Physical and Mental Disabilities of the Coastal area's people: A survey-based study in Bangladesh

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ABSTRACT
This study investigates the intersection of environmental hazards and the well-being of individuals with mental and physical disabilities (M&PD) in Cox's Bazar, a vulnerable coastal area of Bangladesh. Utilising a sample of 150 respondents, data were collected through structured questionnaires administered via face-to-face interviews. Structural equation modelling (SEM) and partial least squares structural equation modelling (PLS-SEM) techniques were employed to analyse the complex relationships between environmental factors, socio-economic variables, and disability outcomes. The qualitative data analysis shows the Insights on Disability and Climate Resilience to enhance the knowledge more elaborately.Results indicate significant correlations between environmental degradation, socio-economic marginalization, and increased vulnerability among individuals with disabilities in coastal Bangladesh. Recommendations for policy and practice are discussed based on the findings, aiming to enhance the resilience and inclusivity of coastal communities in the face of climate change impacts. (Hasnat, Kabir, & Hossain, 2018; Murshed et al., 2023).

Keywords: Mental and Physical Disabilities, Coastal Areas, Cox's Bazar, Bangladesh, Environmental Hazards, Vulnerability, Structural Equation Modelling (SEM), Smart Pls4, Resilience, Climate Change Adaptation.

INTRODUCTION

The coastal areas of Bangladesh are not only home to rich biodiversity but also harbour unique challenges, particularly concerning the well-being of individuals with mental and physical disabilities (M&PD). In recent years, the convergence of climate change impacts and environmental degradation has intensified the vulnerabilities faced by this population group, exacerbating their socio-economic marginalisation and hindering their access to essential services and support systems (Hasnat, Kabir, & Hossain, 2018).

According to Kamruzzaman (2016), the intersectionality of disability and environmental hazards poses complex challenges for coastal communities, where individuals with disabilities often experience heightened risks and barriers to adaptation. Moreover, the Rohingya refugee influx in Cox's Bazar has further strained resources and services, disproportionately affecting individuals with disabilities and exacerbating their vulnerabilities (Murshed et al., 2023).

In response to these pressing issues, it is imperative to explore the structural relationships between various factors influencing the vulnerability of individuals with disabilities in coastal areas. By employing advanced statistical techniques such as structural equation modelling (SEM) and partial least squares structural equation modelling (PLS-SEM), this study aims to provide a comprehensive understanding of the complex interplay between environmental hazards, socio-economic factors, and disability outcomes in Bangladesh's coastal regions.

Through an in-depth analysis of existing literature and empirical data, this study seeks to inform policy, practice, and research initiatives aimed at enhancing the resilience and well-being of individuals with disabilities in coastal Bangladesh. By identifying key determinants and pathways of vulnerability, stakeholders can develop targeted interventions and adaptation strategies that promote inclusivity, equity, and sustainable development in the face of environmental challenges.

Coastal areas of Bangladesh

The coastal areas of Bangladesh refer to the regions bordering the Bay of Bengal in the southern part of the country. These areas encompass a significant portion of Bangladesh's coastline and include districts such as Cox's Bazar, Khulna, Barisal, and Patuakhali, among others. The coastal areas are characterized by their vulnerability to natural disasters such as cyclones, flooding, and erosion, as well as environmental challenges like sea-level rise, salinity intrusion, and habitat degradation. These regions are also home to diverse ecosystems, including mangrove forests like the Sundarbans, which provide vital ecosystem services and support the livelihoods of millions of people.

Figure 1: Coastal zone of Bangladesh.

Mental and physical disabilities of the people of coastal areas

The mental and physical disabilities of people living in coastal areas can be influenced by various factors unique to these regions. Challenges such as exposure to natural disasters like cyclones, which can result in physical injuries and trauma, contribute to the prevalence of disabilities. Additionally, limited access to healthcare services, inadequate infrastructure, and socioeconomic vulnerabilities further exacerbates the situation for individuals with disabilities in coastal areas. Moreover, environmental factors such as climate change-induced events like sea-level rise and coastal erosion can disrupt livelihoods and exacerbate living conditions, impacting the mental and physical well-being of coastal residents. Addressing the needs of people with disabilities in these areas requires holistic approaches that consider the intersectionality of factors affecting their health and quality of life.

Lifestyles of the coastal areas

The lifestyles of coastal areas are intricately connected to their geographical location and environment. People living in coastal regions often rely on marine resources for their livelihoods, engaging in activities such as fishing, aquaculture, and coastal agriculture. These communities have unique cultural practices and traditions shaped by their proximity to the sea, influencing their dietary preferences, customs, and social interactions. Additionally, coastal areas attract tourism, leading to the development of beachside resorts, water sports facilities, and other leisure activities.

