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Disease Burden in the Context of Disasters: Insights from Over 6.7 million Respondents in the Bangladesh Disaster-Related Statistics of 2021

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Original Research

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Abstract

Objectives: The objective of this study was to explore the burden of disasters and adverse health outcomes during and following disasters in Bangladesh.

Methods: We analyzed 6 788 947 respondents' data from a cross-sectional and nationally representative 2021 Bangladesh Disaster-related Statistics (BDRS). The key explanatory variables were the types of disasters respondents faced, while the outcome variables were the disease burden during and following disasters. Descriptive statistics were used to determine disease burden. A multilevel mixed-effects logistic regression model assessed the association between disease burden and disaster types, along with socio-demographic characteristics of respondents.

Results: Nearly 50% of respondents experienced diseases during disasters, rising to 53.4% afterward. Fever, cough and diarrhea were prevalent during and after disasters, with increases in skin diseases, malnutrition, and asthma post-disaster. Vulnerable groups, such as children aged 0–4, hijra individuals, those with lower education, people with disabilities, and rural residents, especially in Chattogram, Rangpur, and Sylhet divisions, were most affected. Floods, cyclones, thunderstorms, and hailstorms significantly increased disease likelihood during and after disasters.

Conclusions: The study underscores the complex relationship between disasters and health outcomes in Bangladesh, stressing the need for targeted public health interventions, improved health care infrastructure, and evidence-based policies to mitigate disaster-related health risks.

The global anxiety regarding climate change and its interconnected natural disasters is evident, affecting nearly every country. However, the outcomes are particularly evident in low- and middle-income countries (LMICs), with Bangladesh ranking seventh among the world's most vulnerable countries.[1,2] The rapid acceleration of climate change has intensified the frequency and severity of natural disasters in the country, mirroring the global experience, encompassing hurricanes, floods, and droughts.[1,3] Given its high susceptibility to the surrounding sea, Bangladesh is significantly impacted by elevated global temperatures, leading to rising sea levels due to the melting of ice caps and glaciers and increasing vulnerability in coastal regions.[1,4,5] River erosion is also increasing nowadays due to the adverse effects of climate change.[3] Consequently, around 7 million people have already been displaced, and 13 million are at risk of displacement by 2050.[2,6] Furthermore, extreme weather events, including intense storms and heatwaves, have become more prevalent, causing extensive disruptions to ecosystems, human settlements, and economies.[7] Observations also highlight alterations in the patterns of these events, such as shifting rainfall timings and escalating erratic rainfall.[8] The compounding effects of climate change amplify the impacts of natural disasters, presenting communities with intricate, multi-faceted challenges.[3,9] These events disrupt lives and livelihoods, strain resources, exacerbate existing vulnerabilities, and pose significant obstacles to sustainable development efforts.[1,10]

The detrimental impacts of climate change on health have become increasingly apparent, presenting substantial challenges to global public health.[11] Elevated temperatures contribute to heat-related illnesses, heightening the risk of heatstroke and dehydration among vulnerable populations.[11–13] Alterations in precipitation patterns and temperature foster the proliferation of

vector-borne diseases, including malaria and dengue fever.[14] Extreme weather events, such as hurricanes and floods, result in injuries, displacement, and disruptions to health care infrastructure, exacerbating physical and mental health issues.[15] Climate change-induced air pollution worsens respiratory conditions, leading to increased rates of asthma and other respiratory diseases.[16] Anticipated shifts in infectious disease patterns due to ecosystem changes and disease vector migration further compound health challenges.[17] Societies already grappling with socio-economic disparities bear a disproportionate burden of these health impacts.[4,9]

However, in Bangladesh, evidence on these health effects is scarce, with available research predominantly focused on the effects of climate change on maternal and child health as well as non-communicable diseases.[18–20] Furthermore, these studies often emphasize long-term effects rather than immediate impacts during and after adverse climate events.[47,48] While understanding these long-term consequences is crucial, the lack of immediate effects poses a dilemma for policymakers in determining the prioritization of health care services in response to adverse climate change and in event of any natural disasters.[1,4,10] Compounding this challenge is the absence of a comprehensive list of disease burdens during and following disasters, along with the rankings and intensities of disasters on adverse health outcomes.[21,22] Limited literature in LMICs exacerbates these gaps, with few studies available for are not comparable for Bangladesh.[18,22–24] Thus, we conducted this study to explore the burden of disasters and adverse health outcomes during and following disasters in Bangladesh.

