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Aging Medicine

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ORIGINAL ARTICLE OPEN ACCESS

Prevalence and Correlates of Geriatric Depression: A Community-Based Cross-Sectional Study in Bangladesh

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Received: 9 October 2025 | **Revised:** 15 October 2025 | **Accepted:** 7 February 2026

Keywords: Bangladesh | geriatric depression | mental health | older adults

ABSTRACT

Objectives: This study aimed to estimate the prevalence of geriatric depression and identify its associated socio-demographic, lifestyle, health, and psychosocial determinants among community-dwelling older adults in Bangladesh.

Methods: A community-based cross-sectional study was conducted between April and December 2024 among 719 adults aged ≥ 60 years, selected by multistage random sampling across four administrative divisions. Data were collected using interviewer-administered questionnaires. Depression was assessed using the GDS-15 (cut-off ≥ 5). Logistic regression models were applied to identify determinants, and adjusted odds ratios (AORs) with 95% confidence intervals (CIs) were reported.

Results: The prevalence of geriatric depression was 35.2%. Poor family bonding (AOR = 6.580, 95% CI = 3.540–12.210, $p < 0.001$), financial instability (AOR = 3.660, 95% CI = 2.550–5.260, $p < 0.001$), dissatisfaction with lifestyle (AOR = 3.590, 95% CI = 2.240–5.770, $p < 0.001$), and daily life stress (AOR = 3.640, 95% CI = 2.560–5.190, $p < 0.001$) were significant predictors. Comorbidities, lack of regular exercise, mobility, and hearing problems also increased depression risk.

Conclusion: Geriatric depression is common in Bangladesh and influenced by multidimensional determinants. Integrating geriatric mental health services into primary care and strengthening family and social support systems are essential for prevention and early management.

1 | Introduction

By 2030, the global population aged 60 and above will account for one in six individuals, increasing from 1 billion in 2020 to 1.4 billion. Furthermore, this age group is projected to double by 2050. Additionally, the population aged 80 and above is expected to triple, reaching 426 million, during the period from 2020 to 2050 [1]. Geriatric depression presents a significant global health challenge, with prevalence rates varying across different regions. Depression affects about 280 million people worldwide. An estimated 3.8% of people suffer from depression, including 5.7% of individuals over 60 [1, 2]. Globally, depression affects approximately 5.7% of individuals aged 60 years and older [2–5], but the burden is notably higher in South Asia, including India and Bangladesh, where community-based studies report rates between 20% and 37% [6, 7].

The World Health Organization (WHO) states that inheritance, chronic illness and disability, pain, dissatisfaction over limitations in activities of daily living (ADL), personality types (dependent, anxious, or avoidant), unfavorable life events (separation, divorce, bereavement, poverty, social isolation), and inadequate social support are among the factors that increase the risk of depression in older adults [8]. The WHO risk framework has been locally validated through previous Bangladeshi studies employing the Bangla-translated GDS-15 scale, confirming its reliability and cultural relevance [8, 9]. However, Previous research conducted in many countries has revealed a variety of risk factors for depressive symptoms in older adults, these factors include being female [9, 10] being older [11], being widowed, separated, or divorced [12], and having a lower level of education [13]. Additionally, visual impairment [14], functional limitations [15], diabetes, heart diseases, stroke and comorbid physical illness [16] were associated with greater risk of depression. Even while geriatric depression is becoming more widely acknowledged as a serious public health issue worldwide [17].

Despite this growing burden, research on geriatric depression in Bangladesh remains scarce. The country's fast-aging population as of 2023, with over 16 million people in Bangladesh aged 60 or older, represents 9.5% of the population. This proportion is projected to increase to 21.9% by 2050, and with 36 million people aged 60 and above [18], combined with its unique socio-cultural and economic challenges, has created a complex environment where older adults are at heightened risk of mental health issues.