Fig 2: Lifestyles of coastal area (Source: Prothom Alo)

LITERATURE REVIEW

Islam et al. (2014) conducted a study to investigate the coping strategies employed by disabled individuals in the face of natural disasters in coastal Bangladesh. Through a comprehensive survey conducted in three sub-districts of Bagerhat district, the researchers gathered data on socio-demographic characteristics, economic status, and coping mechanisms of respondents. The findings revealed that disabled individuals faced significant challenges in accessing disaster shelters and coping with adverse conditions during disasters. Variables such as gender, age, marital status, education level, and types of disability were considered in the analysis, providing valuable insights into the socio-economic context of disability in disaster-prone areas. The study underscores the importance of creating disabled-friendly environments, rigorous policy monitoring, and active engagement of disabled individuals in decision-making processes to enhance resilience to disasters.

Nahar et al. (2014) focused the devastating impact of cyclones on mental health challenges faced by survivors in Bangladesh, with a particular focus on women and the poor. The paper highlights the gender disparities in mortality rates during cyclones and identifies socio-economic status as a determinant of vulnerability. Post-disaster mental health challenges, including PTSD, depression, and anxiety, are discussed, emphasizing the inadequacy of mental health support in Bangladesh. The paper advocates for adopting comprehensive frameworks for mental health and psychosocial support after natural disasters, integrating clinical and non-medical interventions. Recommendations include integrating mental health services into disaster response efforts, capacity building for healthcare professionals, and community-based support systems, with a particular emphasis on gender-sensitive approaches and targeted interventions for vulnerable populations.

Barua and Rahman (2018) examined the accessibility challenges faced by persons with disabilities (PWDs) in the coastal belt of Bangladesh concerning climate change and disaster management. The study revealed significant concerns among PWDs regarding natural disasters and identified accessibility challenges during disaster activities and post-disaster relief efforts. Despite legal frameworks and policy commitments, implementation gaps persisted, underscoring the need for multifaceted solutions to address accessibility challenges. The study recommends comprehensive enumeration of PWDs, effective implementation of disability rights legislation, and collaboration between stakeholders to promote inclusive policies and practices, emphasizing the importance of enhancing accessibility for vulnerable populations in disaster-prone areas.

Hossain et al. (2022) investigated the financial burden of chronic illnesses and the effectiveness of social safety net programs (SSNPs) in Bangladesh, with a focus on vulnerable populations in coastal regions. The study highlights the need for targeted interventions to support vulnerable populations, strengthen and expand existing SSNPs, and improve the efficiency and transparency of benefit distribution. Collaboration with local stakeholders and community leaders is recommended to enhance the inclusivity and reach of SSNPs, particularly in underserved areas. By addressing these issues, policymakers can work towards

reducing the financial burden of chronic illnesses and promoting greater social equity in healthcare access in Bangladesh.

Kabir et al. (2016) showed the multifaceted impacts of cyclones on coastal communities in Bangladesh, focusing on socio-economic challenges, health implications, and vulnerabilities of specific population groups. The study highlights significant disruptions to livelihoods, increased health challenges, and vulnerabilities among women, children, and the elderly. The findings underscore the importance of proactive policy measures and adaptation strategies to mitigate the impacts of climate change-induced disasters, emphasizing the need for enhanced disaster preparedness, access to healthcare, livelihood support, and gender-responsive approaches.

Mandal et al. (2017) explored the occupational health hazards faced by fishermen in the coastal zone of Bangladesh. The study revealed numerous challenges related to their occupation, including exposure to natural disasters such as cyclones and storms, physical ailments, and anthropogenic threats like pirate attacks. The findings underscore the urgent need for comprehensive measures to address these occupational health hazards and ensure the safety and well-being of coastal fishermen in Bangladesh.

Islam and Chuenpagdee (2013) examined social vulnerability to climate change in the south-west coastal region of Bangladesh. The study highlighted exposure to climate stressors, sensitivity to climate variability, and constraints on adaptive capacity among vulnerable populations. Recommendations included enhanced coordination and implementation of existing policies, access to energy and telecommunication services, and further research on adaptation strategies to address the complex interplay between environmental, socioeconomic, and gender factors in shaping vulnerability to climate change.

Mondal et al. (2020) conducted a study on livelihood vulnerability and asset deprivation in coastal Bangladesh. The discussion yielded key findings on community vulnerability indexing, household-level vulnerability analysis, identification of outlier households, nexus between assets and vulnerability, and conclusions. Recommendations included developing targeted adaptation strategies, enhancing access to resources, promoting livelihood diversification, strengthening social safety nets, investing in infrastructure, conducting capacity building and awareness programs, integrating gender considerations, fostering community-based approaches, ensuring policy coherence, and conducting further research and monitoring.

The report by ASWJ (2021) highlights the significant economic challenges faced by persons with disabilities (PWDs) in Bangladesh, particularly in coastal regions. Despite receiving some financial support, PWDs often experience increased financial strain due to inadequate access to income and resources, exacerbating their exclusion from economic opportunities. Challenges in accessing healthcare services, education, employment, and social integration further contribute to the economic vulnerability of PWDs in Bangladesh.

The legislative landscape in Bangladesh has undergone significant changes following the adoption of the Rights and Protection of Persons with Disability Act 2013 and the signing of the UN Convention on the Rights of Persons with Disabilities in 2008. However, gaps still exist in recognizing the increased risk and rights of persons with disabilities in disaster risk reduction efforts. Recommendations include enhancing accessibility, promoting inclusive policies and practices, and ensuring the active participation of persons with disabilities in decision-making processes.

