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Prevalence of Depressive Symptoms and Associated Factors Among Older Adults in Coastal Bangladesh: A Community-Based Cross-Sectional Study

Md. Biplob Hossain[1] | Md. Imran Kayes[1] | Md. Monir Hossain Shimul[1,2,3] | Tamim Mahmud[4] | Ferdous Ara Joty[5] | Nayeem Hassan[1] | Foysal Ahmed[1] | Hafiz T. A. Khan[6,7] | Salamat Khandker[1] | A. B. M. Alauddin Chowdhury[1] | Md. Imdadul Haque[1,8]

[1]Department of Public Health, Daffodil International University, Dhaka, Bangladesh | [2]Department of Community Medicine and Public Health, Gonoshasthaya Samaj Vittik Medical College, Dhaka, Bangladesh | [3]Centre for Community Health and Research (CCHR), Gonoshasthaya Samaj Vittik Medical College, Dhaka, Bangladesh | [4]Department of Computer Science and Engineering, Daffodil International University, Dhaka, Bangladesh | [5]Department of Physiology, Delta Medical College, Dhaka, Bangladesh | [6]Public Heath Group, College of Nursing, Midwifery and Healthcare, University of West London, London, UK | [7]Oxford Institute of Population Ageing, University of Oxford, Oxford, UK | [8]Department of Family Medicine and Public Health, Spencer Fox Eccles School of Medicine, University of Utah, Salt Lake City, Utah, USA

Correspondence: Md. Monir Hossain Shimul (shimul2375@gmail.com)

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ABSTRACT

Background: Depressive symptoms in later life are a major public health concern among older adults globally, particularly in low- and middle-income countries with limited mental health services. In Bangladesh, the aging population faces socioeconomic disadvantage, chronic health conditions, and restricted healthcare access. Older adults in coastal regions are additionally exposed to environmental hazards such as cyclone, flooding, coastal erosion, salinity intrusion, or environmentally related displacement, which may increase psychological stress and vulnerability to depressive symptoms.

Methods: A community-based cross-sectional study was conducted from July 2025 to February 2026 in selected coastal districts of Bangladesh, including Bhola, Patuakhali, Cox's Bazar, and Chittagong. A total of 386 adults aged 60 years and above were selected through simple random sampling from household listings. Data were collected via structured face-to-face interviews using the 15-item Geriatric Depression Scale (GDS-15) and questionnaires on sociodemographic, lifestyle, health, and environmental factors. Descriptive statistics, chi-square tests, and multivariable logistic regression analyses were used to identify factors associated with depressive symptoms.

Results: Among 386 participants, 158 (40.9%; 95% CI: 36.1–45.9%) screened positive for depressive symptoms, including 98 (25.4%) with mild, 51 (13.2%) with moderate, and 9 (2.3%) with severe symptom severity. In adjusted analyses, physical weakness (AOR = 2.17; 95% CI: 1.33–3.55) and environmental stressor exposure (AOR = 2.30; 95% CI: 1.66–3.19) were associated with higher odds of depressive symptoms. Lack of involvement in daily activities (AOR = 1.65; 95% CI: 1.24–2.19), absence of regular exercise (AOR = 1.42; 95% CI: 1.09–1.86), unhealthy eating habits (AOR = 1.55; 95% CI: 1.16–2.07), and absence of recreational facilities (AOR = 1.46; 95% CI: 1.12–1.90) were also independently associated with higher odds. Vision/eye problems and hearing problems showed inverse associations in the revised analysis, whereas mobility problems and comorbidities were not statistically significant after adjustment.

Conclusions: Depressive symptoms are highly prevalent among elderly populations in coastal Bangladesh and are associated with social, health, and environmental vulnerabilities. The findings may support consideration of community-based mental health screening and integration of psychosocial support into services for older adults in climate-vulnerable communities. However, these implications should be regarded as hypotheses for service planning rather than direct evidence of intervention effectiveness. Prospective and intervention studies are needed to determine whether targeted screening, psychosocial support, or disaster preparedness interventions improve mental health outcomes.

1 | Introduction

Depression in later life is a major public health concern and one of the most disabling mental disorders worldwide [1]. Older adults frequently face physical, social, and psychological challenges that increase their vulnerability to depressive symptoms [2]. Evidence from Bangladesh and South Asia is particularly relevant because older adults in these settings may experience overlapping burdens of chronic illness, financial insecurity, limited social protection, and restricted access to mental healthcare. Previous Bangladeshi studies have reported substantial levels of depressive symptoms among older adults, although estimates vary according to population, setting, instrument, and sampling approach [3, 4].

The burden of late-life depression is particularly concerning in low- and middle-income countries (LMICs), where limited mental health services and socioeconomic disadvantages may increase vulnerability among older populations [5]. In Bangladesh, studies have reported a high prevalence of depression among older adults, ranging from approximately 45% to 52.5% across different settings [6, 7]. Previous research has identified several associated factors, including financial dependency, social isolation, chronic diseases, and inadequate social support [8–10].

Bangladesh is experiencing a demographic transition characterized by a rapidly growing elderly population. Individuals aged 60 years and above accounted for approximately 9.3% of the total population in 2022, and this proportion is expected to increase further in the coming decades [11]. As life expectancy rises, age-related health conditions, including depression, are expected to place an increasing burden on individuals, families, and healthcare systems [12]. Studies have demonstrated that sociodemographic characteristics, including age, marital status, education, and income, as well as chronic health conditions, are important factors associated with depression among older adults [13–18].

Beyond individual and health-related factors, environmental conditions may also influence mental health. Coastal regions of Bangladesh are highly vulnerable to climate-related hazards, including cyclones, flooding, salinity intrusion, and coastal erosion [19, 20]. Such exposures can disrupt livelihoods, housing, and social networks, generating persistent psychological stress among affected populations [21, 22]. Evidence from disaster-affected and hazard-prone settings suggests that older adults may be particularly vulnerable to environmental hazards because age-related mobility limitations, chronic illnesses, functional impairments, and dependence on family or community support can constrain their ability to evacuate, relocate, rebuild livelihoods, or access healthcare following hazardous events [23–25]. Environmental displacement may also disrupt established social networks and sources of informal support, whereas livelihood losses can increase economic dependency and psychological stress [26]. These vulnerabilities may be particularly relevant in coastal communities where repeated hazards can affect housing, income-generating activities, food and water security, and access to health services.

Climate-related adversity in coastal settings may operate through both acute and persistent pathways. Acute exposures include discrete events such as cyclones and floods, which may produce immediate displacement, injury, property loss, and disruption of services. In contrast, salinity intrusion, coastal erosion, livelihood deterioration, recurrent displacement, and prolonged resource insecurity may represent chronic or cumulative environmental stressors [22–24]. These pathways may have different temporal relationships with mental health and should therefore not be interpreted as equivalent forms of exposure.

