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Anxiety, depression, and their co-occurrence among menopausal women aged 30 to 49 years in Bangladesh: Evidence from the 2022 Bangladesh Demographic and Health Survey

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Abstract

Anxiety and depression are important contributors to women's mental health burden, and the menopausal transition may increase vulnerability to both conditions. Evidence on menopausal mental health in South Asia, especially in Bangladesh remains limited. Thereby, this study aimed to estimate the prevalence of anxiety, depression, and their co-occurrence among menopausal women aged 30-49 years in Bangladesh and to identify socio-demographic factors independently associated with these outcomes. Data were obtained from the nationally representative 2022 Bangladesh Demographic and Health Survey. The analysis included 2,182 menopausal women aged 30-49 years. Anxiety and depression were assessed using the GAD-7 (cutoff ≥6) and PHQ-9 (cutoff ≥10), respectively. Survey-weighted bivariate analyses and multivariable logistic regression were performed. Associations were reported as adjusted odds ratios (AORs) with 95% confidence intervals. The weighted prevalence of anxiety, depression, and co-occurring anxiety and depression was approximately 26%, 7%, and 6%, respectively. Being widowed, divorced, or separated was associated with higher odds of anxiety (AOR=1.63), depression (AOR=1.78), and co-occurrence (AOR=1.77). Anxiety was also associated with healthcare access problems (AOR=1.52) and household decision-making participation (AOR=1.57). Depression and co-occurrence were associated with administrative division and internet use, while depression was additionally associated with religion and age at first marriage. Anxiety was more prevalent than depression among menopausal women in Bangladesh. Marital dissolution was consistently associated with all three outcomes. These findings highlight the need to strengthen

mental health screening and support for menopausal women, particularly those experiencing marital loss or barriers to healthcare access.

Keywords: menopause; menopausal age; anxiety; depression; comorbidity; Bangladesh; Demographic and Health Survey

1 Introduction

Menopause is a major biological transition in women's reproductive life, characterized by the permanent cessation of menstruation following the loss of ovarian follicular activity. The menopausal transition and the years surrounding the final menstrual period are increasingly recognized as periods of vulnerability to common mental disorders, particularly anxiety and depression [1, 2]. Hormonal fluctuations during this period may influence mood regulation through changes in serotonergic, dopaminergic, and γ-aminobutyric acid (GABA)-ergic neurotransmission [2]. These interconnected biological and psychosocial changes make mental health an important component of women's health during and after the menopausal transition.

Mental health disorders constitute a major public health concern worldwide, with anxiety and depressive disorders among the most common conditions affecting populations across countries [3]. Globally, approximately one in seven people lives with a mental disorder, while anxiety and depressive disorders affect an estimated 4.4% and 5.7% of the population, respectively [3-5]. Women experience a disproportionate burden of these conditions, with anxiety and depressive symptoms reported at substantially

higher rates than among men [6]. In Bangladesh, recent national evidence suggests that anxiety symptoms affect approximately one in five ever-married women, whereas depressive symptoms have been reported in nearly 5% [7]. During menopause, these mental-health concerns may be further intensified by hormonal changes, vasomotor symptoms, sleep disturbances, and psychosocial stressors, potentially resulting in greater impairment in daily functioning and quality of life [2]. Anxiety and depression may also co-occur, with their combined presence potentially imposing a greater psychological and functional burden than either condition alone. Examining their co-occurrence is therefore important for understanding the broader mental-health needs of women during midlife.

Evidence from Bangladesh similarly indicates a considerable burden of menopausal symptoms and related psychological concerns, although much of the available evidence has been derived from localized, community-based, or clinical samples. In Kushtia, Rahman et al. documented frequent physical, sleep-related, and psychological menopausal symptoms among women aged 40-70 years, including depressive mood and anxiety, with several symptoms more prominent among peri- and postmenopausal women [8]. Other research among Bangladeshi women has reported greater depressive symptoms among postmenopausal than premenopausal women and associations between depression and symptoms such as fatigue and concentration difficulties [9]. A population-based study in Dhaka reported major depression among 30.4% of women aged 41-60 years; although menopausal status itself was not significantly associated with depression, depressive symptoms were more common among peri- and postmenopausal women than among premenopausal women [10].