Methods

Data Source and Sampling Strategy

The data analyzed in this study were sourced from the Bangladesh Disaster-related Statistics (BDRS) 2021 — a cross-sectional, nationally representative survey conducted by the Government of Bangladesh through the Bangladesh Bureau of Statistics (BBS). Employing a 2-stage stratified random sampling approach, the survey selected households that were nationally representative, and respondents were drawn from these selected households. In the first stage, among the selected 29 199 primary sampling units (PSUs, the smallest areas covering 120 households generated as part of the Bangladesh National Census 2011 generated by the BBS), a total of 4240 PSUs were chosen as a sample through simple random sampling (SRS) from the highest disaster-prone areas among the country's 64 districts. Subsequently, 30 households were systematically selected from each of the disaster-prone PSUs (mauzas/mahallas) in the second stage. This methodology resulted in a robust sample of 75 15 977 households, with a total of 127 200 sample households selected from all 64 districts of Bangladesh affected by natural disasters over the last 6 years (2015-2020). The target population comprises all residents of the households. The data for children aged 0-15 years were recorded from their mothers. Further detailed information about this survey has been published elsewhere.[25]

Study Sample

We analyzed data from a sub-sample of 6 788 947 respondents (weighted) from the original sample who met the inclusion criteria for this study. The inclusion criteria were: (i) all individuals residing in the selected households and (ii) those who reported disaster-related data, including before and after disease information. Respondents who did not report this data were excluded from the analysis.

Outcome Variable

The primary focus of this study was the disease burden in Bangladesh during and following disasters, including water-borne, vector borne, mental health, nutritional, and other diseases.[25] During the survey, household's head were asked, "Which diseases did household members primarily suffer from due to disasters from 2015 to 2020?". Respondents were given options to name the diseases they faced during the time of disaster and following the disaster. Data collectors, including health care personnel, assisted respondents in reporting such information in cases where they were unable to specify disease names, allowing them to provide explanations about the diseases. Finally, we considered these responses together and calculated whether they faced any disease during disaster (yes, no) and following disaster (yes, no).

Explanatory Variable

The primary explanatory variable considered was the types of disaster (disruption of the functioning of a community or a society at any scale due to hazards) respondents faced.[49] The responses assessed by asking, "From 2015 to 2020, in which was your household last affected by any of the following disasters?". In response to this question, participants were provided with a chart listing the disaster's name, including drought, flood, waterlogging, cyclone, tornado, storm/tidal surge, thunderstorm/lightning, river/coastal erosion, landslide, and salinity, and were asked to indicate "yes" or "no" for each of these diseases. An open option (other disaster) with the choice to indicate "yes" or "no" was also provided if the types of disasters respondents faced were not in the predefined list. We incorporated this information into the analysis.

Covariates

We considered a range of covariates to adjust the association between the outcome and explanatory variables, selected in 2 stages. First, we conducted a comprehensive search across 5 databases (Medline, CINAHL, Web of Science, ScienceDirect, and Embase), as well as Google and Google Scholar, for relevant studies conducted in LMICs, including Bangladesh.[15,18,26–28] In the second stage, we listed the variables from the selected studies and assessed their availability in our survey, considering their statistical significance. Finally, the variables found statistically significant were included in the analysis. These included age of the respondents (0-4 years, 5-17 years, 18-36 years, 37-60 years, 61 and over years), gender (male, female, transgender), education (never attended school, primary, secondary, higher, not applicable), marital status (unmarried, married, divorced/separated/widowed, not applicable), disability status (yes vs no), occupation (agriculture, business, services, day-laborer, housewife, students, unemployed, inactive, others, not applicable), and religion (Islam, Hindu, others). Place of residence (rural, urban, city corporation) and division (Barishal, Chattogram, Dhaka, Khulna, Mymensingh, Rajshahi, Rangpur, Sylhet) were also taken into consideration. The survey collected disability-related data using the Washington Group guidelines, covering all 8 functional domains: vision, hearing, mobility, fine

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motor skills, communication, learning, play, and behavior.[50] The response options were: (i) no difficulty, (ii) some difficulty, (iii) a lot of difficulty, or (iv) unable to see/hear/walk/use hands/communicate/learn/play/control behavior at all. We reclassified the responses, categorizing children as having a specific disability if they indicated "a lot of difficulty" or "unable to function at all." Otherwise, they were considered not to have a disability.

Statistical Analysis

Descriptive statistics were employed to characterize the respondents. We explored variations in diseases during and following disasters across selected explanatory variables by conducting cross-tabulation, and the significance of such changes was determined using a proportion test. A multi-level mixed-effect logistic regression model was utilized to assess the association between exposure and outcome variables while adjusting for different confounders. The rationale for selecting this model is based on the nested structure of BDRS data. Individual data are nested within households, and households are nested within clusters. Previous studies indicate that, in such cases, a multilevel mixed-effect model produces more precise results than simple logistic regression analysis.[29] We ran 2 separate models for during disaster and following disaster, adjusting for covariates. Multicollinearity was checked before running each model, and any variables showing high multicollinearity (Variance Inflation Factor (VIF) >5) were deleted. Sampling weight was considered in all analyses. Results were reported as adjusted odds ratios (aOR) along with corresponding 95% confidence intervals (95% CI). Stata version 17.0 (StataCorp.org, College Station, Texas, USA) was used for all analyses.