However, the extent and determinants of geriatric depression in Bangladesh have not been thoroughly explored. Without a clear understanding of the factors contributing to depression in this population, public health policies and interventions may be ineffective or misdirected, leaving a vulnerable population without adequate support. Failing to address these determinants may result in ineffective mental health interventions, inadequate healthcare services, and missed opportunities to improve the quality of life for this population.

This study aims to provide the most comprehensive assessment to date of the prevalence and determinants of geriatric depression in Bangladesh. Specifically, it seeks to answer the question: What socio-demographic, lifestyle, health, and psychosocial factors are associated with depression among community-dwelling older adults in Bangladesh? The inclusion of these factors was pre-specified, informed by established frameworks and previous regional literature, rather than post hoc selection.

2 | Methodology

2.1 | Study Design and Settings

A community-based cross-sectional design was employed to estimate the prevalence of geriatric depression and identify its determinants among older adults in Bangladesh. Data were collected between April and December 2024 through structured, interviewer-administered questionnaires in both urban and rural communities to capture variation across geographic, cultural, and socioeconomic contexts.

2.2 | Study Area and Population

The study population consisted of community-dwelling older adults aged ≥60 years, the conventional threshold for geriatric age in South Asia. To ensure representativeness, four administrative divisions—Barishal, Chattogram, Dhaka, and Mymensingh—were purposively selected, each contributing one city corporation (urban) and one district (rural). Within these sites, wards and upazilas were randomly chosen as primary sampling units (Figure S1). Eligible participants were recruited regardless of living arrangements, including those residing with families and those living alone.

2.3 | Sample Size and Sampling Technique

The sample size for this study was calculated using the standard formula: $= \frac{Z^2 * p * q}{d^2}$; where $Z = 1.96$ for 95% confidence, $p = 0.369$ (expected prevalence), $q = 1 - p$, and $d = 0.0362$ (margin of error). This yielded 684 participants, which was increased by 5% for non-response, resulting in a target of 719.

Participants were selected through multistage random sampling. Sample allocation to each division was proportional to its elderly population size as per the 2022 BBS Demographic Yearbook to ensure representativeness. From each division, one city corporation and one district were chosen, followed by two wards and two upazilas, respectively. Households with at least one eligible older adult were listed, and one individual per household was randomly recruited. Approximately 45 participants were drawn from each cluster using systematic randomization (every alternate eligible household) to minimize bias (Figure S2).

2.4 | Inclusion and Exclusion Criteria

Eligible participants were men and women aged 60 years or older, residing in the selected areas, and willing to provide informed consent. Exclusion criteria included individuals with severe cognitive impairment, advanced dementia, profound hearing or speech disabilities that precluded reliable communication, or those too ill to participate in an interview.

2.5 | Data Collection Tools

A structured questionnaire was developed in Bangla, adapted from previous validated tools and tailored to the Bangladeshi context (File S1). It covered socio-demographic, lifestyle, health, and psychosocial domains, alongside the Geriatric Depression Scale (GDS-15). The instrument was translated and back-translated between English and Bangla to ensure linguistic accuracy. The Bangla version of the GDS-15 has demonstrated satisfactory reliability in prior studies (Cronbach's $\alpha = 0.82$) [17]. In the present pilot, Cronbach's $\alpha = 0.84$ confirmed internal consistency. A pilot test was conducted on 30 older adults in a non-sampled area, and necessary

modifications were made to improve clarity, cultural appropriateness, and flow. The pilot data were not included in the final analysis.

2.6 | Study Variables

The primary outcome of interest was geriatric depression, assessed using the 15-item Geriatric Depression Scale (GDS-15). This instrument, widely validated in community and clinical settings, requires binary ("yes/no") responses and yields a score ranging from 0 to 15. In this study, depression severity was classified as normal (0–4), mild (5–8), moderate (9–11), and severe (12–15). A threshold score of ≥ 5 was operationalized to indicate probable depression.