Despite the substantial evidence on depressive symptoms among older adults in Bangladesh, evidence specifically addressing older adults living in climate-vulnerable coastal settings remains limited. Existing Bangladeshi studies have largely examined general rural, urban, or geographically localized older populations and have not consistently incorporated individual-level exposure to coastal hazards such as flooding, cyclones, erosion, salinity intrusion, and environmentally related displacement. Consequently, the extent to which environmental vulnerability is associated with depressive symptoms alongside sociodemographic and health-related factors remains insufficiently characterized.

A conceptual framework was developed a priori to guide covariate selection and distinguish potential confounders from explanatory variables. Sociodemographic characteristics were considered upstream determinants that may influence health conditions, socioeconomic circumstances, lifestyle, psychosocial stress, environmental exposure, and depressive symptoms. This framework was used to guide multivariable adjustment rather than selecting covariates solely according to statistical significance in bivariate analyses. Therefore, this study was conducted to address this gap by examining depression among older adults living in selected coastal districts of Bangladesh. Depression was assessed using the 15-item Geriatric Depression Scale (GDS-15), a widely used screening tool for identifying depressive symptoms among older adults [27, 28]. Depressive symptoms were defined as a GDS-15 score of ≥5.

The specific objectives of this study were (i) to estimate the prevalence and severity of depressive symptoms among older adults residing in coastal Bangladesh and (ii) to identify sociodemographic, economic, lifestyle, health-related, psychosocial, and environmental factors associated with depression. We hypothesized that socioeconomic disadvantage, chronic health conditions, lifestyle and psychosocial factors, and exposure to environmental stressors would each be associated with depressive symptoms among older adults. The analytical strategy

therefore considered these domains within a prespecified conceptual framework while adjusting for core sociodemographic characteristics considered potential confounders.

2 | Methodology

2.1 | Study Design and Settings

A community-based cross-sectional study was conducted from July 2025 to February 2026 to assess the prevalence of and factors associated with depressive symptoms among older adults living in coastal regions of Bangladesh.

2.2 | Study Area

The study was conducted in four selected coastal districts of Bangladesh: Bhola, Patuakhali, Cox's Bazar, and Chattogram (Figure 1). These districts were selected purposively to represent geographically diverse and climate-vulnerable coastal settings. The study areas are characterized by exposure to climate-related hazards, including cyclones, flooding, coastal erosion, and salinity intrusion, which may affect livelihoods, health, and psychological well-being.

The selected coastal areas include predominantly rural communities where access to specialized healthcare services may be limited. The study therefore focused on older adults residing in these settings, although recognizing that purposive selection of the four districts limits the generalizability of the findings to other coastal districts or the national older adult population.

2.3 | Sample Size Determination

The required sample size was calculated using the standard formula for estimating a single population proportion: $n = (Z^2 \times p \times q) / d^2$, where n represents the required sample size, Z is the standard normal deviate at a 95% confidence level (1.96), p is the estimated prevalence of depression among elderly individuals in Bangladesh (0.352) [29], $q = 1 - p$ (0.648), and d is the margin of error (0.05). The calculated minimum sample size was 351. An additional 10% was added to account for potential nonresponse or incomplete responses, resulting in a target sample size of 386 participants.

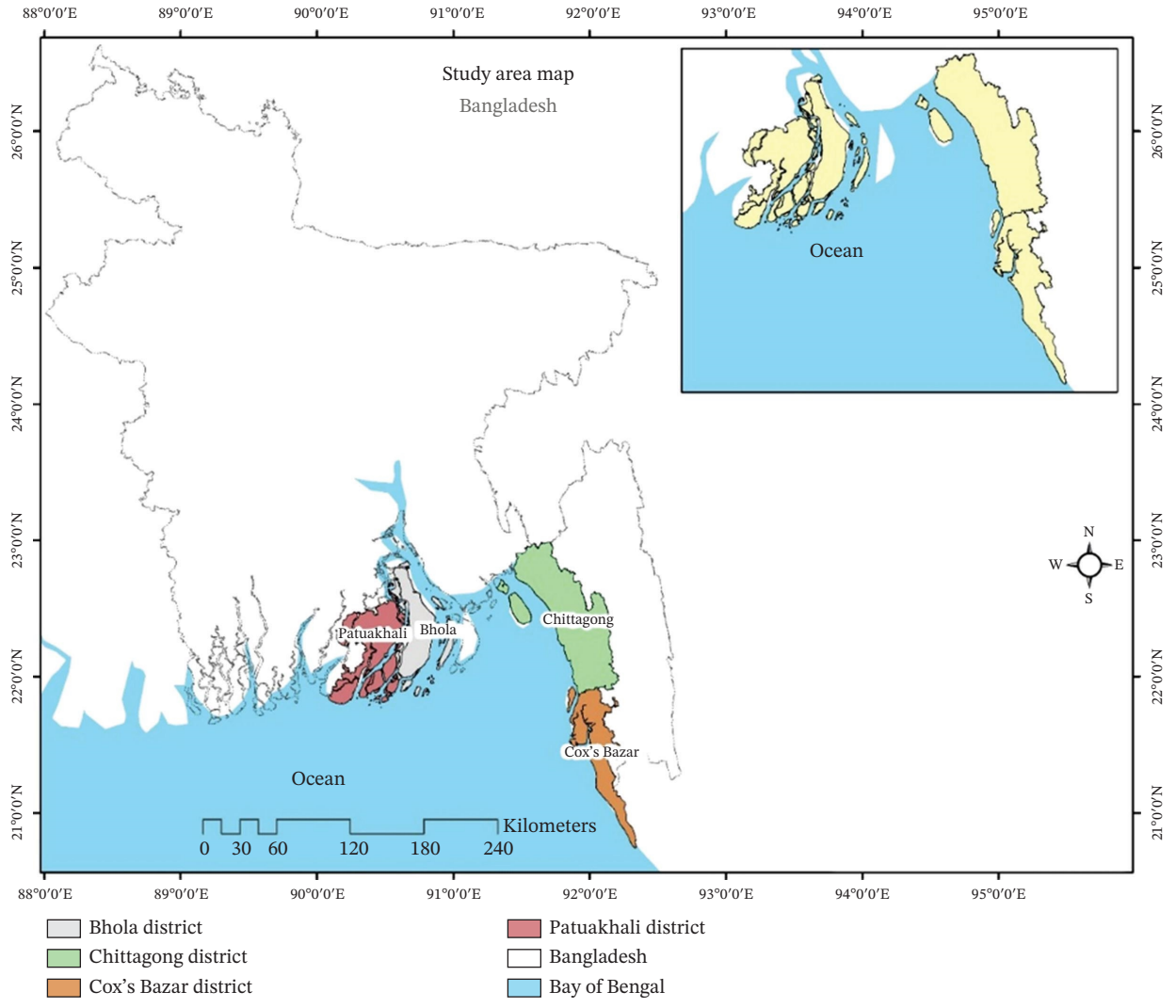

FIGURE 1 | Study area shown in Bangladesh map.