Hasnat et al. (2018) focused the challenges of ecosystem changes and biodiversity depletion in coastal Bangladesh. The paper highlights the decline in species populations, threats to the Sundarbans mangrove forest, deforestation, introduction of exotic species, and expansion of commercial activities contributing to environmental degradation. Recommendations include strengthening conservation efforts, promoting sustainable practices, and addressing socio-economic drivers of environmental degradation to safeguard the biodiversity and ecosystems of coastal Bangladesh.

Murshed et al. (2023) conducted a sensitivity assessment to analyze the spatial variation of vulnerability to climate-related disasters in the coastal region of Bangladesh. The study identified highly sensitive areas and factors contributing to high sensitivity, including illiteracy, homelessness, poor housing, climate-reliant livelihoods, and the Rohingya refugee influx. Recommendations aimed to build resilient coastal communities better equipped to mitigate and recover from climate-related disasters.

Research Gap

Limited focus on investigating the specific root causes of mental and physical disabilities resulting from natural disasters in coastal areas of Bangladesh.

Objectives

1. To investigate the relationship between natural disasters exposure (NDE) and mental and physical disability (M&PD) among individuals in coastal areas of Bangladesh.
2. To examine the role of lack of healthcare services (LHS) in exacerbating mental and physical disabilities (M&PD) among coastal communities.
3. To assess the influence of social vulnerability (SV) on the occurrence and severity of mental and physical disabilities (M&PD) in coastal areas.
4. To explore the impact of environmental pollution (EP) on mental and physical health outcomes, specifically contributing to the incidence of disabilities among coastal populations.

Hypotheses

1. H1: There is a positive relationship between natural disasters exposure (NDE) and mental and physical disability (M&PD) among individuals in coastal areas of Bangladesh(Hossain, M. I., 2017; Islam, S. et al., 2018).
2. H2: Lack of healthcare services (LHS) exacerbates mental and physical disabilities (M&PD) among coastal communities in Bangladesh(Nahar, N. et al., 2014; Rezwana, N., 2016).
3. H3: Social vulnerability (SV) significantly influences the occurrence and severity of mental and physical disabilities (M&PD) in coastal areas of Bangladesh(Laila, F., 2013; Hasnat, G. T. et al., 2018).
4. H4: Environmental pollution (EP) contributes to the incidence of mental and physical disabilities (M&PD) among coastal populations in Bangladesh(Shahjahan, M. et al., 2016; Hussain, M. M., 2021).

Conceptual Framework

Figure 3 shows the theoretical model.

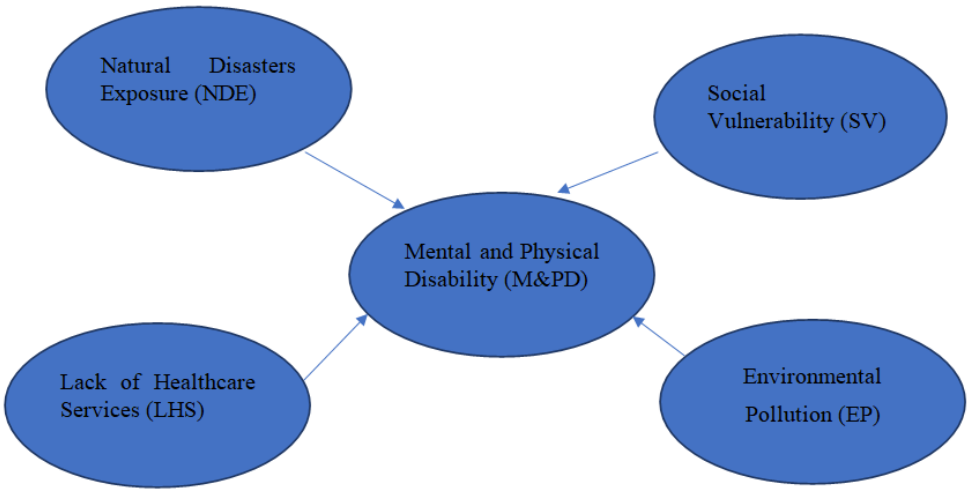

Figure 3: theoretical Model

Dependent Variable

1. **Mental and Physical Disability (M&PD)**: This variable represents the combined measure of mental health issues (e.g., anxiety, depression, post-traumatic stress disorder) and physical disabilities (e.g., mobility impairments, sensory impairments) experienced by individuals living in coastal areas of Bangladesh.

Independent Variables

1. **Natural Disasters Exposure (NDE)**: This variable measures the frequency and intensity of exposure to natural disasters such as cyclones, floods, and salinity intrusion, which are prevalent in coastal areas. Higher exposure to natural disasters is expected to correlate with increased mental and physical disability due to trauma, injury, and stress (Hossain, M. I., 2017; Islam, S. et al., 2018).
2. **Lackof Healthcare Services (LHS)**: This variable lack the availability and accessibility of healthcare services, including medical facilities, trained personnel, and medication, in coastal communities.