Results

Background Characteristics of the Population

Table 1 presents the background characteristics of the respondents. Approximately 70% of the total respondents were children aged 0-17 years, with 46% of them falling between the ages of 5-17 years. About 58% of the total respondents were male. Nearly 53% of the total population had an education level below primary. Approximately 2.4% of the total respondents reported having a disability.

Table 1. Background characteristics of the respondents (Weighted *N* = 6 788947)

Characteristics	Frequency (*n*)	Percentage (%)
Age group		
0–4 years	1,676,752	24.7
5–17 years	3,150,316	46.4
18–36 years	1,605,756	23.7
37–60 years	257,129	3.8
61 and over	98,992	1.5
Gender		
Male	3,939,431	58.0
Female	2,848,226	41.9
Hijra	1,290	0.02
Education		
Never attended school	679,748	13.3
Primary	2,021,474	39.5
Secondary	1,752,493	34.3
Higher	658,479	12.9
Not applicable[+]	1,676,752	na
Marital status		
Unmarried	2,710,138	71.2
Married	960,605	25.2
Divorced/ separated/ widowed	137,396	3.6
Not applicable[++]	2,980,809	na
Disability status		
No	6,623,277	97.6
Yes	165,669	2.4
Occupation		
Agriculture	194,477	3.8
Business	124,522	2.4
Services	240,219	4.7
Day-labourer	330,899	6.5
Housewife	384,804	7.5
Students	3,276,616	64.1
Unemployed	178,201	3.5
Inactive	110,660	2.2
Others	271,797	5.3
Not applicable[+]	1,676,752	Na
Religion		
Islam	5,943,198	87.5
Hindu	768,310	11.3
Others	77,438	1.1
Residence		
Rural	6,064,523	89.3
Urban	684,302	10.1
City corporation	40,121	0.6
Division		
Barishal	856,088	12.6
Chattogram	728,180	10.7
Dhaka	1,079,164	15.9
Khulna	898,573	13.2
Mymensingh	649,051	9.6
Rajshahi	988,367	14.6
Rangpur	939,232	13.8
Sylhet	650,291	9.6

Notes: All analyses were weighted.
[+] = excluding children aged under-5
[++] = excluding respondent aged 0–9-years
na = not applicable.

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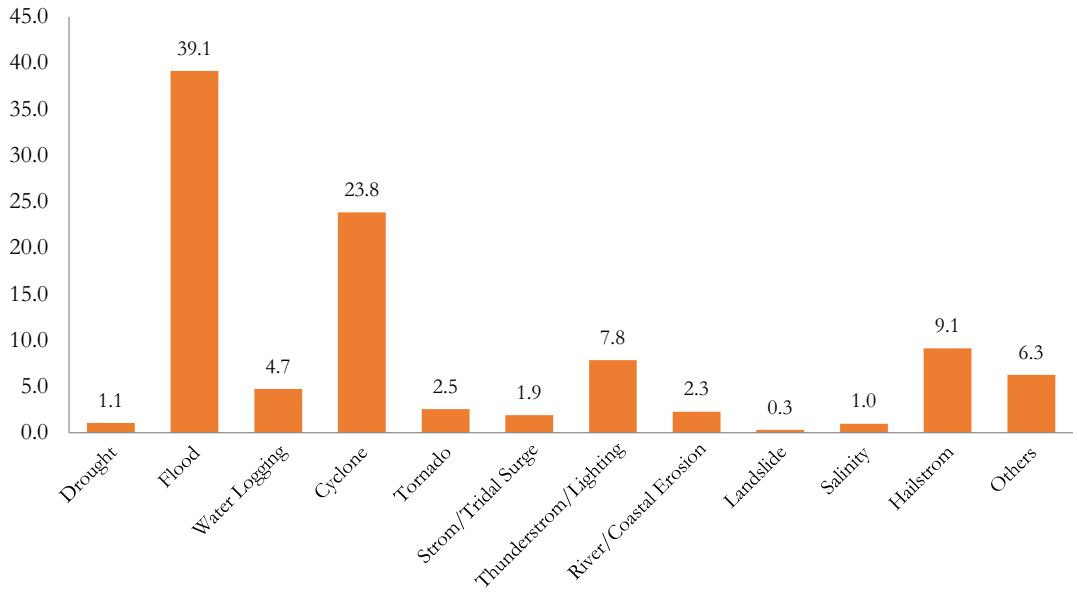

Figure 1. Types of diseases affecting households in Bangladesh, 2015-2020.

Around 64% of the total respondents identified as students. The largest portion of the respondents resided in rural areas (89%), with the majority located in Dhaka (16%) and Rajshahi (15%) divisions.

Pattern of Natural Disaster in Bangladesh, 2015-2020

The types of disasters that affected households included in the survey during 2015-2020 are presented in Figure 1. Approximately 39% of the total households analyzed reported being observed and affected by floods, followed by cyclones (23.8%) and hailstorms (9.1%). Other frequently encountered natural disasters included thunderstorms (7.8%), waterlogging (4.7%), tornadoes (2.5%), river/coastal erosion (2.3%), tidal surges (1.9%), drought (1.1%), salinity (1%), landslides (0.3%), and other disasters (6.3%).