2.4 | Sampling Technique

A multistage sampling strategy was used. The four study districts were purposively selected, after which the required sample was allocated proportionally according to the estimated older adult population of each district. Within each selected district, eligible older adults were identified from available local sampling frames, and individuals were selected using computer-generated random numbers.

Household listings of eligible older adults were obtained from local Union Parishad records and community health worker registers within the selected districts. These records served as the district-specific sampling frames. No additional village- or ward-level sampling was undertaken. Each eligible individual in the sampling frame was assigned a unique identification number and selected through a computer-generated random number procedure.

The final sample comprised 96 participants from Bhola, 98 from Patuakhali, 94 from Cox's Bazar, and 98 from Chattogram.

2.5 | Eligibility Criteria and Participant Selection

Individuals were eligible if they were aged 60 years or older, had lived in the selected coastal area for at least 1 year, and were able to provide informed consent independently or with assistance from a caregiver.

Individuals were excluded if they were severely ill, resided in institutional care facilities, had severe cognitive impairment that prevented meaningful participation, or were unable to communicate in Bengali. Severe cognitive impairment was assessed pragmatically using caregiver information and the interviewer's observation of the participant's ability to understand and respond appropriately to the questionnaire. No standardized cognitive screening instrument was administered. More than one eligible older adult could be recruited from the same household.

During recruitment, 440 potentially eligible older adults were approached. Of these, 26 declined participation, 18 were excluded because they did not meet the predefined eligibility criteria, and 10 provided incomplete questionnaires. A total of 386 participants completed the interview and were included in the final analysis, corresponding to a response rate of 87.7% (386/440). The recruitment process is presented in Figure 2.

2.6 | Data Collection Instruments

A structured questionnaire was developed in English, adapted from previously used and validated instruments, and tailored to the Bangladeshi context (File S1). The questionnaire was translated from English into Bangla and subsequently back-translated into English to ensure linguistic accuracy and conceptual equivalence.

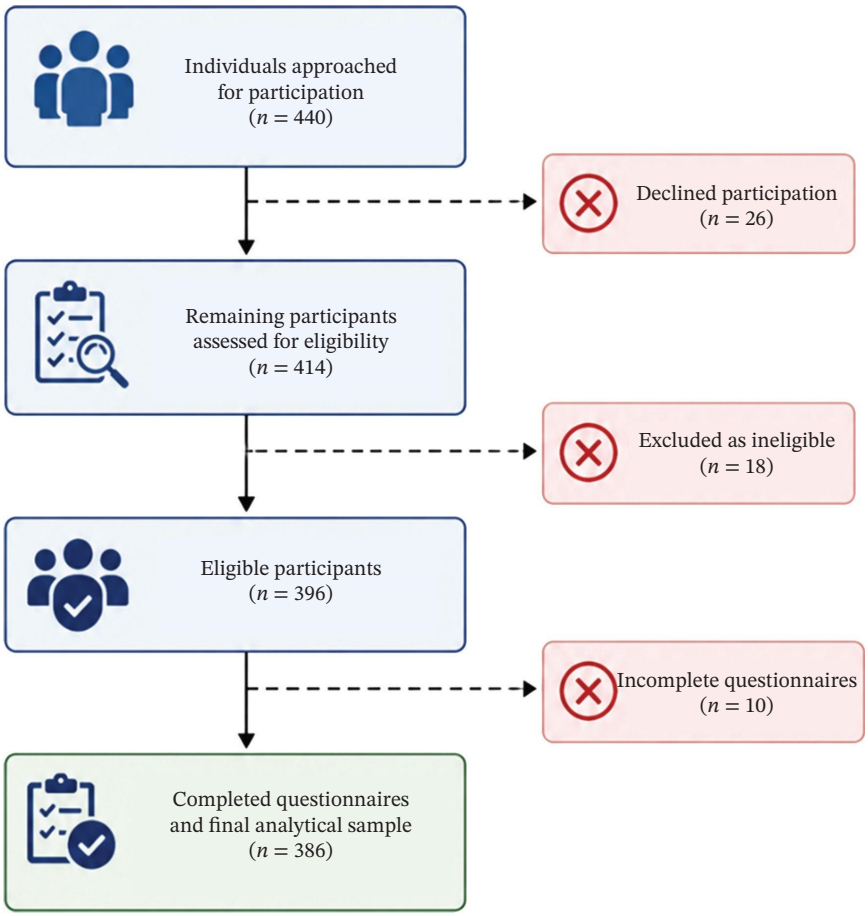

FIGURE 2 | Flow diagram of participant recruitment, eligibility assessment, and inclusion in the final analysis.

Before the main survey, the questionnaire was pilot-tested among 30 older adults in a nonsampled community with characteristics similar to those of the study population. The pilot was conducted to identify ambiguities and improve the clarity, cultural appropriateness, and logical flow of the instrument. Pilot participants were not included in the final analytical sample.

The Bangla version of the GDS-15 has demonstrated satisfactory internal consistency in previous Bangladeshi studies (Cronbach's $\alpha = 0.84$) [29]. In the present pilot study, the GDS-15 demonstrated good internal consistency (Cronbach's $\alpha = 0.82$).

2.7 | Study Variables

2.7.1 | Outcome Variable

The primary outcome was depressive symptoms, assessed using the GDS-15. Each item was scored according to the standard GDS-15 scoring algorithm. Items 1, 5, 7, 11, and 13 were reverse-coded, with "no" receiving 1 point and "yes" receiving 0 points. For the remaining items, yes received 1 point and no received 0 points. Item scores were summed to produce a total score ranging from 0 to 15, with higher scores indicating greater depressive symptom burden. A total score of ≥ 5 was classified as screening positive for depressive symptoms. Scores of 0–4, 5–8, 9–11, and 12–15 were categorized as below the screening threshold, mild, moderate, and severe depressive symptom–severity categories, respectively [27, 28]. For the regression analyses, the outcome was dichotomized as screening positive depressive symptoms versus below the screening threshold.

2.7.2 | Sociodemographic Variables

Sociodemographic variables included age, sex, marital status, educational attainment, occupation, family type, residence, current income, family income, and living arrangement.

2.7.3 | Lifestyle and Psychosocial Variables

Lifestyle variables included smoking history, smokeless tobacco use, physical exercise, sleep characteristics, use of sleeping pills, recreational or social activities, religious practices, and perceived stress. Regular exercise was defined as moderate-intensity physical activity, such as walking, cycling, or gardening, performed at least three times per week. Psychosocial variables included social support, perceived family bonding, satisfaction with children and lifestyle, financial solvency, exposure to abuse, and recent adverse life events. Financial solvency was defined as the participant's perceived ability to meet daily expenses without requiring external financial assistance.