More recent evidence from Dhaka has further shown that menopausal symptom severity increases across menopausal stages and that early post-menopause may be a particularly vulnerable period for impaired quality of life [11]. These findings highlight the importance of mental-health assessment during the menopausal period, while also demonstrating the limitations of the existing evidence base. In addition, broader national analyses of Bangladeshi women have identified important social determinants of anxiety and depression, including attitudes toward wife-beating and women's decision-making autonomy [12-14]. However, these studies have generally examined women of reproductive age as a broad population rather than specifically addressing women with survey-defined menopausal status.

The 2022 Bangladesh Demographic and Health Survey (2022 BDHS), the first national survey in Bangladesh to include the Generalized Anxiety Disorder-7 (GAD-7) and Patient Health Questionnaire-9 (PHQ-9), provides an important opportunity to examine these mental-health outcomes using nationally representative data [15]. Although previous analyses of the 2022 BDHS have documented the prevalence and correlates of anxiety and depression among women [7, 12, 16], evidence remains limited regarding their burden and co-occurrence among women with survey-defined menopausal status. Moreover, the sociodemographic, socioeconomic, reproductive, and autonomy-related factors associated with these outcomes in this population remain insufficiently understood. Addressing these gaps is important because identifying women who experience anxiety, depression, or both can support more targeted screening and integrated mental-health and menopausal care. Therefore, this study aimed to estimate the prevalence of anxiety, depression, and their co-occurrence and

identify their associated socio-demographic factors among women with survey-defined menopausal status in Bangladesh, using nationally representative data from the 2022 BDHS. The findings may inform the integration of mental-health screening and support into culturally appropriate, women-centered healthcare services during midlife.