Disease Prevalence in the Context of Disasters, 2015-2020

Table 2 presents the prevalence of diseases categorized by the type of disasters in Bangladesh from 2015 to 2020 while types of disease across specific type of disaster are presented in Supplementary Tables 1 and 2. Half of the total respondents (50%) reported experiencing 1 or more diseases during disasters, which increased to 53.4% after the disaster, indicating a 3.4% rise in the disease burden from during to post disaster. During the disaster, the most reported diseases were fever (35.6%), followed by cold/cough (35.6%), diarrhea (19.8%), Skin Disease (8.5%), and dysentery (7.7%). In the post-disaster period, the predominant diseases were fever (37.6%), followed by cough (36.0%), and diarrhea (17.2%). Fever, cough, and diarrhea exhibited higher prevalence during the disaster and post-disaster, whereas skin diseases, asthma, and malnutrition were found to be higher in the post-disaster phase.

Distribution of Disease Across Socio-demographic Characteristics of the Respondents, 2025-2020

Table 3 presents the distribution of disease occurrence during and following disasters across the socio-demographic characteristics of the respondents. The prevalence of diseases during disasters was found to be higher among children aged 0-4 years, those with primary education, married respondents, persons with disabilities, those with no formal occupation, Muslim individuals, those residing in rural areas, and those living in Sylhet and Chattogram divisions. The prevalence of diseases following disasters was higher among individuals aged 61 and over, hijra, unmarried individuals, persons with disabilities, day laborers and others, those with religions other than Muslim, those residing in rural areas, and those living in Rangpur and Chattogram divisions. We found a significantly higher prevalence of disease burden following disasters compared to during disasters. However, the most substantial changes occurred in city corporation areas, Barishal, Khulna, and Rangpur divisions, and among individuals aged 61 and above. An alternative scenario was reported for Dhaka, where the disease burden was observed to be higher during disasters compared to after disasters.

Factors Associated with Occurring Diseases During and After Disaster in Bangladesh, 2015-2020

The factors associated with disease occurrence during and following disasters are presented in Table 4. Coastal erosion, drought, storms, salinity, and floods were found associated with increase likelihoods of diseases during and after disasters. Respondents' age, education, place of residence, disability status, occupation, and region were also found to be significantly associated with disease occurrence. Notable trends emerge when comparing the likelihood of diseases during and after disasters for distinct variables. In terms of disaster types, drought demonstrates a higher likelihood during disasters (aOR 2.04, 95% CI 1.99-2.08) and after disasters (aOR 1.34, 95% CI 1.31-1.37), indicating a decrease in likelihood following disaster as compared with hailstorms. Similarly, floods exhibit a higher likelihood during disasters (aOR 1.67, 95% CI 1.67-1.69) and after disasters (aOR 1.11, 95% CI 1.10-1.12), with a noticeable decrease post-disaster as compared previous disaster. River/Coastal Erosion displays a substantially higher likelihood during disasters (aOR 2.29, 95% CI 2.26-2.33) than

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Table 2. Disease prevalence during and post disaster events, 2015-2020

Diseases	During disaster		Following disaster		Percentage change[+]
	Frequency	Percentage	Frequency	Percentage	
Total	**3,397,198**	**50.0**	**3,626,960**	**53.4**	**−3.4***
Diarrhea	1,345,838	19.8	1,169,299	17.2	2.6*
Dysentery	521,408	7.7	551,789	8.1	−0.4**
Malaria	95,216	1.4	104,695	1.5	−0.1**
Skin Disease	576,838	8.5	727,112	10.7	−2.2*
Cold/Cough	2,301,335	33.9	2,444,437	36.0	−2.1*
Fever	2,419,714	35.6	2,549,348	37.6	−2.7*
Typhoid	220,011	3.2	246,653	3.6	−0.4*
Asthma	98,596	1.5	131,261	1.9	−0.4*
Jaundice	131,1789	1.9	175,351	2.6	−0.7*
Malnutrition related disease	155,884	2.3	207,678	3.1	−0.8*
Dengue	18,1901	0.3	25,216	0.4	−0.1*
Chikungunia	10,701	0.2	17,111	0.3	−0.1
Mental Disorder	79,455	1.2	69,171	1.0	0.2*
Chicken Pox	16,7167	0.3	33,846	0.5	−0.2*
Cholera	33,1645	0.5	48,038	0.7	−0.2*
Others	308,1234	4.5	492,960	7.3	−2.8*

Note: All analyses were weighted and Presented as column percentage. Multiple response were considered.
[+]percentage change = during disaster-following disaster.
*Significant at 1% level of significance estimated through proportion test.