Explanatory variables were conceptualized into four domains. Socio-demographic factors included age, sex, marital status, educational attainment, occupation, family type (nuclear or extended), residence (urban or rural), and living arrangements (with family members or alone). Lifestyle characteristics captured behavioral and daily activity patterns, such as smoking history, engagement in physical exercise, duration and quality of sleep, use of sleeping pills, participation in recreational or social activities, religious practices, and perceived stress levels. For the purpose of this study, regular exercise was defined as moderate-intensity activity (e.g., walking, cycling, or gardening) performed at least three times per week.

Health-related variables focused on the presence of comorbid conditions (self-reported diagnoses), functional impairments (visual, hearing, or locomotor disabilities), and chronic illnesses that could influence mental health. Finally, psychosocial determinants encompassed the availability of social support, perceived strength of family bonding, satisfaction with children and lifestyle, financial solvency, exposure to abuse, and recent adverse life events. Here, financial solvency was operationally defined as the individual's perceived ability to meet daily expenses without requiring external financial assistance.

2.7 | Data Collection and Quality Control

Enumerators with prior survey experience conducted face-to-face interviews after receiving intensive training on research ethics, interviewing techniques, and sensitive mental health discussions. Daily supervision, spot checks, and random re-interviews of 10% of participants ensured data accuracy. Questionnaires were checked daily for completeness and internal consistency. Enumerators were rotated across sites to minimize interviewer bias. Quality checks revealed $<2\%$ discrepancies in re-interviews, which were promptly corrected before data entry.

2.8 | Data Analysis

Data were double-entered, validated, and analyzed in SPSS version 22. Descriptive statistics summarized participant characteristics and prevalence estimates. Associations between depression and covariates were first assessed using Chi-square tests. Logistic regression was applied in two stages: bivariate models to calculate crude odds ratios and multivariate models to identify independent predictors, adjusting for confounders. Adjusted odds ratios (AORs) with 95% confidence intervals (CIs) were reported. Model adequacy was evaluated using the Hosmer–Lemeshow goodness-of-fit test, and statistical significance was set at $p < 0.05$.

2.9 | Ethical Clearance

The study protocol was reviewed and approved by the Research Ethics Committee (REC) of the Faculty of Health and Life Sciences, Daffodil International University (Approval number: FHLSREC/DIU/2024/SMIG-06) (File S2). Ethical approval encompassed all aspects of participant recruitment, informed consent, and data protection.

2.10 | Human Ethics and Consent to Participate

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 (English version of consent form is attached as File S3). 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.

3 | Results

Table 1 shows that participants' mean age (± SD) was 65.9 ± 4.9 years, and the majority (84.2%) were aged 60–70 years and age was found to be associated ($p < 0.001$) with geriatric depression. About 76.1% are male and 88.5% are married and among the participants, 40.7% are illiterate. Among the participants, 56.9% were living with all family together and living status was associated ($p < 0.001$) with geriatric depression. 60.2% of participants had 3–4 children and the number of children was found associated ($p < 0.001$) with geriatric depression.

Figure 1 presents the distribution of participants based on their levels of geriatric depression. Among the participants, the majority, comprising 64.8%, indicate no geriatric depression. Additionally, 18.1% of participants report mild depression, while 10.3% indicate moderate depression. Furthermore, 6.8% of participants report experiencing severe depression.

Table 2 presents the significant associations between various lifestyle factors and the odds of depression among geriatrics. Not being involved in daily activities is associated with 1.48 times higher odds of depression (95% CI: 0.97–2.26, $p = 0.070$). A history of substance abuse increases the odds by 2.99 times (95% CI: 1.220–7.310, $p = 0.001$), and lack of regular exercise is linked

TABLE 1 | Association between geriatrics depression and their socio-demographic factors.