2.7.4 | Health-Related Variables

Health-related variables included comorbid conditions, visual problems, hearing problems, mobility problems, and chronic illnesses that could influence mental health. Comorbidity was defined as the presence of at least one self-reported chronic health condition and was coded as a binary variable (yes/no).

2.7.5 | Environmental Exposure

Environmental exposure was defined as self-reported experience of at least one major environmental hazard during the preceding 12 months, including cyclone, flooding, coastal erosion, salinity intrusion, or environmentally related displacement. Participants reporting at least one such event were classified as environmentally exposed. The variable was coded dichotomously (1 = exposed; 0 = not exposed) for regression analyses. The questionnaire did not collect sufficiently detailed standardized information on the timing, severity, number of episodes, or material losses associated with individual environmental events to permit quantitative analysis of exposure intensity.

2.7.6 | Exploratory Variables

Sleep difficulty, concentration problems, hospital admission, medication use, oral health, and self-rated health were collected as exploratory measures but were not included in the primary regression models because they were not prespecified as core explanatory variables and/or were considered potentially downstream of health status or depressive symptoms. Their omission was intended to reduce potential overadjustment and model complexity. Daily life stress was assessed using a nonvalidated single-item measure. Because perceived stress and depressive symptoms were assessed concurrently and may share subjective affective content, their association may partly reflect common method or construct overlap rather than an independent etiological relationship.

2.8 | Data Collection Procedures

Field data collection was conducted from August to December 2025 through face-to-face interviews at participants' residences or designated community locations. Trained enumerators administered the structured questionnaire.

Enumerators received training on interview techniques, ethical considerations, confidentiality procedures, and appropriate administration of the survey instruments. Field supervisors regularly monitored the data collection process to ensure adherence to the study protocol and maintain data quality.

2.9 | Data Processing and Statistical Analysis

Completed questionnaires were checked for completeness, coded, and entered into the Statistical Package for the Social Sciences (SPSS Version 29.0; IBM Corp., Armonk, New York, United States). Missing data were assessed for each study variable before analysis. For analyses in which missing information was present, complete-case analysis was used; therefore, participants with missing information in the outcome or covariates required for a particular model were excluded from that model.

Descriptive statistics, including frequencies, percentages, means, standard deviations, and ranges, were used to summarize participant characteristics and estimate the prevalence of depressive symptoms. Associations between depressive symptoms and categorical explanatory variables were initially examined using chi-square tests. Pearson's chi-square test was used when expected cell counts met conventional assumptions. For sparse cells, Fisher's exact test or exact/Monte Carlo tests were used as appropriate. Expected cell counts were examined before interpreting categorical associations.

Potential confounders were selected based on the study objectives, prior literature, and an a priori conceptual framework, rather than solely on statistical significance in bivariate analyses. Core sociodemographic characteristics, including age and sex, were considered a priori, together with other theoretically relevant variables where appropriate. Bivariate analyses were therefore used descriptively and were not used as the sole basis for confounder selection. No automated forward selection, backward elimination, or stepwise procedure was applied.

Two domain-specific multivariable logistic regression models were conducted to examine associations with screening positive depressive symptoms. The first model included health-related and environmental factors, whereas the second included lifestyle and psychosocial factors. District was included as a fixed-effect covariate to account for potential geographical confounding across the four selected districts. District-level cluster-robust variance estimation was not used because only four districts were included.

Crude odds ratios (CORs) and adjusted odds ratios (AORs) with 95% confidence intervals (CIs) were reported. Odds ratios were interpreted as measures of association and not as risk ratios or prevalence ratios.

Multicollinearity was assessed using variance inflation factors (VIFs). VIF values ranged from 1.2 to 3.4, with a maximum VIF of 3.4, indicating no evidence of problematic multicollinearity. The goodness-of-fit of the final logistic regression model was assessed using the Hosmer–Lemeshow test. The final model showed adequate fit (Hosmer–Lemeshow $\chi^2 = 7.4$, $df = 8$, $p = 0.493$), with a model χ^2 of 38.6 and Nagelkerke pseudo-R^2 of 0.16. The regression analysis included 158 participants with screening positive depressive symptoms and 228 participants below the screening threshold. Additional model-level diagnostic information is provided in Table S1. Because the prevalence of screening positive depressive symptoms was relatively high, modified Poisson regression with robust variance estimation was additionally conducted as a sensitivity analysis to estimate adjusted prevalence ratios (APRs). The direction and magnitude of the APR estimates were compared with those obtained from the primary logistic regression models.

3 | Results

3.1 | Prevalence and Severity of Depressive Symptoms

Table 1 presents the distribution of depressive symptom severity categories assessed using the GDS-15. Among the 386 participants, 158 (40.9%; 95% CI: 36.1–45.9%) screened positive for depressive symptoms (GDS-15 score ≥ 5), whereas 228 (59.1%; 95% CI: 54.1–63.9%) scored below the screening threshold. Among all participants, 98 (25.4%; 95% CI: 21.3–30.0%) had mild depressive symptom severity, 51 (13.2%; 95% CI: 10.2–17.0%) had moderate symptom severity, and 9 (2.3%; 95% CI: 1.2–4.4%) had severe symptom severity. These findings indicate that although most participants scored below the GDS-15 screening threshold, a substantial proportion had mild to moderate depressive symptom severity.

TABLE 1 | Distribution of GDS-15 depressive symptom severity categories among participants ($N = 386$).

GDS category	*n*	%	95% CI
Below screening threshold	228	59.1	54.1–63.9
Any depressive symptoms	158	40.9	36.1–45.9
Mild	98	25.4	21.3–30.0
Moderate	51	13.2	10.2–17.0
Severe	9	2.3	1.2–4.4

3.2 | Sociodemographic Characteristics Associated With Depressive Symptoms

Table 2 presents the association between sociodemographic characteristics and depressive symptoms. The mean age of participants was 65.61 years (SD: 11.23), with an observed range of 60–86 years. The prevalence of depressive symptoms was highest among participants aged 60–65 years (49.2%) and generally declined across the older age categories, ranging from 28.3% among those aged 66–70 years to 22.2% among those aged 76–80 years; 25.0% of participants aged ≥ 80 years screened positive. Age was significantly associated with depressive symptoms ($\chi^2 = 18.94$, $p = 0.001$).

Depressive symptoms were reported by 44.9% of males and 35.9% of females, although the difference was not statistically significant ($\chi^2 = 3.20$, $p = 0.073$). Educational status and occupation were not significantly associated with depressive symptoms ($p = 0.105$ and $p = 0.283$, respectively). Marital status was significantly associated with depressive symptoms ($\chi^2 = 19.76$, $p < 0.001$), with a higher prevalence among married participants (45.7%) than widowed participants (15.0%).