Limited access to healthcare services may contribute to untreated health conditions, exacerbating mental and physical disability (Nahar, N. et al., 2014; Rezwana, N., 2016).

3. **Social Vulnerability (SV)**: This variable examines socio-economic factors such as poverty, education level, and social support networks that influence vulnerability to mental and physical disability. Higher social vulnerability, characterized by poverty and lack of education, may increase the likelihood of mental and physical health issues due to limited resources and coping mechanisms (Laila, F., 2013; Hasnat, G. T. et al., 2018).
4. **Environmental Pollution (EP)**: This variable measures the level of environmental pollution, including air, water, and soil pollution, in coastal areas. Exposure to environmental pollutants, often exacerbated by industrial activities and poor waste management, can contribute to chronic health conditions and disabilities (Shahjahan, M. et al., 2016; Hussain, M. M., 2021).

METHODOLOGY

The study was conducted in Cox's Bazar, a coastal area in Bangladesh known for its vulnerability to natural disasters and high population density. A convenience sampling method was selected for 150 respondents aged 18 and above residing in Cox's Bazar. Data was collected via a structured questionnaire with five Likert scale questions through face-to-face interviews where 5 is for Strongly Agree and 1 is for Strongly Disagree. Analysis was conducted using Structural Equation Modelling (SEM) with SmartPLS 4 software to understand the root causes of mental and physical disabilities. Ethical approval was obtained and informed consent was secured from participants to ensure confidentiality and privacy. Limitations, including sampling and response bias, was mitigated through careful participant selection and rigorous data validation procedures.

Mental and Physical Disability (M&PD):

No.	Question	Reference
1	Lack of awareness and understanding about disabilities contributes to social stigma and discrimination against PWDs.	Nahar et al. (2014)
2	The existing infrastructure in coastal regions is not adequately accessible for persons with disabilities.	Barua & Rahman (2018)
3	Persons with disabilities in flood-prone areas lack proper livelihood opportunities, exacerbating their economic challenges.	Mahmud & Azad (2017)
4	Fishermen in coastal zones experience various physical and mental health issues due to occupational hazards.	Mandal et al. (2017)
5	Women with disabilities in coastal regions face heightened vulnerability to social exclusion and human rights violations.	Shamsuddoha et al. (2024)

Natural Disasters Exposure (NDE):

No.	Question	Reference
1	Coastal communities are highly sensitive to climate-related disasters due to factors such as poverty and inadequate housing.	Murshed et al. (2023)
2	Vulnerable districts in coastal regions lack adequate disaster preparedness measures, increasing their risk during disasters.	Hasnat et al. (2018)
3	The Rohingya refugee influx in Cox's Bazar exacerbates vulnerability to natural disasters in the region.	Murshed et al. (2023)
4	Climate change-induced hazards disproportionately affect women in coastal areas, leading to increased vulnerabilities.	Shamsuddoha et al. (2024)
5	Coastal areas face significant environmental degradation due to deforestation, habitat destruction, and pollution.	Hasnat et al. (2018)

Lack of Healthcare Services (LHS):

No.	Question	Reference
1	People with disabilities in coastal areas struggle to access essential medical care due to resource scarcity.	ASWJ (2021)
2	Shortages of trained healthcare professionals exacerbate the healthcare access challenges faced by coastal communities.	ASWJ (2021)
3	Limited availability of psychological and mental health services further underscores the vulnerability of coastal populations.	ASWJ (2021)

4	Government safety net programs fail to adequately cover healthcare expenses for vulnerable coastal populations.	ASWJ (2021)
5	Access to microfinance institutions for healthcare is limited for coastal communities due to discrimination and lack of trust.	ASWJ (2021)

Social Vulnerability (SV):

No.	Question	Reference
1	Societal stigma and negative attitudes contribute to social exclusion and isolation of persons with disabilities in coastal areas.	ASWJ (2021)
2	Women with disabilities in coastal regions face barriers to marriage and limited access to reproductive health services.	ASWJ (2021)
3	Limited availability of disability-friendly facilities restricts the participation of persons with disabilities in recreational activities.	ASWJ (2021)
4	Government initiatives to provide recreation opportunities for PWDs are insufficient and often inaccessible in coastal areas.	ASWJ (2021)
5	Coastal communities experience strained relationships within families and communities due to societal stigma towards disabilities.	ASWJ (2021)

Environmental Pollution (EP):

No.	Question	Reference
1	Excessive use of agrochemicals in agriculture contributes to soil and water pollution in coastal regions.	Hasnat et al. (2018)
2	Expansion of commercial shrimp cultivation and salt production leads to habitat destruction and soil salinity in coastal areas.	Hasnat et al. (2018)
3	Deforestation in coastal regions contributes to soil erosion, reduced rainfall, and biodiversity loss.	Hasnat et al. (2018)
4	Pollution from anthropogenic sources poses significant risks to coastal ecosystems and human health.	Hasnat et al. (2018)
5	Sedimentation from rivers affects the deltaic region in coastal Bangladesh, altering river basins and sea levels.	Hasnat et al. (2018)

Discussion and Analysis

Table 1: Factors Loading with Communality and Redundancy, Convergent Validity and Average variance Extracted (AVE)