after disasters (aOR 1.17, 95% CI 1.15-1.19), suggesting a significant decrease post-disaster likely to hailstorm. Turning to individual-level factors, hijra individuals show a higher likelihood of diseases both during disasters (aOR 2.04, 95% CI 1.75-2.38) and after disasters (aOR 2.69, 95% CI 2.28-3.17), with a further increase post-disaster as compared with males. Education level has varying impacts, with primary education exhibiting a slightly higher likelihood during disasters (aOR 1.07, 95% CI 1.06-1.08) and secondary education displaying a higher likelihood after disasters (aOR 1.11, 95% CI 1.10-1.12) as compared with those who had no education. Regarding marital status, married individuals have a higher likelihood of diseases during disasters (aOR 1.01, 95% CI 1.01-1.02) compared to after disasters (aOR 0.99, 95% CI 0.99-1.01). Disability status also plays a role, with individuals with a disability exhibiting a higher likelihood of diseases both during disasters (aOR 1.48, 95% CI 1.46-1.50) and after disasters (aOR 1.33, 95% CI 1.31-1.35) as compared to those without disabilities, with a slight decrease post-disaster. In terms of occupation, services showed a higher likelihood of diseases during disaster (aOR 1.08, CI 1,07-1.10) and lower of after disaster (aOR 0.98, CI 0.97-0.99) as compared with those who were from agricultural backgrounds. Religion introduces nuances, as Hindu individuals show a slightly lower likelihood of diseases during disasters (aOR 0.95, 95% CI 0.94-0.96) and a higher likelihood after disasters (aOR 1.05, 95% CI 1.04-1.06) as compared with individuals who practice Islam. Meanwhile, individuals with other religions exhibit a lower likelihood of diseases during disasters (aOR 0.79, 95% CI 0.77-0.80) and a higher likelihood after disasters (aOR 1.16, 95% CI 1.14-1.19) as compared to Islam. Rural residents display a higher likelihood of diseases both during disasters (aOR 1.86, 95% CI 1.80-1.91) and after disasters (aOR 1.85, 95% CI 1.80-1.91), with minimal change in post-disaster as compared with who resided in city corporations. Urban residents exhibit a higher likelihood both during disasters (aOR 1.76, 95% CI 1.71-1.81) and after disasters (aOR 1.73, 95% CI 1.68-1.78), with minimal change in post-disaster as compared with city corporation residents. Considering different divisions, significant variations emerge, with each division showcasing unique patterns in disease likelihood during and after disasters.

Discussion

The objectives of this study were to explore the disease burden in Bangladesh during and following disasters and the factors associated with them from 2015 to 2020. The findings of this study indicate that 50% of the total respondents faced 1 or more diseases during disasters, which increased to 53.4% after disasters, reflecting a 3.4% increase from during to after disasters. Fever, cough and diarrhea were found to be highly prevalent both during and following disasters, while skin diseases, malnutrition, and asthma increased following disasters. Children aged 0-4 years, hijra individuals, those with comparatively lower education, persons with disabilities, those residing in rural areas, and those living in Chattogram, Rangpur, and Sylhet divisions were the most affected by disasters. The most influential disasters were flood, cyclone, thunderstorm, and hailstorm, each showing a significant increase in the likelihood of diseases both during and following disasters. The rising prevalence of diseases alongside increasing disasters indicates a risk to the poor health status of Bangladesh, posing challenges in achieving the Sustainable Development Goals' targets related to climate change (goal 13) and health and well-being for all (goal 3).

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Table 3. Distribution of diseases during and after disasters across socio-demographic characteristics of the respondents, 2015-2020

Characteristics	During disaster		Following disaster		Percentage change[+]
	Frequency	Percentage	Frequency	Percentage	
Age group					
0–4 years	874,965	52.2	911,452	54.4	–2.2*
5–17 years	1,566,464	49.7	1684098	53.5	–3.8*
18–36 years	780,810	48.6	844,481	52.6	–4.0*
37–60 years	126,073	49.0	132,557	51.6	–3.6*
61 and over	48,886	49.4	54,372	54.9	–5.5*
Gender					
Male	1964868	49.9	2106585	53.5	–3.6*
Female	1431663	50.3	1519649	53.4	–3.1*
Hijra	666	51.6	727	56.3	–4.7**
Education					
Never attended school	335,947	49.4	355,594	52.3	–2.9*
Primary	1,027,834	50.9	1096239	54.2	–3.3*
Secondary	852,661	48.7	926,071	52.8	–4.4*
Higher	305,791	46.4	337,604	51.3	–4.9*
Marital status					
Unmarried	1329679	49.1	1434500	52.9	–3.8*
Married	474,840	49.4	508,796	53.0	–4.4*
Divorced/ separated/ widowed	65,213	47.5	70,086	51.0	–3.5*
Disability status					
No	3302973	49.9	3528859	53.3	–3.2*
Yes	94,225	56.9	98,101	59.2	–2.3*
Occupation					
Agriculture	92,701	47.7	101,571	52.2	–4.5*
Business	58,554	47.0	63,619	51.1	–4.1*
Services	119,314	49.7	124,919	52.0	–2.3*
Day-labourer	170,575	51.6	185,469	56.1	–5.5*
Housewife	194,827	50.6	204,341	53.1	–3.5*
Students	1,598,763	48.8	1729676	52.8	–4.0*
Unemployed	91,799	51.5	96,204	54.0	–3.5*
Inactive	57,665	52.1	61,443	55.5	–3.4*
Others	138,036	50.8	148,266	54.6	–3.8*
Religion					
Islam	2,986,277	50.3	3154474	53.1	–3.2*
Hindu	372,404	48.5	424,403	55.2	–7.3*
Others	38,517	49.7	48,083	62.1	–12.4*
Residence					
Rural	3,061,889	50.5	3247903	53.6	–3.1*
Urban	321,650	47.0	361,165	52.8	–5.8*
City corporation	13,659	34.0	17,892	44.6	–10.6*
Division					
Barishal	423,811	49.5	519,563	60.7	–11.2*