2 Methods

2.1 Data source and sampling design

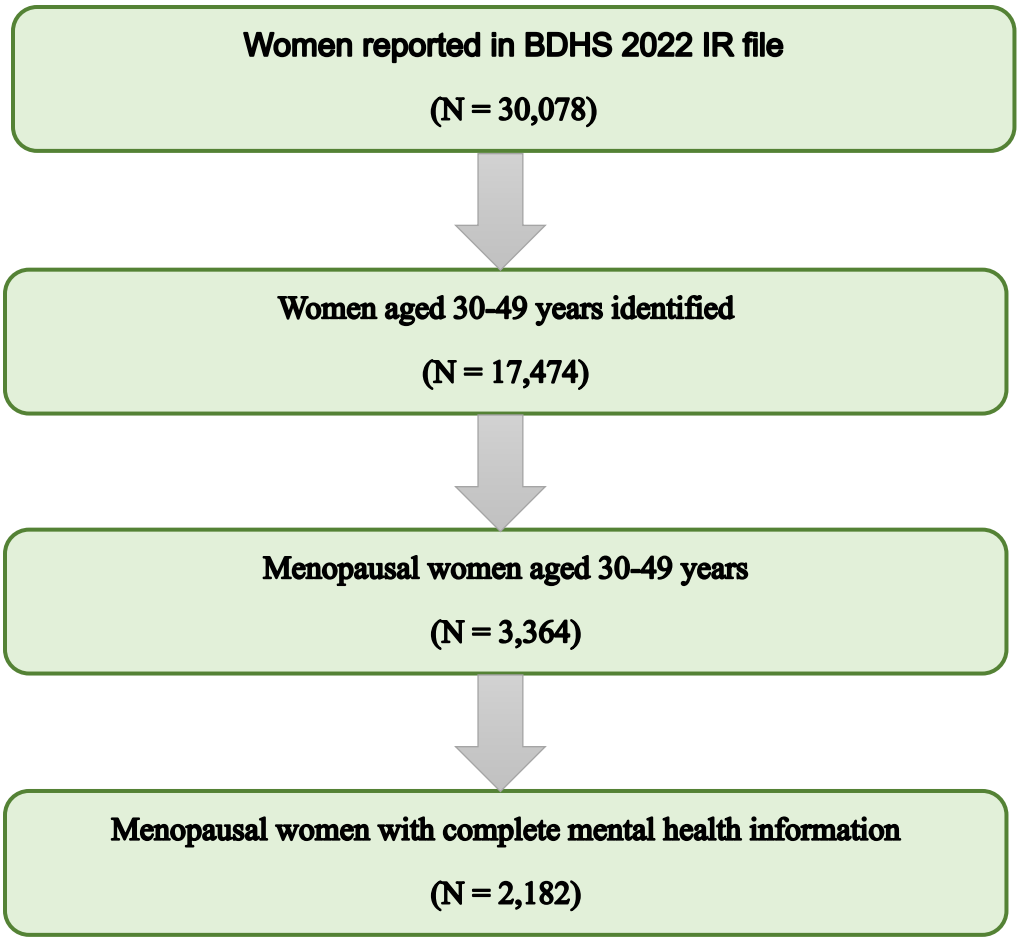
This analysis draws on the 2022 BDHS, a nationally representative, cross-sectional household survey conducted under the stewardship of the National Institute of Population Research and Training (NIPORT), a body operating within Bangladesh's Ministry of Health and Family Welfare. Fieldwork was implemented by Mitra and Associates (Dhaka), with technical and financial backing from the United States Agency for International Development (USAID). A two-stage, stratified cluster sampling approach was applied, with the sampling frame built from the 2011 Population and Housing Census maintained by the Bangladesh Bureau of Statistics. Strata were constructed by crossing Bangladesh's eight administrative divisions with urban and rural residence. At the first stage, 675 enumeration areas were drawn with probability proportional to size (238 urban and 437 rural clusters); at the second stage, 45 households were systematically selected within each enumeration area, of which 30 households received the survey's long-form questionnaire and the remaining 15 the short form. Across the 30,375 households sampled, complete interviews were achieved with 30,078 ever-married women aged 15-49 years, yielding a response rate of 99.1%.

A full account of the sampling procedure and fieldwork protocol is available in the official survey report [15].

2.2 Study population and analytic sample

The study included women aged 30–49 years, consistent with the age range used by the Bangladesh Demographic and Health Survey (BDHS) to assess reproductive and menopausal health among women in midlife. We used the BDHS operational definition of menopause rather than a clinical definition, to ensure consistency with the survey data and to permit nationally representative population-based analysis [15]. Accordingly, women who were not currently pregnant or experiencing postpartum amenorrhea were classified as menopausal based on their reported menstrual history. This included women whose last menstrual period occurred six or more months before the survey or before their last birth, women who had undergone hysterectomy, and women who reported being menopausal or having never menstruated. Women who were currently pregnant, experiencing postpartum amenorrhea, or did not meet the BDHS definition were excluded. The final analytic sample comprised 2,182 menopausal women aged 30-49 years (Fig 1).

Fig 1. Selection of study participants



2.3 Outcome variables: anxiety, depression, and their co-occurrence

Three related mental health outcomes were constructed for this study: symptoms of anxiety, symptoms of depression, and the co-occurrence of both. All three drew on two psychometric screening instruments that were fielded for the first time in the 2022 round of the BDHS.

2.3.1 Anxiety symptoms were captured with the seven-item Generalized Anxiety Disorder scale (GAD-7), which asks how often, over the two weeks before interview, a

woman experienced a set of symptoms spanning nervousness and edginess, uncontrollable or excessive worry, difficulty relaxing, restlessness, irritability, and a sense of impending dread. Each item was rated on a four-point frequency scale from "not at all" to "nearly every day," scored 0 to 3, and summed into a total ranging from 0 to 21; the seven items showed good internal consistency in this sample (Cronbach's α = 0.83). Consistent with the threshold applied in the official 2022 BDHS report, a summed score of six or higher was used to denote moderate-to-severe anxiety, producing a binary contrast between this group and women with no or only mild symptoms [15, 17].