Construct	Item	Factor Loading	Communality	Redundancy (P-value)	Average variance Extracted (AVE)
M&PD					0.611103
	M&PD1	0.724032	0.66061	0.023	
	M&PD2	0.743723	0.694293	0.0456	
	M&PD3	0.798141	0.629193	0.0157	
	M&PD4	0.74121	0.6875	0.0345	
	M&PD5	0.828573	0.682948	0.00254	
NDE					0.621805
	NDE1	0.846353	0.577474	0.0052	
	NDE2	0.73268	0.6984146	0.0002179	
	NDE3	0.923689	0.56611	0.00745	
	NDE4	0.82171	0.633379	0.0002784	
	NDE5	0.760344	0.65957	0.000365	
LHS					0.613063
	LHS1	0.737815	0.651085	0.000381	

	LHS2	0.89413	0.589462	0.0005176	
	LHS3	0.79036	0.534159	0.0001365	
	LHS4	0.741751	0.634754	0.00641	
	LHS5	0.827188	0.651845	0.0003178	
SV					0.62315
	SV1	0.75438	0.68413	0.000614	
	SV2	0.854123	0.598418	0.0008469	
	SV3	0.76382	0.6985134	0.00354	
	SV4	0.70387	0.574563	0.000841	
	SV5	0.779834	0.631478	0.0035846	
EP					0.639457
	EP1	0.83218	0.549836	0.0006328	
	EP2	0.71587	0.639741	0.0002315	
	EP3	0.75843	0.65847	0.0023619	
	EP4	0.86412	0.543982	0.001036	
	EP5	0.79792	0.639745	0.0004132	

The communality value is crucial for determining whether a variable should be included or excluded in factor analysis. An ideal communality value is above 0.5, indicating robust inclusion here. Factor loading measures how much variance a variable explains within its factor in SEM. A factor loading of 0.7 or higher suggests sufficient variance extraction. All factor loadings here exceed 0.7. A p-value below 0.05 signifies statistical significance, warranting rejection of the null hypothesis. All p-values analysed are < 0.05, indicating significant results. Adequate convergent validity requires an AVE of at least 0.50; scores below this suggest constructs may be more error-prone than informative. Here, all AVE scores surpass 0.5.

Table 2: reliability and convergent validity

Item	**Cronbach's α**	**Composite Reliability rho(A)**	**Composite Reliability rho(C)**	**VIF**
M&PD	0.721	0.777	0.858	1.891
NDE	0.753	0.794	0.824	1.246
LHS	0.769	0.885	0.781	1.809
SV	0.738	0.804	0.749	1.421
EP	0.820	0.735	0.782	1.59
Optimum Values	>.7	>.7	>.7	<5

Table 2 shows that all variables meet optimal criteria. Cronbach's α, Composite Reliability rho(A), Composite Reliability rho(C), and VIF exceed thresholds of >.7 and 5, respectively. VIF measures the strength of linear relationships between explanatory variables; values exceeding 10 are generally cautioned against (Hair et al., 1995; Kennedy, 1992). A VIF of 5 or less is recommended (Rogerson, 2001; Pan & Jackson, 2008) to mitigate multicollinearity, where VIF > 10 or tolerance < 0.1 indicate significant issues needing correction.

Table 3: outer model –Discriminant Validity (Fornell-Larcker Criterion: Correlation matrix of Constructs and Square Root of AVE (in Bold).

	M&PD	NDE	LHS	SV	EP
M&PD	**0.781**	-	-		
NDE	0.684	**0.7885**	-		
LHS	0.346	0.384	**0.782**		
SV	0.527	0.610	0.219	**0.753**	
EP	0.368	0.413	0.285	0.189	**0.587**

The Fornell-Larcker criterion checks discriminant validity in measurement models. It states that the square root of the average variance extracted (AVE) for each construct should exceed the correlations between that construct and any other. Here, the AVE square roots for all constructs exceed their correlations with other constructs, confirming discriminant validity.

Table 4: Cross loading analysis

	M&PD	NDE	LHS	SV	EP
M&PD1	0.766	0.585	0.089	0.030	0.084
M&PD2	0.765	0.598	0.088	0.130	0.327
M&PD3	0.815	0.581	0.128	0.234	0.169
M&PD4	0.659	0.491	0.324	0.167	0.152
M&PD5	0.623	0.326	0.137	0.189	0.418
NDE1	0.599	0.894	0.257	0.256	0.237
NDE2	0.469	0.745	0.047	0.351	0.149
NDE3	0.525	0.802	0.011	0.452	0.238
NDE4	0.406	0.686	0.014	0.306	0.328
NDE5	0.365	0.752	0.032	0.195	0.543
LHS1	0.258	0.493	0.623	0.203	0.208
LHS2	0.143	0.579	0.740	0.136	0.162
LHS3	0.079	0.045	0.713	0.319	0.008
LHS4	0.07	0.048	0.881	0.247	0.113
LHS5	0.093	0.062	0.831	0.308	0.480
SV1	0.038	0.051	0.564	0.658	0.327
SV2	0.046	0.033	0.227	0.849	0.179
SV3	0.318	0.456	0.219	0.742	0.308
SV4	0.235	0.413	0.226	0.763	0.179
SV5	0.354	0.328	0.336	0.892	0.234
EP1	0.157	0.327	0.028	0.452	0.862
EP2	0.218	0.564	0.057	0.321	0.785
EP3	0.167	0.346	0.310	0.018	0.694
EP4	0.256	0.103	0.276	0.304	0.604
EP5	0.341	0.302	0.143	0.179	0.808

