavailability of fresh water and hygienic toilet system were the most negative set of conditions that create them more vulnerable towards adverse situation (Table 04).

Table 04. Measurement of Actual Health Vulnerability of Study area's People

SI No.	Indicators	Average score	Actual health vulnerability index
1	Has anyone in your family been suffered from diseases due to disaster in past 10 years?	1	
2	Has anyone in your family died due to disaster in past 10 years?	0.03	
3	Is anyone in your family chronically ill very often?	0.35	
4	Has anyone in your family been so sick for 2 weeks after a disaster that they had to miss work or school?	0.62	
5	Has there enough medical facility after a disaster?	0.67	
6	How much time it takes to reach nearest vehicle station?	0.5	
7	How long distance does it take to get a health facility (in kilometer)?	0.58	
8	What percentage of households in your family received treatment from government or private hospitals after a disaster?	0.44	
9	What percentage of households in your family received proper facilities for child delivery and immunization?	0.44	
10	Households having health insurance?	0.5	
11	Households having family members who have first aid knowledge?	0.67	
12	Do you use shelter during disaster?	0.85	
13	Is there enough facility in the shelter?	0.05	
14	Do you think the shelter has great influence to create diseases from one people to another?	0.96	AHVI= $\frac{\sum \text{Score obtain per statement}}{\text{Obtainable score}}$
15	After a disaster from which source did you get medical treatment?	0.46	
16	Did you have any medical check-up in a monthly basis?	0.67	AHVI=12.37/26 =0.48
17	Did you have stored food for using after a disaster?	0.03	
18	Did you have enough capacity to buy food and medicine during a disaster?	0.65	
19	Did you have relief facility after a disaster?	0.25	
20	Have there anyone in your family who has taken health related training?	0.05	
21	Is there fresh water available every day?	0.65	
22	What is your main source of water?	0.25	
23	Do you have used any purification treatment process for drinking water?	0.05	
24	What kind of toilet do you have?	0.54	
25	Do you use any kind of hand washing materials after toilet?	0.25	
26	Households having any kind of saving?	0.86	

Perceived health vulnerability index

Perceived risk is a subjective judgment of an individual, an individual's perceived susceptibility to a threat is a key component of many health behavior change theories (Ferrer and Klein, 2015). This study

found out the study area’s people perception of their future disaster induced health vulnerability (Table 05). The result showed that people in study area thought there would be more chances of live loss due to disaster-induced health problems in the future. On the other hand, as per respondents’ perception, in future there will less financial vulnerability than present situation.

Table 05. Measurement of Perceived Health Vulnerability of Study area’s People

SI No	Indicators	Average score	Perceived health vulnerability index
01	Likelihood of future health problem due to disaster	0.78	
02	Chances of live loss due to disaster induced health problem	0.81	
03	Physical capability to cope with natural disaster	0.73	
04	Sensitivity to contagious diseases due to disaster	0.68	
05	Availability of medical facility to cope with disaster induced health risk	0.79	PHVI= \sum Score obtain per statement/ Obtainable score
06	Chances of medical facility interruption during disaster	0.80	
07	Chances of changing health condition by disaster	0.73	
08	Have there any disaster plan during disaster period?	0.31	PHVI=7.32/11 =0.67
09	If yes, effectiveness of emergency health plan to fight against disaster induce health risk.	0.64	
10	Future financial facility to take treatment after disaster	0.52	
11	Agree with Govt. health related policies for DRR and CC	0.53	

Relationship between selected characteristics of the respondents and Actual Health Vulnerability

Pearson Product Moment co-efficient was computed to determine the extent of relationship between the dependent variable and independent variables (at 1% and 5% level of significance). The results of correlation analysis are shown in Table 06.

Table 06. Relation between the demographic characteristics of the respondents with their actual health vulnerability

Dependent variable	Independent variable	Co-efficient Correlation (r)
Vulnerability Index	Education	-0.268 ^{''}
	Marital status	0.211 ^{''}
	Income	-0.312 ^{''}
	gender	-0.158 [']

(^{''})Significant at the 0.01 level of probability; ([']) Significant at the 0.01 level of probability

Respondent’s education and their actual health vulnerability: The co-efficient of correlation between education and their health vulnerabilities was negative and significant at the 1% probability level (r = -.268^{''}). This indicates that level of vulnerabilities will increase with decreasing of educational level. Uneducated people did not know how to mitigate vulnerabilities to fight against disaster. So, if the percentage of educated people increases in the study area, they will be more functional before, during and after disaster.

Respondent’s marital status and their actual health vulnerabilities: The co-efficient correlation between marital status and their health vulnerabilities was positive and significant at the 1% probability level (r = .211^{''}). This data indicates that vulnerabilities will increase if the respondent’s marital status becomes single and married to divorced and widow. Widow and divorced women and men are more vulnerable because of absence of supporting person and the most considered factor is age issue.

Respondent’s income and their actual health vulnerabilities: The co-efficient correlation between income and their health vulnerabilities was negative and significant at the 1% probability level (r = -.312^{''}). This indicated that vulnerabilities increase with decreasing in income level. Because if the affected area’s people had low-income level, then they have less capacity to fight against disaster and it will increase their vulnerabilities in an ongoing process.