Living arrangement was not significantly associated with depressive symptoms ($\chi^2 = 2.73$, $p = 0.434$). Participants with a current source of income had a higher prevalence of depressive symptoms than those without a current income source (47.2% vs. 34.6%; $\chi^2 = 6.36$, p = 0.012). Similarly, depressive symptoms were more prevalent among participants reporting insufficient family income than among those reporting sufficient family income (48.6% vs. 32.0%; $\chi^2 = 10.84$, $p = 0.001$). Family type and house type were not significantly associated with depressive symptoms.

3.3 | Health-Related and Environmental Factors Associated With Depressive Symptoms

Table 3 presents crude and adjusted associations of demographic, health-related, and environmental factors with depressive

TABLE 2 | Association between sociodemographic characteristics and depressive symptoms among older adults ($N = 386$).

Variable	Category	Depressive symptoms		χ^2 value	*p*
		No, *n* (%)	Yes, *n* (%)		
Age	Mean age, years	65.61 ± 11.23 (range: 60–86)			
	60–65	124 (50.8)	120 (49.2)	18.94	0.001
	66–70	66 (71.7)	26 (28.3)		
	71–75	18 (75.0)	6 (25.0)		
	76–80	14 (77.8)	4 (22.2)		
	80+	6 (75.0)	2 (25.0)		
Sex	Male	119 (55.1)	97 (44.9)	3.20	0.073
	Female	109 (64.1)	61 (35.9)		
Educational status	Illiterate	145 (59.7)	98 (40.3)	7.66	0.105
	Primary	56 (59.6)	38 (40.4)		
	SSC	8 (40.0)	12 (60.0)		
	HSC	15 (78.9)	4 (21.1)		
	Bachelor and above	4 (40.0)	6 (60.0)		
Occupation	Job	9 (64.3)	5 (35.7)	6.25	0.283
	Business	14 (40.0)	21 (60.0)		
	Housewife	100 (62.1)	61 (37.9)		
	Day labor	20 (62.5)	12 (37.5)		
	Fisher man	56 (58.3)	40 (41.7)		
	Farmer	29 (60.4)	19 (39.6)		
Marital status	Married	177 (54.3)	149 (45.7)	19.76	< 0.001
	Widow	51 (85.0)	9 (15.0)		
Living arrangement	Alone	5 (55.6)	4 (44.4)	2.73	0.434
	With family (all together)	177 (61.5)	111 (38.5)		
	With spouse only	27 (51.9)	25 (48.1)		
	With children only	19 (51.4)	18 (48.6)		
Current income	No	125 (65.4)	66 (34.6)	6.36	0.012
	Yes	103 (52.8)	92 (47.2)		
Enough family income	No	107 (51.4)	101 (48.6)	10.84	0.001
	Yes	121 (68.0)	57 (32.0)		

(Continues)

TABLE 2 | (CONTINUED)

Variable	Category	Depressive symptoms		χ^2 value	*p*
		No, *n* (%)	Yes, *n* (%)		
Family type	Single	131 (62.4)	79 (37.6)	2.09	0.148
	Joint	97 (55.1)	79 (44.9)		
House type	Kancha	163 (58.2)	117 (41.8)	0.95	0.621
	Pacca	24 (66.7)	12 (33.3)		
	Kancha-Pacca	41 (58.6)	29 (41.4)		

Note: Percentages are row percentages representing the prevalence of depressive symptoms within each category. Mean age is presented descriptively and was not included in the categorical χ^2 test. For variables with sparse cells, exact or Monte Carlo *p* values were used instead of the Pearson chi-square approximation where appropriate.

TABLE 3 | Crude and adjusted associations of demographic, health-related, and environmental factors with depressive symptoms among older adults ($N = 386$).

Variable	Category	*n* (%)	Depressive symptoms, *n* (%)	Crude OR (95% CI)	*p*	Adjusted OR (95% CI)	*p*
Age, years	Per 1-year increase	386 (100.0)	158 (40.9)	0.97 (0.94–0.99)	0.002	1.01 (0.99–1.03)	0.176
Comorbidities	Yes	270 (69.9)	109 (40.4)	0.92 (0.59–1.45)	0.723	0.91 (0.69–1.19)	0.496
	No	116 (30.1)	49 (42.2)	Ref.	—	Ref.	—
Vision/eye problem	Yes	170 (44.0)	40 (23.5)	0.29 (0.18–0.46)	< 0.001	0.65 (0.46–0.92)	0.014
	No	216 (56.0)	118 (54.6)	Ref.	—	Ref.	—
Mobility problem	Yes	195 (50.5)	54 (27.7)	0.36 (0.23–0.55)	< 0.001	0.84 (0.60–1.17)	0.301
	No	191 (49.5)	104 (54.5)	Ref.	—	Ref.	—
Hearing problem	Yes	117 (30.3)	24 (20.5)	0.29 (0.17–0.49)	< 0.001	0.62 (0.41–0.94)	0.025
	No	269 (69.7)	134 (49.8)	Ref.	—	Ref.	—
Physical weakness	Yes	151 (39.1)	76 (50.3)	1.89 (1.25–2.87)	0.003	2.17 (1.33–3.55)	0.002
	No	235 (60.9)	82 (34.9)	Ref.	—	Ref.	—
Environmental stressor	Yes	146 (37.8)	91 (62.3)	3.62 (2.33–5.61)	< 0.001	2.30 (1.66–3.19)	<0.001
	No	240 (62.2)	67 (27.9)	Ref.	—	Ref.	—

Note: Percentages in the "*n* (%)" column are percentages of the total sample. Percentages in the "Depressive symptoms, *n* (%)" column represent the prevalence of depressive symptoms within each category.
Abbreviations: OR, odds ratio; CI, confidence interval; Ref., reference category.

symptoms. In the crude analyses, age was inversely associated with depressive symptoms per 1-year increase (COR = 0.97; 95% CI: 0.94–0.99; $p = 0.002$), although this association was not statistically significant after adjustment (AOR = 1.01; 95% CI: 0.99–1.03; $p = 0.176$).

Physical weakness was positively associated with depressive symptoms in both crude and adjusted analyses. Participants reporting physical weakness had higher odds of depressive symptoms than those without weakness (COR = 1.89; 95% CI: 1.25–2.87; $p = 0.003$; AOR = 2.17; 95% CI: 1.33–3.55; $p = 0.002$). Environmental stressor exposure showed the strongest health/environmental association, with exposed participants having substantially higher odds of depressive symptoms in both crude and adjusted analyses (COR = 3.62; 95% CI: 2.33–5.61; $p < 0.001$; AOR = 2.30; 95% CI: 1.66–3.19; $p < 0.001$).