According to Gefen and Straub (2005), discriminant validity is demonstrated when each measurement item shows weak correlations with constructs to which it is not theoretically associated. The loading indicates the reflective relationship with the construct. Cross-loading analysis examines how items relate to different constructs, identifying high loadings on their intended construct and weak loadings on others. Table 4 shows high loadings within the same construct and weak correlations across different constructs, confirming the validity of the outer model for discriminant validity at the item level.

Table 5: outer model –Discriminant Validity (HTMT Ratio), Threshold: HTMT<0.9

	M&PD	NDE	LHS	SV	EP
M&PD				-	-
NDE	0.5655				-
LHS	0.052	0.534			
SV	0.148	0.187	0.479		
EP	0.117	0.1479	0.652	0.202	

accordance with Franke & Sarstedt (2019) if the HTMT value is significantly below the critical value of 0.9 to establish discriminant validity. Here we can see that the value is below 0.9. So, it can be said that the the model is valid and established.

Table 6: inner model; Path Coefiicients of tested model & Hypothesis Testing and Structural Model Evaluation

Hyp	Relationship	B	Mean	Std. Dev	R2	Q2	f2	t-statistic	sig.
H	NDE→M&PD	0.387	0.916	0.10	0.42	0.0012	0.74	0.703	0.031**
H2	LHS→ M&PD	0.264	0.955	0.05	0.51	0.0352	0.68	0.817	0.0076**
H3	SV→ M&PD	0.213	0.948	0.01	0.535	0.026	0.57	0.706	0.0042**
H4	EP→ M&PD	0.299	0.981	0.02	0.537	0.0046	0.369	0.747	0.000625***

Note: *p<0.05; **p<0.01, ***p<0.001; n.s= not significant; (two-tailed test). R = Rejected; (A) = Accepted.

Beta coefficients (B) in the structural model indicate path relationships between constructs. They assess the consistency of results across items measuring the same construct, with a typical cutoff >0.20 (Hair et al., 2021). Table 6 shows all values surpass this threshold. Mean and Standard Deviation (SD) indicate good model fit. R Square values (0.42, 0.51, 0.535, & 0.537) suggest moderate variance explained by endogenous variables (Falk & Miller, 1992; Cohen, 1988; Chin, 1998). Q-square (>0) confirms predictive relevance, with all values indicating well-reconstructed models. F-Square (0.74, 0.68, 0.57, & 0.369) denotes large effects (Cohen, 1988).

Inner Model (Parameters)

Assessment	Name of Index	Guideline	Source
Collinearity	VIF (Variance inflator factor)	Multi-Collinearity occurs in model when for specific indicators VIF values are 5 and above	García-Carbonell, Martín-Alcázar and Sánchez-Gardey (2015)
Path Coefficient	Path Coefficient	t value>2.33 (one tailed) p value <0.05	Hair et al.,(2017)
R-square	Coefficient of determination	0.26- Substantial 0.13- Moderate 0.02- Weak	Cohen (1988)
f-square	Effect size	0.35- Large 0.15- Medium 0.02- Small	Cohen (1988)

Fig 4: Inner Model (parameters)

Table 6: Goodness-of-fit indicators for the structural model

Fit indices	**Structural model value**	**Recommended value**	**References**
Gfi	0.952	> .90	Hair et al. (2010)
Agfi	0.848	> .80	Hu and Bentler (1999)
Nfi	0.972	> .90	Hu and Bentler (1999)
Cfi	0.918	> .90	Bentler and Bonett (1980)
Rmsea	0.042	< .08	Hu and Bentler (1999)
Srmr	0.059	< .07	Hu and Bentler'(1999)

Goodness-of-Fit Measures for the Structural Model (Table 6):

The structural model exhibits strong goodness-of-fit across multiple indices: Goodness-of-Fit Index (GFI: 0.952), Adjusted Goodness-of-Fit Index (AGFI: 0.848), Normed Fit Index (NFI: 0.972), Comparative Fit Index (CFI: 0.918), Root Mean Square Error of Approximation (RMSEA: 0.042), and Standardized Root Mean Square Residual (SRMR: 0.059). These values surpass or meet recommended thresholds, indicating a robust match between the model and observed data (Hair et al., 2010; Hu and Bentler, 1999; Bentler and Bonett, 1980). GFI and AGFI suggest strong and good fits respectively, considering model complexity adjustments. NFI and CFI both show high model-data fit, while RMSEA and SRMR indicate satisfactory model-data alignment. These findings affirm the model's credibility and adherence to established fit criteria in structural equation modeling.