(*Continued*)

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Table 3. (*Continued*)

Characteristics	During disaster		Following disaster		Percentage change[+]
	Frequency	Percentage	Frequency	Percentage	
Chattogram	440,624	60.5	443,759	60.9	0.4*
Dhaka	540,313	50.1	468,394	43.4	6.7*
Khulna	302,589	33.7	421,787	46.9	–13.2*
Mymensingh	368,922	56.8	341,477	52.6	4.2*
Rajshahi	375,901	38.0	420,465	42.5	–4.5*
Rangpur	546,854	58.2	617,956	65.8	–7.6*
Sylhet	398,185	61.2	393,559	60.5	0.7*

Note: All analyses were weighted and Presented as row percentages.
[+]percentage change = during disaster-following disaster.
* and ** indicate significance at the 1 and 5% levels of significance, respectively, determined through proportion test.

Table 4. Factors associated with diseases occurrence during and following diseases in Bangladesh, 2021

Variables	During disaster, aOR (95% CI)	Following disaster, aOR (95% CI)	Likelihood change (aOR)[+]
Disaster (ref: Hailstorm)			
Drought	2.04 (1.99–2.08)***	1.34 (1.31–1.37)***	0.70
Flood	1.67 (1.67–1.69)***	1.11 (1.10–1.12)***	0.56
Water Logging	1.66 (1.64–1.68)***	1.16 (1.15–1.18)***	0.50
Cyclone	1.00 (0.99–1.01)	0.75 (0.75–0.76)***	0.25
Tornado	0.76 (0.75–0.78)***	0.85 (0.84–0.86)***	–0.09
Strom/Tridal Surge	1.78 (1.75–1.81)***	1.02 (1.00–1.04)***	0.76
Thunderstorm/ Lighting	1.44 (1.42–1.45)***	1.23 (1.22–1.24)***	0.21
River/Coastal Erosion	2.29 (2.26–2.33)***	1.17 (1.15–1.19)***	1.12
Landslide	1.08 (1.03–1.12)***	0.67 (0.64–0.70)***	0.41
Salinity	1.71 (1.67–1.75)***	1.86 (1.82–1.91)***	–0.15
Others disaster	1.20 (1.19–1.21)***	0.99 (0.98–1.00)	0.21
Age	1.00 (1.00–1.2)***	1.00 (0.99–1.00)***	0
Gender (ref: Male)			
Female	1.00 (0.99–1.00)	0.99 (0.99–1.00)***	0.02
Hijra	2.04 (1.75–2.38)***	2.69 (2.28–3.17)***	–0.65
Education (ref: Never attended school)			
Primary	1.07 (1.06–1.08)***	1.14 (1.13–1.15)***	–0.07
Secondary	1.02 (1.00–1.03)	1.11 (1.10–1.12)***	–0.09
Higher	0.98 (0.97–0.99)***	1.08 (1.07–1.09)***	–0.10
Marital status (ref: Unmarried)			
Married	1.01 (1.01–1.02)***	0.99 (0.99–1.01)***	0.02
Divorced/ separated/ widowed	0.92 (0.91–0.93)***	0.92 (0.90–0.93)***	0
Disability status (ref: No)			
Yes	1.48 (1.46–1.50)***	1.33 (1.31–1.35)***	0.15
Occupation (ref: Agriculture)			
Business	0.97 (0.96–0.98)***	0.92 (0.90–0.93)***	0.05
Services	1.08 (1.07–1.10)***	0.98 (0.97–0.99)***	0.10
Day-labourer	1.15 (1.14–1.16)***	1.09 (1.07–1.10)***	0.06
Housewife	1.09 (1.08–1.10)***	1.00 (0.98–1.01)	0.09
Students	1.00 (0.99–1.01)	0.92 (0.91–0.93)***	0.08
Unemployed	1.01 (0.99–1.02)	0.95 (0.94–0.97)***	0.06
Inactive	1.04 (1.02–1.06)***	1.08 (1.06–1.10)***	–0.04
Others	0.98 (0.97–1.00)***	1.14 (1.12–1.16)***	–0.16
Religion (ref: Islam)			
Hindu	0.95 (0.94–0.96)***	1.05 (1.04–1.06)***	–0.10
Others	0.79 (0.77–0.80)***	1.16 (1.14–1.19)***	–0.37
Residence (ref: City corporation)			
Rural	1.86 (1.80–1.91)***	1.85 (1.80–1.91)***	0.01
Urban	1.76 (1.71–1.81)***	1.73 (1.68–1.78)***	0.03
Division (ref: Barishal)			
Chattogram	1.48 (1.46–1.49)***	0.92 (0.91–0.93)***	0.86
Dhaka	0.88 (0.87–0.88)***	0.42 (0.41–0.42)***	0.46
Khulna	0.59 (0.58–0.59)***	0.60 (0.60–0.61)***	–0.01
Mymensingh	1.08 (1.07–1.09)***	0.60 (0.60–0.61)***	0.48
Rajshahi	0.54 (0.53–0.54)***	0.39 (0.39–0.39)***	0.15
Rangpur	1.20 (1.19–1.21)***	1.05 (1.04–1.07)***	0.15
Sylhet	1.26 (1.24–1.27)***	0.76 (0.76–0.77)***	0.50