Vision/eye problems were associated with lower odds of depressive symptoms in the revised analysis (COR = 0.29; 95% CI: 0.18–0.46; $p < 0.001$; AOR = 0.65; 95% CI: 0.46–0.92; $p = 0.014$). Hearing problems were similarly associated with lower odds in the revised analysis (COR = 0.29; 95% CI: 0.17–0.49; $p < 0.001$; AOR = 0.62; 95% CI: 0.41–0.94; $p = 0.025$). Mobility problems were significantly associated with depressive symptoms in the crude analysis (COR = 0.36; 95% CI: 0.23–0.55; $p < 0.001$), but the association was attenuated and became nonsignificant after

adjustment (AOR = 0.84; 95% CI: 0.60–1.17; $p = 0.301$). Comorbidities were not significantly associated with depressive symptoms in either the crude or adjusted analysis (AOR = 0.91; 95% CI: 0.69–1.19; $p = 0.496$).

3.4 | Lifestyle and Psychosocial Factors Associated With Depressive Symptoms

Table 4 presents crude and adjusted associations of lifestyle and psychosocial factors with depressive symptoms. Lack of involvement in regular daily activities was associated with higher odds of depressive symptoms in both crude and adjusted analyses (COR = 2.31; 95% CI: 1.50–3.57; $p < 0.001$; AOR = 1.65; 95% CI: 1.24–2.19; $p = 0.001$). Similarly, participants who did not engage in regular exercise had higher odds of depressive symptoms after adjustment (AOR = 1.42; 95% CI: 1.09–1.86; $p = 0.010$). Unhealthy eating habits were also independently associated with higher odds of depressive symptoms (AOR = 1.55; 95% CI: 1.16–2.07; $p = 0.003$).

The absence of recreational facilities was independently associated with higher odds of depressive symptoms (AOR = 1.46; 95% CI: 1.12–1.90; $p = 0.005$). In contrast, smoking history, smokeless tobacco use, regular religious practice, and use of sleeping pills were not statistically significant in the adjusted analyses (all $p > 0.05$). The association with regular religious practice approached but did not reach conventional statistical significance (AOR = 1.31; 95% CI: 0.99–1.73; $p = 0.055$).

Psychosocial stress demonstrated a particularly strong association with depression. Participants reporting stress in their daily lives had markedly higher odds of depressive symptoms (AOR = 2.18; CI: 1.63–2.92; $p < 0.001$).

4 | Discussion

In the present study, 40.9% of older adults screened positive for depressive symptoms on the GDS-15. This estimate should be interpreted in relation to previous studies among older adults in Bangladesh, which have reported varying prevalence estimates according to study setting, sampling strategy, measurement procedures, and study period. A repeated cross-sectional study of older Bangladeshi adults during the COVID-19 pandemic also demonstrated substantial depressive symptom burden and identified several sociodemographic and health-related correlates, highlighting the heterogeneity of depression estimates across populations and contexts [4]. The present estimate therefore reflects the burden observed in the selected coastal communities and should not be interpreted as a nationally representative

TABLE 4 | Crude and adjusted associations of lifestyle and psychosocial factors with depressive symptoms among older adults ($N = 386$).

Variable	Category	*n* (%)	Depressive symptoms, *n* (%)	Crude OR (95% CI)	*p*	Adjusted OR (95% CI)	*p*
Involved in daily activities	No	135 (35.0)	75 (55.6)	2.31 (1.50–3.57)	< 0.001	1.65 (1.24–2.19)	0.001
	Yes	251 (65.0)	83 (33.1)	Ref.	—	Ref.	—
History of smoking	Yes	124 (32.1)	45 (36.3)	0.77 (0.49–1.21)	0.254	0.94 (0.69–1.28)	0.695
	No	262 (67.9)	113 (43.1)	Ref.	—	Ref.	—
History of smokeless tobacco use	Yes	101 (26.2)	37 (36.6)	0.78 (0.48–1.27)	0.321	0.91 (0.64–1.29)	0.596
	No	285 (73.8)	121 (42.5)	Ref.	—	Ref.	—
Regular exercise	No	203 (52.6)	97 (47.8)	1.73 (1.13–2.65)	0.011	1.42 (1.09–1.86)	0.010
	Yes	183 (47.4)	61 (33.3)	Ref.	—	Ref.	—
Healthy eating habits	No	180 (46.6)	90 (50.0)	1.95 (1.28–2.97)	0.002	1.55 (1.16–2.07)	0.003
	Yes	206 (53.4)	68 (33.0)	Ref.	—	Ref.	—
Regular practice of religion	No	113 (29.3)	58 (51.3)	1.76 (1.12–2.76)	0.014	1.31 (0.99–1.73)	0.055
	Yes	273 (70.7)	100 (36.6)	Ref.	—	Ref.	—
Taking sleeping pills	Yes	68 (17.6)	35 (51.5)	1.56 (0.91–2.65)	0.103	1.28 (0.95–1.73)	0.111
	No	318 (82.4)	123 (38.7)	Ref.	—	Ref.	—
Having recreational facilities	No	191 (49.5)	93 (47.7)	1.83 (1.20–2.79)	0.005	1.46 (1.12–1.90)	0.005
	Yes	195 (50.5)	65 (33.3)	Ref.	—	Ref.	—
Any stresses in your daily life	Yes	173 (37.9)	106 (61.3)	3.61 (2.27–5.75)	< 0.001	2.18 (1.63–2.92)	<0.001
	No	213 (62.1)	52 (30.1)	Ref.	—	Ref.	—

Note: Percentages in the "*n* (%)" column are percentages of the total sample. Percentages in the "Depressive symptoms, *n* (%)" column represent the prevalence of depressive symptoms within each category.

Abbreviations: OR, odds ratio; CI, confidence interval; Ref., reference category.

prevalence. More broadly, depression in later life remains an important public health concern, particularly among populations experiencing chronic disease, functional limitations, socioeconomic disadvantage, and restricted access to healthcare [1, 3]. The findings of the present study are consistent with a multidimensional understanding of depressive symptoms in older age, in which physical health, lifestyle, psychosocial circumstances, and environmental context may all be relevant.

4.1 | Health-Related Factors

Several health-related characteristics were associated with depressive symptoms. Comorbidity was associated with depressive symptoms in the observed analyses, consistent with extensive evidence that depression and chronic physical diseases frequently coexist. The relationship may be bidirectional: Chronic illness can impose functional, social, and psychological burdens, whereas depressive symptoms may adversely affect health behaviors, treatment adherence, and management of physical conditions [17, 18]. However, in the adjusted analysis, the association of comorbidity was not necessarily equivalent to that of individual functional impairments, suggesting that the relationship between overall disease burden and depressive symptoms may be influenced by the specific nature and functional consequences of health conditions.