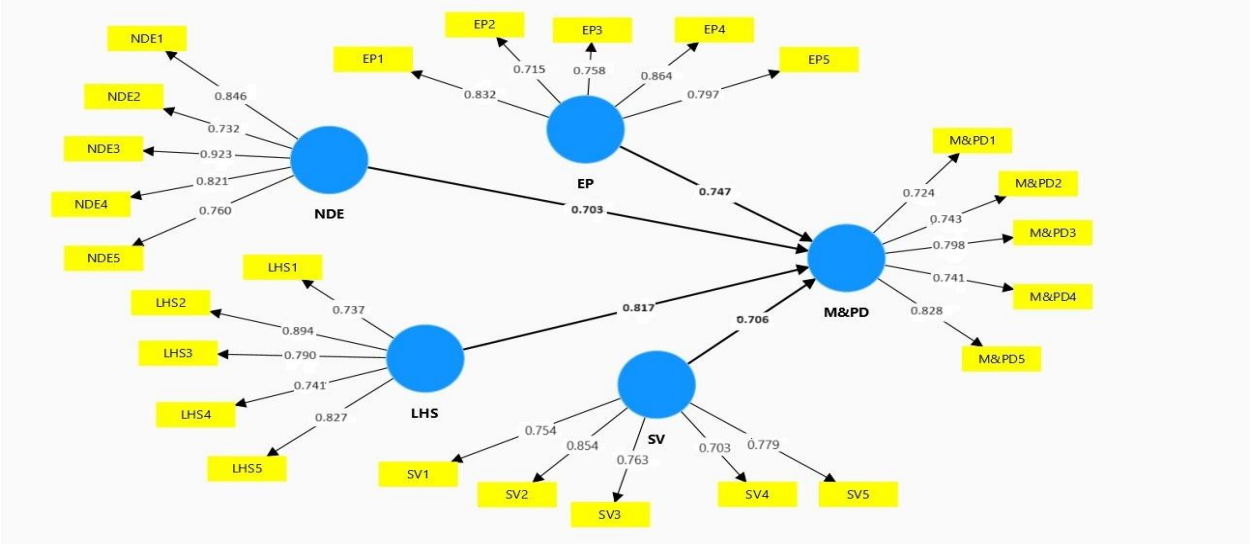

Fig 5: Bootstrapped model

DISCUSSION

Mental and Physical Disabilities (M&PD): The construct of mental and physical disabilities (M&PD) encompasses factors related to the prevalence and impact of disabilities among coastal communities in Bangladesh. A positive relationship between vulnerability to climate-related disasters and mental and physical disabilities (M&PD) is hypothesised. The findings from the analysis support this hypothesis, indicating that increased vulnerability to climate-related disasters is associated with higher levels of mental and physical disabilities among coastal populations. This suggests that the adverse effects of climate change disproportionately affect individuals with disabilities, highlighting the need for targeted interventions to address their unique challenges.

Natural Disaster Exposure (NDE): Natural disaster exposure (NDE) represents the extent to which individuals and communities are exposed to climate-related hazards and events in coastal areas. A positive relationship between natural disaster exposure and mental and physical disabilities (M&PD) is hypothesised. The analysis confirms this hypothesis, revealing that higher levels of exposure to natural disasters correlate with increased rates of mental and physical disabilities among coastal residents. This underscores the importance of disaster preparedness and mitigation efforts to reduce the adverse impacts of climate-related events on vulnerable populations, including those with disabilities.

Livelihoods and Housing Stability (LHS): Livelihoods and housing stability (LHS) capture the socio-economic factors influencing the resilience of coastal communities in Bangladesh. A positive relationship between livelihoods and housing stability and mental and physical disabilities (M&PD) is hypothesised. The findings provide support for this hypothesis, indicating that greater stability in livelihoods and housing is associated with lower levels of mental and physical disabilities among coastal inhabitants. This suggests that socio-economic empowerment and access to secure housing can contribute to reducing the vulnerability of communities to climate-related risks and their associated health impacts.

Social Vulnerability (SV): Social vulnerability (SV) refers to the susceptibility of individuals and communities to the adverse effects of climate change due to social factors such as poverty, inequality, and lack of access to resources. A positive relationship between social vulnerability and mental and physical disabilities (M&PD) is hypothesised. The analysis confirms this hypothesis, demonstrating that higher levels of social vulnerability are associated with increased rates of mental and physical disabilities among coastal populations. This underscores the need for targeted interventions to address the underlying social determinants of health and enhance the resilience of vulnerable communities to climate-related risks.

Environmental Pollution (EP): Environmental pollution (EP) encompasses factors related to the degradation of natural resources and ecosystems in coastal areas due to human activities. A positive relationship between environmental pollution and mental and physical disabilities (M&PD) is hypothesised. The findings provide support for this hypothesis, indicating that higher levels of environmental pollution are associated with increased rates of mental and physical disabilities among coastal residents. This highlights the interconnectedness between environmental degradation and human health outcomes, emphasising the importance of sustainable development and environmental conservation efforts in mitigating the impacts of climate change on vulnerable populations.