Respondent's gender and their actual health vulnerabilities: The co-efficient of correlation between gender and their health vulnerabilities was negative and significant at the 5% level of probability ($r = -.158'$). This negative relationship indicates that vulnerabilities will increase if the study area's male population decreases or the female population increases. As women have less strength and most of them have no proper knowledge to reduce health risks arising from different kinds of adverse situations, they are more vulnerable than males.

Relationship between selected characteristics of the respondents and Perceived Health Vulnerability

Pearson Product Moment co-efficient was computed to find out the extent of relationship between the dependent variable and independent variables (at 1% and 5% level of significance). The results of correlation analysis are shown in [Table 07](#).

Table 07. Relation between the demographic characteristics of the respondents and perceived health Vulnerability

Dependent variable	Independent variable	Co-efficient Correlation (r)
Perceived Health Vulnerability	Age	-0.320"
	Education	0.346"
	Marital status	0.357"
	Income	-0.461"

(")Significant at the 0.01 level of probability; (') Significant at the 0.01 level of probability

Respondent's age and their perceived health Vulnerability: The co-efficient correlation between age and their perceived health vulnerability was negative and significant at the 1% probability level of ($r = -.320''$). It indicates that the perceived health risk will be increased if the age of respondents will decrease. Because most of the respondents in the study were middle-aged, they thought that old people had less health capacity to cope with this kind of adverse situation.

Respondent's education and their perceived health Vulnerability: The co-efficient correlation between education and their perceived health vulnerability was positive and significant at the 1% probability level ($r = .346''$). It means that assessing the possibility of suffering negative health events will be increased with the increase of educational level of respondents. Because if the people in study area will literate, they will understand how to deal with an emergency and disaster arising from it.

Respondent's marital status and their perceived health Vulnerability: The co-efficient of correlation between marital status and perceived health vulnerability was positive and significant at the 1% level of probability ($r = .357''$). According to the result, the perceived health risk of respondents will be increased with the change of respondent's marital status, like from married to divorced or widow. Because most of the divorced and widow in the study area was woman and the vulnerability of woman is always greater than the man.

Respondent's income and their perceived health Vulnerability: The co-efficient of correlation between income and their perceived health vulnerability was negative and significant at the 1% level of probability ($r = -.461''$). Decreasing the level of income as well as increasing the perceived health risks. Because if respondents cannot take proper treatment for their existing disabilities, then it will increase their vulnerability towards disaster or any kind of negative situation in the near future.

IV. Conclusion

The analysis expressed that the people in the research area will have more chances of tangible and intangible loss due to disaster-induced health problems. The perceived health risk will be increased with the increased age of respondents that describe the old people had less health capacity to cope with this kind of adverse situation, decreased education level, marital status like from married to divorced or widow, decreased income level. Public Education, increased employment facilities, emergency service planning, and the implementation of training systems can be done to reduce health and other impacts

by communicating information about disaster health risks to people. Health and emergency management authorities should improve disaster mitigation and adaptation policies at the local and wider scale to raise awareness of the health risks related to disasters and promote effective adaptive behaviors by adaptation policy. It can be accomplished by increasing the general understanding of present vulnerability, susceptibility, severity and urgency related to disaster related health risks. Efforts are needed to identify the current gaps so that information can be disseminated to respondents in a format that is accessible, easily understood and retained. To reduce the vulnerability of disaster livelihood resilience, mitigation strategies need to be developed through new policies, innovative and advanced technologies, and a new lifestyle. Community-based solutions should be developed and instigated to make sure that public can take in decisions affecting their well-being. Health issues should be included in any climate change related adaptation plan. The study indicates that study area people are not concerned about disaster, vulnerability and its impact on health. Public health and emergency management officials have an important role in communicating information about climate change health risks to research area. However, the findings also suggest that if health authorities in Amtoli are providing information to the public through their rural health models and innovation, programs, social media and websites, local newspapers addressing disaster health risk issues, it will be much better for quick adaptation. Furthermore, many people were not taking the needed actions to adapt to disaster related health risks. It is necessary that the existing efforts to change the behaviors of some vulnerable populations, such as seniors, have limited efficiency to lessen their vulnerability. Furthermore, widespread and vigorous research is needed to better understand the link between disaster and health. Unless steps are taken and put in place immediately to mitigate and adapt to disaster in coastal areas, the study area will have to recompense a heavy fee for economic loss and human lives.

To sum up the following recommendations are made regarding disaster and health vulnerability: 1. Improving the income level by public investment in empowering people and enhancing human capacity through education, 2. existing gender specific measures like: divorce rate, gender equality, different interventions, policies, and strategies need to work simultaneously to enhance women resiliency to disaster. It is significant to emphasise understanding and associate communities to effectively prepare for, respond to, and recover from the potential impacts of recurring disasters on health, well-being, and quality of life. Strategies could be included for assessing vulnerabilities and evolving adaptation strategies, capacity development of health professionals and suitable disaster risk reduction/management programs. Without this targeted focus, communities will continue to experience the substantial losses and risks to health arising from disaster.

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