Variable and categories	Geriatric depression		χ^2 value	*p*
	No	Yes		
	n (%)	*n* (%)		
Age				
60–70	408 (56.7)	198 (27.5)	12.17	< 0.001
70–80	54 (7.5)	54 (7.5)		
80+	4 (0.6)	1 (0.1)		
Mean ± SD	65.9 ± 4.9			
Residence				
Urban	232 (32.2)	128 (17.8)	0.04	0.830
Rural	234 (32.5)	125 (17.4)		
Sex				
Men	358 (49.8)	189 (26.3)	0.40	0.520
Women	108 (15.0)	64 (8.9)		
Marital status				
Married	416 (57.9)	220 (30.6)	1.25	0.530
Unmarried	3 (0.4)	1 (0.1)		
Widow	47 (6.5)	32 (4.5)		
Education qualification				
Illiterate	177 (24.6)	116 (16.1)	6.28	0.170
Primary School	122 (17.0)	54 (7.5)		
High School	57 (7.9)	30 (4.2)		
College	81 (11.3)	44 (6.1)		
Graduation	29 (4.0)	9 (1.3)		
Currently living status				
Alone	13 (1.8)	14 (1.9)	12.30	< 0.001
All together	286 (39.8)	123 (17.1)		
Only with spouse	119 (16.6)	85 (11.8)		
Only with children	48 (6.7)	31 (4.3)		
Number of children				
< 2	80 (11.1)	67 (9.3)	20.51	< 0.001
3–4	309 (43.0)	124 (17.2)		
4+	77 (10.7)	62 (8.6)		

to 3.11 times higher odds (95% CI: 1.280–7.590, $p = 0.002$). Not having a hobby shows an AOR of 1.19 (95% CI: 0.890–2.010, $p < 0.001$). Regular practice of religion is associated with

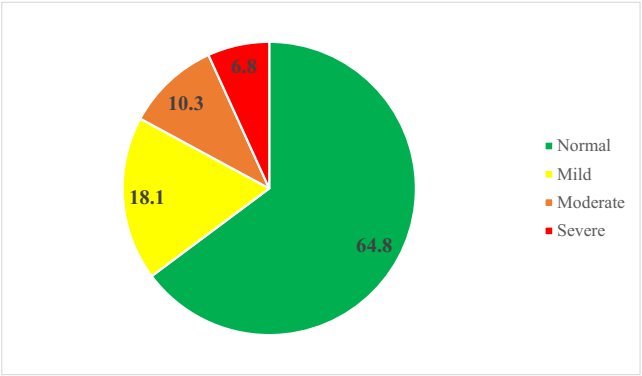

FIGURE 1 | Prevalence of geriatric depression among the participants.

lower odds of depression (AOR: 0.52, 95% CI: 0.370–0.740, $p < 0.001$). Additionally, experiencing daily life stress significantly increases the odds of depression by 3.64 times (95% CI: 2.560–5.190, $p < 0.001$).

Table 3 shows significant associations between certain health factors and the odds of depression among geriatrics. The presence of co-morbidities is linked to 3.53 times higher odds of depression (95% CI: 2.430–5.120, $p < 0.001$). Individuals with hearing problems have 1.78 times higher odds of depression (95% CI: 1.100–2.870, $p = 0.001$). Mobility problems are associated with 2.11 times higher odds of depression (95% CI: 1.450–3.070, $p < 0.001$).

Table 4 presents that participants who reported dissatisfaction with their children were found to have a 1.43 times higher risk of geriatric depression (AOR 1.43, 95% CI: 1.010–2.020). Furthermore, participants who reported experiencing poor family bonding were found to be at a significantly increased risk, with a 6.58-fold higher likelihood of geriatric depression (AOR 6.58, 95% CI: 3.540–12.210). Similarly, participants who expressed dissatisfaction with their lifestyle exhibited a 3.59-fold increased risk of geriatric depression (AOR 3.59, 95% CI: 2.240–5.770). Additionally, participants who reported financial instability were found to have a 3.66 times higher risk of geriatric depression (AOR 3.66, 95% CI: 2.550–5.260).