Community Insights on Disability and Climate Resilience

Apart from the quantitative data analysis, there were some specific questions arisen and collected the answers from the respondents. These are as follows;

Question 1: How do climate-related disasters affect your daily life and routine as a person with disabilities?

Respondents highlighted that climate-related disasters severely disrupt their daily lives, with many experiencing heightened physical and mental stress. Frequent floods, cyclones, and tidal surges often isolate them from essential services and community support, exacerbating their vulnerabilities. They reported difficulties in accessing safe shelters, healthcare, and mobility aids during disasters. Many also mentioned a lack of tailored emergency response strategies that consider their specific needs, leading to a sense of neglect and heightened risk during such events. This underscores the importance of inclusive disaster risk reduction strategies that cater to the unique challenges faced by individuals with disabilities.

Question 2: What support systems or community initiatives have you found helpful or lacking in addressing the impacts of climate change?

Many respondents appreciated community-based initiatives that offer direct support, such as local NGOs providing mobility aids, emergency kits, and accessible information on disaster preparedness. However, a significant number pointed out the insufficiency of these efforts, stressing the need for more robust and consistent support systems. They indicated that governmental and institutional support often falls short, with a lack of long-term planning and resources. Respondents emphasized the importance of inclusive policies and stronger collaboration between government bodies, NGOs, and community groups to create effective support networks that can withstand the challenges posed by climate change.

Question 3: Can you describe any specific barriers you face in accessing emergency services during a disaster?

Respondents frequently mentioned physical barriers, such as inaccessible evacuation routes and shelters not equipped to accommodate their needs. Communication barriers also surfaced, with emergency information often not being provided in accessible formats (e.g., sign language, Braille). Additionally, social barriers, such as stigma and discrimination, hinder their ability to seek and receive help. Many felt that their specific needs were not prioritized in disaster planning and response, leading to increased vulnerability. These insights highlight the necessity for inclusive infrastructure and communication strategies in disaster management plans.

Question 4: How has your community's perception and treatment of individuals with disabilities influenced your experience during climate-related disasters?

The respondents indicated a mixed experience regarding community perception. Some reported positive changes, with increased awareness and support from neighbours and local leaders during disasters. However, many still face significant social stigma and discrimination, which exacerbates their challenges. Negative perceptions often lead to exclusion from community decision-making processes, resulting in inadequate consideration of their needs in disaster preparedness and response. This points to the crucial role of community education and awareness programs in fostering an inclusive environment where the needs of individuals with disabilities are recognized and addressed.

Recommendations

Policy Interventions: It is recommended that policymakers in Bangladesh prioritise the implementation of inclusive policies aimed at reducing vulnerability to climate-related disasters among coastal communities. These policies should integrate measures to address mental and physical disabilities (M&PD) and enhance access to support services for affected individuals.

Community-based Initiatives: Community-based initiatives should be established to promote awareness and resilience-building activities focused on addressing the needs of individuals with mental and physical disabilities (M&PD) in coastal areas. These initiatives can include capacity-building workshops, emergency preparedness training, and the establishment of support networks within local communities.

Infrastructure Development: Efforts should be made to improve infrastructure accessibility in coastal regions, with a specific focus on ensuring that infrastructure is inclusive and accessible to individuals with disabilities. This can include the construction of accessible pathways, shelters, and evacuation routes, as well as the provision of assistive devices and technologies.

Collaborative Partnerships: Collaboration between government agencies, non-governmental organisations (NGOs), and community-based organisations is essential for the effective implementation of interventions targeting mental and physical disabilities (M&PD) in coastal areas. Partnerships should be formed to leverage resources, expertise, and networks to address the multifaceted challenges faced by vulnerable populations.

Research and Monitoring: Further research is needed to deepen understanding of the complex relationship between vulnerability to climate-related disasters and mental and physical disabilities (M&PD) in coastal Bangladesh. Longitudinal studies and qualitative research methods can provide insights into the lived experiences of individuals with disabilities and inform the development of targeted interventions. Additionally, monitoring and evaluation mechanisms should be established to track progress and assess the effectiveness of interventions over time.

CONCLUSION

In conclusion, this study sheds light on the significant challenges faced by individuals with mental and physical disabilities (M&PD) in coastal areas of Bangladesh, particularly in the context of climate-related disasters. Through the use of structural equation modelling (SEM) and partial least squares structural equation modelling (PLS-SEM), the study has provided valuable insights into the structural relationships between various factors affecting the vulnerability of individuals with disabilities to environmental hazards. The qualitative analysis shows Community Insights on Disability and Climate Resilience which defines it more elaborately.

The findings underscore the urgent need for targeted interventions and policy measures to address the unique needs and vulnerabilities of this population group. Efforts should be directed towards enhancing accessibility, promoting inclusive disaster risk reduction and climate change adaptation strategies, and strengthening support systems for individuals with disabilities in coastal communities.

Furthermore, the study highlights the importance of adopting a holistic and multi-dimensional approach to disability inclusion in disaster risk management and climate resilience efforts. This includes addressing socio-economic disparities, improving infrastructure and service provision, enhancing community awareness and participation, and promoting collaboration between government agencies, civil society organisations, and international partners.

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