2.3.2 Depressive symptoms were measured with the nine-item Patient Health Questionnaire (PHQ-9), which covers anhedonia, low mood, sleep and appetite disturbance, fatigue, feelings of worthlessness or guilt, poor concentration, psychomotor changes, and thoughts of self-harm over the same two-week reference period, again scored 0 to 3 per item. Summed scores ranged from 0 to 27 and showed strong internal consistency (Cronbach's α = 0.81). A summed score of ten or above was used to define probable depression, likewise dichotomized against lower scores [15, 18]. For both instruments, responses recorded as "don't know," "refused," or left blank were treated as missing and excluded from the relevant outcome calculation.

2.3.3 Co-occurring anxiety and depression: Menopausal women who met the both threshold for moderate-to-severe anxiety, and moderate-to-severe depression at the same time were classified as having co-occurring anxiety and depression.

2.4 Covariates

The choice of covariates was guided by prior evidence on the correlates of anxiety and depressive symptoms among Bangladeshi women [12-14, 16], and spanned four broad domains. Socio-demographic covariates included five-year age group, marital status (currently married versus widowed, divorced, or separated), religion, place of residence (urban or rural), and administrative division. Socioeconomic covariates comprised the respondent's own and her husband's educational attainment, her occupational category, household wealth quintile, exposure to mass media, and personal internet use. Reproductive covariates included age at first marriage, age at first birth, total number of children ever born, current contraceptive method, and any prior history of pregnancy termination. A final set of covariates captured women's autonomy, attitudes, and access to care: participation in household decision-making, whether the respondent personally justified wife-beating under any of the circumstances asked about in the survey, self-reported difficulty accessing healthcare, and the size of the spousal age gap. Together, these domains were intended to allow adjustment for the demographic, socioeconomic, reproductive, and sociocultural factors most plausibly related to both the menopausal transition and women's mental health in this setting. Details operational definitions are presented in Supplementary Table 1.

2.5 Statistical analysis

All analyses were weighted and accounted for the survey's stratified, multistage cluster design — including primary sampling units, strata, and sampling weights — using the 'svyset' command in Stata, so that reported estimates and their standard errors are

nationally representative. The analytic sample was first summarized descriptively. Design-adjusted chi-square tests were then used to examine bivariate associations between each covariate and each outcomes. At this exploratory stage, covariates associated with an outcome at $p < 0.25$, rather than the conventional $p < 0.05$, were carried forward into multivariable modeling, following the purposeful variable-selection approach recommended by Bursac et al. (2008) to reduce the chance of dropping variables that confound the association of interest [19]. Four multivariable logistic regression models — one for each outcome — were then fitted, yielding unadjusted (UORs) and adjusted odds ratios (AORs) with 95% confidence intervals (CIs), with statistical significance set at $p < 0.05$. The presence of multicollinearity among predictors was checked by examining the standard errors of the regression coefficients, all of which remained below 1.0 and therefore gave no indication of a collinearity problem [20].

Missing data were managed based on variable type and missingness mechanism across 2,182 observations. Outcome measures (GAD-7 anxiety and PHQ-9 depression) with missing values were excluded from their respective outcome analyses via listwise deletion. For explanatory covariates—such as husband's education, age at first birth, decision autonomy, justification of wife-beating, and spousal age gap—missingness ranged from 2% to 10%, primarily due to non-applicability or non-response among non-partnered women. Little's MCAR test was statistically significant ($\chi^2 = 748.37$, df $= 135$, $p < 0.001$), rejecting the Missing Completely at Random assumption and supporting a Missing at Random (MAR) mechanism. To prevent sample loss and selection bias, missing covariate values were imputed using Multiple Imputation by Chained Equations

(MICE) with fully conditional specification [21]. Ten imputed datasets were generated, incorporating all outcome variables, primary predictors, and socio-demographic factors into the imputation model. Sample characteristics were compared before ("actual data") and after imputation ("imputed data"), and multivariable regression models were fitted across the imputed datasets with parameter estimates pooled using Rubin's rules.