4 | Discussion

Geriatric depression represents a major public health challenge linked to the global demographic transition toward aging populations. While international studies demonstrate variability in late-life depression across different cultural and socioeconomic contexts [19, 20], the present findings underscore the urgent need for Bangladesh-specific strategies addressing psychosocial and economic vulnerabilities among older adults. In Bangladesh, previous investigations have consistently reported high levels of depressive symptoms among the elderly, both in rural and urban settings [21]. The findings of this study reinforce that geriatric depression in Bangladesh is not an isolated occurrence but part of a broader mental health burden driven by rapid demographic change, shifting family structures, and limited mental health resources.

TABLE 2 | Association between geriatric depression and their lifestyle factor.

	Unadjusted model			Adjusted model		
Variables	**Crude odds ratio (COR)**	**95% confidence interval (CI)**	***p***	**Adjusted odds ratio (AOR)**	**95% confidence interval (CI)**	***p***
Involved in daily activities						
No	1.37	0.890–2.110	0.01	1.48	0.970–2.260	< 0.001
Yes		Ref.				
History of smoking						
Yes	1.35	0.930–1.970	0.11	—	—	—
No		Ref.				
History of substance abuse						
Yes	3.07	1.250–7.480	0.01	2.99	1.220–7.310	0.001
No		Ref.				
Regular exercise						
No	2.98	1.200–7.280	0.01	3.11	1.280–7.590	0.002
Yes		Ref.				
Hobby						
No	0.83	0.420–0.940	0.02	1.19	0.890–2.010	< 0.001
Yes		Ref.				
Healthy eating habits						
No	0.87	0.590–1.290	0.15	—	—	—
Yes		Ref.				
Regular practice of religion						
No	0.47	0.320–0.680	< 0.01	0.52	0.370–0.740	< 0.001
Yes		Ref.				
Taking sleeping pills						
Yes	0.86	0.540–1.370	0.54	—	—	—
No		Ref.				
Having any entertainment facilities						
No	1.60	0.750–3.50	0.21	—	—	—
Yes		Ref.				
Participation in social work						
No	1.22	0.790–1.870	0.36	—	—	—
Yes		Ref.				
Any stresses in your daily life						
Yes	3.02	2.010–4.530	< 0.01	3.64	2.560–5.190	< 0.001
No		Ref.				

The study's objectives were to determine the prevalence of geriatric depression and to identify its associated factors, with the hypothesis that sociodemographic, lifestyle, health, and psychosocial determinants would play critical roles. The results strongly support this hypothesis. Age was found to be an important factor, with older participants exhibiting a higher likelihood of depressive symptoms. This aligns with earlier studies that have linked advancing age to heightened vulnerability due to accumulated health problems, bereavement, and increasing social isolation [22]. The cultural context of Bangladesh, where multigenerational living is common, adds complexity to this relationship. While living with family can offer emotional

TABLE 3 | Association between geriatric depression and their health factor.

Variables	Unadjusted model			Adjusted model		
	Crude odds ratio (COR)	95% confidence interval (CI)	*p*	Adjusted odds ratio (AOR)	95% confidence interval (CI)	*p*
Co-morbidities						
Yes	3.07	2.100–4.510	< 0.001	3.53	2.430–5.120	< 0.001
No		Ref.				
Vision/eye problems						
Yes	1.76	0.540–1.080	0.130	—	—	—
No		Ref.				
Hearing problems						
Yes	2.04	1.250–3.340	< 0.001	1.78	1.100–2.870	0.001
No		Ref.				
Mobility problems						
Yes	1.65	1.120–2.430	0.001	2.11	1.450–3.070	< 0.001
No		Ref.				

support and protection, the present findings indicate that living arrangements may also interact with other stressors, sometimes exacerbating feelings of dependency or neglect. Prior research has emphasized the protective role of family support in reducing depression [23], and large-scale surveys in African and Asian contexts have similarly highlighted how family dynamics influence elderly well-being [24].