(*Continued*)

Note:
***P value <0.001
[+]likelihood change = adjusted odds ratio during disaster-adjusted odds ratio following disaster.

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This study revealed that approximately 50% of the total respondents experienced 1 or more forms of diseases during disaster, and this figure increased to 53.4% in the aftermath of the disaster. While most of these diseases are easily treatable, the significant rise in this number signals substantial challenges.[11] This higher burden can be attributed to several comprehensive reasons.[30] Firstly, the immediate impact of the disaster, such as injuries and exposure to unsanitary conditions, likely contributed to the surge in reported diseases.[15] Inadequate shelter, contaminated water sources, and disrupted sanitation systems further contribute to the transmission of infectious agents.[14,31] Additionally, disruptions to health care infrastructure and accessibility in the post-disaster scenario may have hindered prompt medical attention, allowing diseases to proliferate.[30,32] The psychosocial toll of disasters, including stress, trauma, and displacement, can weaken individuals' immune systems, making them more susceptible to illnesses.[33,34] The pre-existing health vulnerabilities within LMICs, such as malnutrition and limited access to preventive health care, exacerbate the impact of disasters on overall health.[17,19,33] Furthermore, the economic strain induced by disasters can impede individuals' ability to afford health care services, exacerbating the burden of preventable and treatable diseases.[32,35]

The documented surge in disease burden observed from pre- to post-disaster primarily stems from an elevation in the prevalence of specific health issues, notably skin diseases, diarrhea, and malnutrition.[14] The intensified occurrence of skin diseases may be linked to factors such as exposure to unsanitary conditions, compromised hygiene, and limited access to clean water sources in the aftermath of a disaster.[27,36] The rise in diarrhea cases could be attributed to contaminated water supplies, disrupted sanitation infrastructure, and challenges in maintaining proper hygiene practices during and after the disaster.[51] Furthermore, an increase in malnutrition rates is likely influenced by disrupted food supply chains, limited access to nutritious food, and the socio-economic fallout accompanying disasters.[28,41] The documented surge in disease burden observed from pre- to post-disaster primarily stems from an elevation in the prevalence of specific health issues, notably skin diseases, diarrhea, and malnutrition.[14] The intensified occurrence of skin diseases may be linked to factors such as exposure to unsanitary conditions, compromised hygiene, and limited access to clean water sources in the aftermath of a disaster.[31] The rise in diarrhea cases could be attributed to contaminated water supplies, disrupted sanitation infrastructure, and challenges in maintaining proper hygiene practices during and after disasters. Furthermore, an increase in malnutrition rates is likely influenced by disrupted food supply chains, limited access to nutritious food, and the socio-economic fallout accompanying disasters.[25,36]

Upon examination of socio-economic characteristics, a discernible pattern emerged, revealing an increased likelihood of disease prevalence during and post-disaster among respondents with comparatively disadvantaged socio-demographic profiles.[37] During and after disasters, young children (0-4 years old) and the elderly (60 and above) face heightened disease burdens. For young children, factors like limited access to clean water, sanitation, and proper nutrition contribute to an increased risk of infectious diseases.[17,36] Disrupted health care services and challenges in obtaining vaccinations exacerbate their vulnerability. The elderly, with pre-existing health conditions and limited mobility, encounter increased health risks.[22,28] Evacuation difficulties and restricted access to health care amplify their health concerns. Mental health issues, including post-traumatic stress disorders, further contribute to the overall disease burden for both age groups.[33]

Individuals with lower levels of education faced heightened susceptibility, potentially owing to limited awareness of preventive measures, reduced access to health care information, and challenges in adopting health-promoting behaviors.[38,39] Similarly, the elevated risk observed among hijra, or disabled respondents, may be attributed to social and physical vulnerabilities that exacerbate the impact of disasters, including difficulties in accessing essential services, evacuation challenges, and potential discrimination.[40] The intersectionality of socio-economic disadvantages amplifies the health disparities experienced by these groups during crisis situations.[32,41]