Physical weakness remained positively associated with depressive symptoms after adjustment. Physical weakness may restrict mobility, independence, participation in daily activities, and social engagement, potentially contributing to poorer psychological well-being. Conversely, depressive symptoms may reduce energy, motivation, and perceived physical capacity, making reverse causality plausible. Thus, the observed association should be interpreted as an epidemiological relationship rather than evidence that physical weakness causes depressive symptoms.

Vision and hearing problems showed inverse associations in the revised analysis. These findings should be interpreted cautiously because they may reflect differences in healthcare access, adaptation to sensory impairment, reporting patterns, social support, or residual confounding rather than a protective effect of sensory impairment. Previous research among older adults in Bangladesh has demonstrated considerable variation in health status and living arrangements, emphasizing the importance of social and contextual factors in interpreting functional health indicators [30]. The unexpected direction of these associations warrants confirmation in larger studies using standardized clinical assessments of sensory function.

4.2 | Lifestyle Factors

Lifestyle characteristics also showed important associations with depressive symptoms. Lack of involvement in daily activities, absence of regular exercise, unhealthy eating habits, and lack of recreational facilities were associated with higher odds of depressive symptoms. Engagement in daily activities and regular physical activity may facilitate mobility, social interaction, independence, and a sense of purpose, all of which may be relevant to psychological well-being. However, these relationships are potentially bidirectional. Depressive symptoms may themselves reduce motivation, energy, appetite, physical activity, and participation in recreational or social activities. Accordingly, the present cross-sectional findings cannot establish whether these lifestyle characteristics preceded depressive symptoms or were partly consequences of them.

The observed association with dietary behavior is also consistent with the broader literature linking dietary patterns and mental health, although dietary quality was assessed relatively broadly in the present study and should not be interpreted as evidence for a specific nutritional pathway. Similarly, sleep-related variables were collected in the study but were not included in the primary regression models. This is relevant because sleep disturbance and insomnia frequently coexist with depressive symptoms, whereas their temporal relationship may be complex. Recent evidence from community mental health settings similarly highlights the substantial burden of insomnia among people with mental health conditions and the need for prospective assessment to clarify directionality [31].

4.3 | Psychosocial Stress

Psychosocial stress emerged as an important correlate of depressive symptoms. Older adults may experience psychological strain related to financial insecurity, changing family roles, social isolation, dependence on others, caregiving responsibilities, and concerns regarding their own health or that of family members. Such stressors may be particularly consequential in settings where formal social protection and specialized mental health services are limited.

The association with perceived stress should nevertheless be interpreted cautiously. In the present study, daily life stress was assessed using a nonvalidated single-item measure and was collected concurrently with depressive symptoms. Because both constructs involve subjective perceptions of emotional and psychological well-being, their association may partly reflect common method or construct overlap. The observed relationship therefore should not be interpreted as demonstrating an independent causal effect of stress on depressive symptoms.

Economic vulnerability was also relevant to the observed pattern of depressive symptoms. Previous evidence indicates that inadequate financial resources, economic dependency, and limited social protection are associated with poorer mental health in later life [10, 16, 32]. In coastal communities, financial insecurity may be particularly important because livelihoods may depend on agriculture, fishing, informal labor, and other activities that are sensitive to environmental disruptions. Nevertheless, the cross-sectional design prevents determination of whether economic hardship preceded depressive symptoms or was partly related to health and functional limitations.

4.4 | Environmental Exposure

Environmental exposure was substantially associated with depressive symptoms after adjustment. This finding is particularly relevant to coastal Bangladesh, where communities are exposed

to cyclones, flooding, salinity intrusion, coastal erosion, and other climate-related pressures [19, 20]. A large quantitative study conducted among coastal communities in Bangladesh found associations between sea-level-rise–related environmental stressors and mental health outcomes, providing context for the present findings [21]. Similarly, a systematic review of observational studies from South and Southeast Asia reported substantial mental health consequences associated with extreme weather events, including psychological distress and depressive symptoms [26].

Several pathways may plausibly link environmental adversity with poorer mental health. Recurrent hazards may disrupt livelihoods, damage homes and assets, contribute to displacement, weaken social stability, and create persistent uncertainty about future economic security. Previous research from disaster-affected communities in Bangladesh has also documented mental health concerns following cyclones and flooding [23, 24, 33, 34]. However, the environmental exposure variable in the present study was based on self-reported experience of at least one environmental event during the preceding 12 months and was analyzed dichotomously. Information on event severity, frequency, duration, material losses, displacement characteristics, and timing relative to depressive symptoms was not available. Therefore, the observed association should not be interpreted as evidence that environmental hazards cause or exacerbate depressive symptoms.

Older adults may be particularly vulnerable to environmental adversity because chronic health conditions, functional limitations, reduced mobility, and dependence on local social networks may constrain their ability to respond to environmental shocks. At the same time, older age may be accompanied by accumulated experience, coping strategies, and community connectedness that could contribute to resilience [25]. This apparent coexistence of vulnerability and resilience underscores the importance of avoiding assumptions that all older adults respond similarly to environmental adversity.

4.5 | Sociodemographic Factors

Age was associated with depressive symptoms in the bivariate analysis, but the pattern did not indicate a simple progressive increase with advancing age [6, 7, 12]. The highest prevalence was observed in the comparatively younger older age group, with lower prevalence across several older age groups. Moreover, age was not independently associated with depressive symptoms in the adjusted continuous-age model. This apparent inverse descriptive gradient should therefore be interpreted cautiously. Differences in social support, survival selection, adaptation, coping, health status, and other unmeasured contextual factors may contribute to such patterns, although these mechanisms were not directly assessed in the present study [2, 35].

Marital status and current income were also associated with depressive symptoms in bivariate analyses. These findings should not, however, be interpreted as independent associations without corresponding adjusted estimates. In later life, marital and family circumstances may influence social support, caregiving responsibilities, financial security, and emotional well-being. Previous research has linked widowhood and other marital transitions with depression among older adults, although the magnitude and direction of these relationships may vary according to gender, caregiving roles, marital quality, and social context [36, 37]. Therefore, the sociodemographic findings in the present study are best viewed as markers of broader social and economic circumstances rather than as demonstrated causal determinants.

4.6 | Reverse Causality and Interpretation of Associations

An important consideration in interpreting the regression findings is the possibility of reverse causality. Depressive symptoms may influence physical activity, participation in daily activities, dietary behavior, recreation, perceived physical functioning, and subjective assessments of stress and financial circumstances. Similarly, physical illness and functional limitation may contribute to depressive symptoms, whereas depressive symptoms may simultaneously influence perceptions and reporting of health status. Evidence on the relationship between depression and physical disease supports the possibility of bidirectional associations rather than simple one-way pathways [17]. These considerations are particularly important because the present study used a cross-sectional design and assessed the outcome and explanatory variables during the same period.