Family size and quality of family relationships emerged as additional important correlates. In this study, approximately 22.1% of participants reported poor family bonding, which corresponded to a 6.58-fold increase in depression risk. Dissatisfaction with children or strained familial relationships heightened the risk of depression, while positive family support appeared protective. These results mirror findings from earlier studies that highlight the significance of family harmony, intergenerational support, and parental satisfaction in safeguarding mental health in later life [25–29]. The role of family thus remains double-edged: when nurturing, it buffers against depressive symptoms, but when conflicted, it can be a potent stressor.

Lifestyle and behavioral factors were also closely linked to geriatric depression. Participants who reported dissatisfaction with their daily lifestyle or who lacked engagement in meaningful activities were more vulnerable to depressive symptoms. This is consistent with evidence from prior studies that show active involvement in daily routines, hobbies, and exercise is associated with improved psychological outcomes [30–33]. Regular physical activity, in particular, has repeatedly been shown to exert protective effects against depression in later life [34]. Conversely, substance abuse, lack of hobbies, and absence of religious or spiritual practices were identified as risks. Studies from both Asian and Western contexts corroborate these findings, showing that hobbies, social engagement, and religiosity foster resilience, while substance use aggravates mental health problems [34–38].

Health-related and psychosocial stressors also played a central role. Older adults experiencing daily stress, multiple comorbidities, or functional limitations were significantly more likely to report depressive symptoms. This finding parallels studies in Turkey and India, where coexisting chronic illnesses and limitations in daily living activities were strongly linked with late-life depression [39, 40]. Sensory impairments such as hearing and vision loss further compounded this risk, echoing global evidence that such deficits reduce communication, restrict social interaction, and contribute to loneliness [41, 42]. Similarly, mobility limitations were associated with depression, supporting earlier studies that emphasize the role of physical functioning in maintaining psychological well-being [22, 43]. These results confirm that the interplay of physical health and mental health is central to understanding depression among older adults.

Economic insecurity emerged as another important determinant. Participants who reported financial strain were substantially more vulnerable to depressive symptoms, a finding consistent with epidemiological evidence from high-income countries where persistent financial hardship has been linked to poorer mental health and functional decline [44]. Research across South Asia and other regions likewise emphasizes the impact of financial instability on elderly well-being, limiting access to healthcare, social participation, and overall quality of life [45, 46]. These findings highlight that addressing geriatric depression in Bangladesh requires attention not only to medical and psychosocial aspects but also to economic security and social protection policies.

The strong influence of family satisfaction, lifestyle engagement, comorbidities, sensory and mobility impairments, and financial insecurity points toward the multidimensional nature of geriatric depression. These determinants extend beyond the biomedical model, reinforcing the hypothesis that

TABLE 4 | Association between geriatrics depression and their psychosocial factor.

Variables	Unadjusted model			Adjusted model		
	Crude odds ratio (COR)	95% confidence interval (CI)	*p*	Adjusted odds ratio (AOR)	95% confidence interval (CI)	*p*
Social assistance in case of emergency						
No	0.34	0.240–0.470	< 0.001	—	—	—
Yes	Ref.					
Satisfied with children						
No	1.50	1.080–2.090	0.001	1.43	1.010–2.020	0.030
Yes	Ref.					
Family bonding						
Bad	5.34	3.160–9.030	< 0.001	6.58	3.540–12.210	< 0.001
Good	Ref.					
Satisfied with lifestyle						
No	3.24	2.130–4.940	< 0.001	3.59	2.240–5.770	< 0.001
Yes	Ref.					
Financial solvency						
No	3.31	2.380–4.600	< 0.001	3.66	2.550–5.260	< 0.001
Yes	Ref.					
Ever experienced abuse						
No	0.75	0.550–1.030	0.080	—	—	—
Yes	Ref.					
Recently faced any sad events in life						
No	0.81	0.600–1.110	0.200	—	—	—
Yes	Ref.					
Previous history of depression						
No	0.36	0.260–0.500	< 0.001	—	—	—
Yes	Ref.					

depression in older adults is rooted in complex interconnections of personal, familial, social, and structural factors. Comparative evidence from multiple countries demonstrates that while cultural contexts may differ, the underlying risk factors are remarkably consistent, supporting the consistency of these findings across sampled divisions, though not claiming national representativeness.