We observed an increased likelihood of diseases during and following disasters linked to the respondents' place and region of residence. This geographical variation in disease burden can be comprehensively explained by several factors.[42] Firstly, differing environmental conditions in various regions may influence the prevalence of vector-borne diseases, waterborne illnesses, and other climate-sensitive health issues. Secondly, disparities in the accessibility and quality of health care services across regions could contribute to variations in disease outcomes.[25,32] For instance, Dhaka, being a capital region, always reported better health outcomes with the strongest health care services delivery system compared to the other regions in Bangladesh.[43] Moreover, with only 12 in number, city corporations in Bangladesh have their specific characteristics, such as administrative centrality in the corresponding region, better infrastructure and living conditions, being comparatively the oldest cities, and having better health care facilities compared to the remaining urban and rural areas in the corresponding regions.[9,44] Collectively, these factors create layers of differences in people's lives, living environments, and health care infrastructure to respond effectively to health crises, contributing to the differentiation in disease burden.[8,32] Additionally, socio-economic variations between regions can impact individuals' ability to adopt preventive measures, access timely medical care, and address health-related needs during and after disasters.[32,45,46]

This study boasts several strengths and a few limitations. Notably, it stands as the first investigation in Bangladesh delving into the disease burden during and following disasters. Leveraging a nationally representative dataset with a sizable sample size and employing advanced statistical techniques, we comprehensively analyzed respondents' socio-demographic and regional characteristics. Consequently, the study's findings hold merit and exhibit ample strengths to inform country-level policy and programs. However, a primary limitation of this study stems from the analysis of cross-sectional data, rendering the reported findings correlational rather than causal. Furthermore, reliance on self-reported data introduces a potential risk of recall bias. The intensity and availability of health care facilities play a pivotal role in shaping disease burden during disasters; however, this aspect could not be addressed due to the absence of relevant data in the survey. A similar limitation was evident for important household-level factors, including the household wealth quintile. Despite these limitations, the study's nature and the robustness of its analysis provide valuable guidance for policymakers to formulate evidence-based policies and programs.

Conclusion

This study revealed that approximately half of the total respondents experienced 1 or more diseases during the event of a disaster, representing a 3.4% increase in the aftermath. This substantial rise is primarily attributed to an increase in skin diseases, diarrhea, and malnutrition. Notably, there are significant variations in disease

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burden at the regional level during and following disasters. The socio-demographic characteristics of the respondents also emerged as significant contributors to disease burden in these circumstances. These findings highlight substantial challenges for Bangladesh, especially considering the escalating frequency of adverse disaster events and the higher burden of disease. To address these challenges, it is crucial to implement tailored public health interventions that specifically cater to the needs of the disaster-affected population, particularly the disadvantaged groups. Additionally, efforts to enhance health care infrastructure are paramount in effectively managing and mitigating the impact of diseases in the wake of disasters.

Significance

Climate change and its induced disasters are now ongoing issues across the world, particularly low- and middle-income countries.

What is Already Known on this Subject?

Previous research has acknowledged the significant burden of disease among populations in low- and middle-income counties (LMICs), like Bangladesh, by how the impact of climate change creates vulnerability. However, the disease burden of the context of disasters regarding during and after disasters among national populations remains largely unexplored in Bangladesh, despite this climatic event's impact on human health and well-being.

What this Study Contributes

The study, using representative samples and rigorous methodology, identified health burdens regarding diseases and extreme climatic events among national populations in Bangladesh. Additionally, the study found that around half of the population experienced disastrous events during and after disasters, such as floods, and most prevalent diseases such as fever, cough, diarrhea, and skin disease, affects people with the disaster events.

Supplementary material. The supplementary material for this article can be found at http://doi.org/10.1017/dmp.2024.288.

Data availability. All the necessary information for the present study has been included by the authors in the publication. Individuals with a passion in the manuscript should get in contact with the appropriate author for any further inquiries. However, in order to access the entire dataset, researchers need to do exactly what we did, which is get in reach with the Bangladesh Bureau of Statistics (https://bbs.gov.bd) and submit a formal study application.

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Author contribution. Co-senior authors were Iqbal Kabir MD and Shohel Rana MD. Rana MS, Kabir MI, and Khan MN developed the study concept. Rana MS performed data analysis along with Alam MB. Rana MS and Kabir MI write first draft of the manuscript. Rana MS, Kabir MI, Alam MB, Chowdhury AR, Lusha MAF, Hossain DM, Islam MS, and Khan MN critically review the manuscript. All authors approved the final version of the manuscript.

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Ethical standard. The survey was reviewed and approved by the Ethical Review Committee of the Bangladesh Buruea of Statistics (BBS). Written informed consent was obtained from all participants in this survey before their inclusion. We explored de-identified data from BBS by submitting a research proposal for this study. Therefore, any additional ethical approvals were not required for this study.

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