The findings should therefore be interpreted as identifying factors associated with depressive symptoms rather than establishing independent causal determinants. Prospective studies with repeated assessment of depressive symptoms, health and functional status, psychosocial conditions, and environmental exposure are needed to clarify temporal ordering and distinguish antecedent factors from consequences of depressive symptoms.

4.7 | Clinical and Public Health Implications

The findings may have implications for community-based mental health services for older adults living in climate-vulnerable settings. Community screening may help identify older adults who require further assessment, but a positive GDS-15 screen should not be equated with a psychiatric diagnosis. The GDS-15 is a screening instrument rather than a substitute for diagnostic assessment; previous validation research has demonstrated its usefulness for identifying depressive disorders in older populations [28]. Older adults with severe, persistent, or treatment-resistant depression require appropriate clinical assessment and evidence-based management rather than screening alone. Contemporary evidence also supports coordinated psychiatric, psychotherapeutic, and nursing approaches for complex depressive disorders [38, 39].

Accordingly, the present findings may support consideration of integrating mental health screening and psychosocial support into community and primary care services for older adults in climate-vulnerable communities. These implications should be regarded as considerations for service planning rather than direct evidence that screening, psychosocial support, or disaster preparedness interventions improve mental health outcomes.

Prospective and intervention studies are required to determine whether targeted approaches are effective and sustainable in coastal communities.

4.8 | Limitations

Several limitations should be considered when interpreting the findings. First, the cross-sectional design precludes establishing temporal or causal relationships between the identified factors and depressive symptoms. The purposive selection of four coastal districts limits representativeness and prevents direct generalization to all older adults living in coastal Bangladesh. The sampling frames were based on available local registers and may not have captured every eligible older adult in the selected communities. Nonparticipation and exclusion of severely ill, institutionalized, or severely cognitively impaired individuals may also have influenced the observed prevalence and associations.

Second, depressive symptoms were assessed using the GDS-15 rather than a formal psychiatric diagnostic assessment. Consequently, the reported prevalence represents screening positive depressive symptoms rather than clinically confirmed depressive disorders. Although the GDS-15 is a validated screening instrument, its results should not be interpreted as diagnostic confirmation. In addition, severe cognitive impairment was assessed pragmatically using caregiver information and interviewer observation rather than a standardized cognitive screening instrument, creating potential for misclassification.

Third, several explanatory variables, including physical weakness, lifestyle behaviors, psychosocial stress, and environmental exposure, were self-reported or assessed using nonvalidated measures. In particular, the single-item assessment of daily life stress may have introduced common method bias because perceived stress and depressive symptoms were assessed concurrently. The environmental exposure measure also did not capture event intensity, frequency, duration, material losses, or precise temporal proximity to depressive symptoms. These limitations may have contributed to residual measurement error and confounding.

Finally, residual confounding from unmeasured sociocultural, family, clinical, and contextual factors cannot be excluded. The study was conducted exclusively in selected climate-vulnerable coastal districts, where environmental and socioeconomic conditions may differ substantially from those in other parts of Bangladesh. The findings should therefore be interpreted as describing associations within the sampled populations rather than as nationally representative estimates.

5 | Conclusion

In this community-based cross-sectional study of older adults in selected coastal districts of Bangladesh, 40.9% screened positive for depressive symptoms using the GDS-15. Depressive symptoms were associated with selected health-related, lifestyle, socioeconomic, and environmental characteristics, particularly physical weakness, limited daily activity, lack of regular exercise, unhealthy eating habits, lack of recreational facilities, and environmental stressor exposure. These findings indicate a substantial burden of depressive symptoms in the sampled coastal populations but should not be interpreted as causal relationships or as representative of all older adults in coastal Bangladesh. Longitudinal research using validated and preferably objective measures of environmental exposure, repeated assessment of depressive symptoms, and standardized measures of psychosocial and functional factors is needed to establish temporal pathways and determine whether environmental adversity precedes changes in mental health.

Author Contributions

Md. Biplob Hossain: Conceptualization, formal analysis, investigation, methodology, writing—original draft, and writing—review and editing. Md. Imran Kayes: Data curation, formal analysis, and writing—review and editing. Md. Monir Hossain Shimul: Methodology, formal analysis, validation, visualization, writing—original draft, and writing—review and editing. Tamim Mahmud: Formal analysis and writing—review and editing. Ferdous Ara Joty: Data curation, formal analysis, and writing—review and editing. Nayeem Hassan: Data curation and writing—review and editing. Foysal Ahmed: Data curation and writing—review and editing. Hafiz T. A. Khan: Supervision and writing—review and editing. Salamat Khandker: Supervision, validation, and writing—review and editing. ABM Alauddin Chowdhury: Supervision and writing—review and editing. Md. Imdadul Haque: Supervision, validation, writing—original draft, and writing—review and editing.

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Ethics Statement

The study protocol was reviewed and approved by the Faculty of Health and Life Sciences, Research Ethics Committee, Daffodil International University (Ethical Clearance Number: FHLSREC/DIU/2025/SMIG-53). Ethical approval encompassed all aspects of participant recruitment, informed consent, and data protection.

Consent

Prior to data collection, participants were informed about the study objectives, voluntary nature of participation, and confidentiality measures. Written informed consent was obtained from all participants. For illiterate individuals, consent was obtained through a thumb impression in the presence of a literate witness. Anonymity was strictly maintained by assigning unique codes instead of personal identifiers. Sensitive responses were handled confidentially, and referral information for mental health support services was provided to participants who screened positive for severe depression. The study adhered to the ethical principles of the Declaration of Helsinki and ensured no coercion or exploitation of vulnerable groups. No experiments on humans and/or the use of human tissue samples were done in this study. The authors have nothing to report.

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The data supporting the conclusions of this article are included within the article.

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Supporting Information

Additional supporting information can be found online in the Supporting Information section. **Supporting Information 1**. File S1: Study questionnaire, including the informed consent form and sections on sociodemographic characteristics, lifestyle factors, health status and health-related factors, and depressive symptoms. **Supporting Information 2**. Table S1: Overall model diagnostics showed a sample of 386 older adults, including 158 with depressive symptoms. The logistic regression model was statistically significant ($\chi^2 = 38.6$, $p = 0.019$), with an AOR of 1.94 (95% CI: 1.12–3.37). The model demonstrated a Nagelkerke pseudo-R^2 of 0.16 and good fit according to the Hosmer–Lemeshow test ($\chi^2 = 7.4$, $df = 8$, $p = 0.493$). Multicollinearity was low, with VIFs ranging from 1.2 to 3.4 (maximum VIF = 3.4).