4.1 | Limitations and Strengths of the Study

The investigation aimed at ensuring variety in the sample, although there could be possible selection bias. It is also possible that self-reported data might create a recall or social desirability bias. Moreover, the cross-sectional design can only make limited causal implications, and its findings may not necessarily generalize to all other elderly populations of Bangladesh. Although the study achieved adequate statistical power due to its large sample size, the cross-sectional design precludes causal inference. Self-reported data may have introduced recall or social desirability bias. Nonetheless, the multidimensional framework and standardized measures enhance the reliability and comparability of results. The multidimensional approach looks at various sociodemographic, lifestyle, health, and psychosocial factors that provide a holistic view on what constitutes geriatric depression causes. The employment of standardized measurement tools also leads to congruence between data points and comparability across studies. Future studies could use longitudinal designs to assess causality, include larger randomized samples for better generalizability, and combine self-reported data with clinical evaluations to reduce bias.

5 | Conclusion

This study demonstrates that nearly one-third of the geriatric population in Bangladesh experiences depressive symptoms, reflecting a substantial and under-recognized public health

concern. Depression among older adults is not driven by any single dimension but rather by the interplay of socio-demographic vulnerabilities, lifestyle practices, health conditions, and psychosocial stressors.

Specifically, the findings highlight that limited financial stability, weak family cohesion, and dissatisfaction with lifestyle are among the strongest determinants of late-life depression. In contrast, engagement in regular physical activity, religious or social practices, and strong family relationships appear to serve as protective factors. These patterns reaffirm that personal and social domains are deeply intertwined in shaping mental well-being in old age.

The implications extend beyond epidemiological description. Addressing geriatric depression in Bangladesh requires integrating routine mental health screening into primary healthcare, training community health workers in geriatric mental health, and strengthening intergenerational family support systems. Policy interventions should also promote social participation, economic security, and accessible community-based rehabilitation for older adults.

These recommendations are consistent with the World Health Organization's Integrated Care for Older People (ICOPE) framework and align with the priorities of the Bangladesh National Mental Health Policy 2022, both emphasizing early detection, integrated service delivery, and age-inclusive social protection measures.

A deeper understanding of the complex determinants of geriatric depression, supported by coordinated policy and community-level initiatives, will be critical to improving psychological well-being, social integration, and quality of life among Bangladesh's rapidly aging population.

Author Contributions

Md. Biplob Hossain: conceptualization, formal analysis, investigation, methodology, writing – original draft, writing – review and editing. **Md. Imdadul Haque:** supervision, validation, writing – original draft, writing – review and editing. **Md. Monir Hossain Shimul:** methodology, validation, visualization, writing – original draft, writing – review and editing. **Rebeka Jesmin Sarker:** writing – original draft, writing – review and editing. **Syed Nazmus Sakib:** data curation, writing – review and editing. **Ajahar Islam Hridoy:** data curation, writing – review and editing. **Kausar Ahammed Nishat:** data curation, writing – review and editing. **Foysal Ahmed:** data curation, formal analysis. **Mohammed Nadir Bin Ali:** validation, writing – review and editing. **Hafiz T. A. Khan:** supervision, writing – review and editing. **Salim Khan:** supervision, writing – original draft, writing – review and editing. **ABM Alauddin Chowdhury:** supervision, writing – review and editing.

Acknowledgments

The authors would like to express their gratitude to all study participants for their valuable contributions, as well as to the research team for their dedication throughout the study.

Funding

This study did not receive any specific funding from public, commercial, or not-for-profit organizations. The research design, methods, participant recruitment, data collection, analysis, and preparation of the manuscript were conducted entirely by the authors without external influence.

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

All data generated or analyzed during this study are included in this published article and its Supporting Information files.

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Supporting Information

Additional supporting information can be found online in the Supporting Information section. **Appendix S1:** agm270065-sup-0001-AppendixS1.docx.