3 Results

3.1 Characteristics of the study population

The analysis included 2,182 menopausal women aged 30-49 years, more than half of the participants were aged 45-49 years (52.1%), while approximately two-thirds lived in rural areas (73.6%). Most participants were married (89.8%) and Muslim (90.3%). Regarding socioeconomic characteristics, more than one-third had no formal education (37.5%), and nearly three-fifths were not engaged in paid work (58.8%). Approximately half had exposure to mass media (50.3%), whereas only 14.2% reported as internet user. Most women married before age 18 years (78.2%), and about half had their first birth before age 18 years (49.5%) (see Table 1).

Table 1. Distribution of study characteristics of menopausal women aged 30-49 years in Bangladesh, (N = 2,182)

Characteristics	Actual data		Imputed data	
	N (%)	Weighted %	N (%)	weighted %
Socio-demographic characteristics				
Age (in years)				
30-34	171 (7.84)	8.14	171 (7.84)	8.14

35-39	303 (13.89)	13.12	303 (13.89)	13.12
40-44	556 (25.48)	26.69	556 (25.48)	26.69
45-49	1,152 (52.80)	52.06	1,152 (52.80)	52.06
Marital status				
Married	1,961 (89.87)	89.78	1,961 (89.87)	89.78
Widowed/divorced/separated	221 (10.13)	10.22	221 (10.13)	10.22
Religion				
Muslim	1,954 (89.55)	90.27	1,954 (89.55)	90.27
Non-Muslim	228 (10.45)	9.73	228 (10.45)	9.73
Place of residence				
Urban	735 (33.68)	26.36	735 (33.68)	26.36
Rural	1,447 (66.32)	73.64	1,447 (66.32)	73.64
Administrative division				
Barishal	253 (11.59)	6.76	253 (11.59)	6.76
Chattogram	251 (11.50)	14.96	251 (11.50)	14.96
Dhaka	295 (13.52)	22.92	295 (13.52)	22.92
Khulna	347 (15.90)	14.81	347 (15.90)	14.81
Mymensingh	212 (9.72)	7.02	212 (9.72)	7.02
Rajshahi	313 (14.34)	15.09	313 (14.34)	15.09
Rangpur	275 (12.60)	12.31	275 (12.60)	12.31
Sylhet	236 (10.82)	6.12	236 (10.82)	6.12
Socioeconomic characteristics				
Women's education				
No formal education	791 (36.25)	37.50	791 (36.25)	37.50
Primary	728 (33.36)	33.73	728 (33.36)	33.73
Secondary	547 (25.07)	24.15	547 (25.07)	24.15
Higher	116 (5.32)	4.61	116 (5.32)	4.61
Husband's education				
No formal education	800 (36.66)	37.89	906 (41.52)	42.78
Primary	508 (23.28)	23.52	556 (25.48)	25.75
Secondary	440 (20.16)	19.44	489 (22.41)	21.82
Higher	211 (9.67)	8.84	231 (10.59)	9.66
Missing	223 (10.22)	10.30	—	—
Women's occupation				
Not working	1,310 (60.04)	58.81	1,310 (60.04)	58.81
Manual labor	710 (32.54)	33.58	710 (32.54)	33.58
Professional	86 (3.94)	4.40	86 (3.94)	4.40
Businesswoman	76 (3.48)	3.20	76 (3.48)	3.20
Household wealth index				
Poorest	402 (18.42)	18.97	402 (18.42)	18.97

Poorer	450 (20.62)	20.62	450 (20.62)	20.62
Middle	446 (20.44)	21.70	446 (20.44)	21.70
Richer	439 (20.12)	20.15	439 (20.12)	20.15
Richest	445 (20.39)	18.55	445 (20.39)	18.55
Mass media exposure				
No	1,062 (48.67)	49.67	1,062 (48.67)	49.67
Yes	1,120 (51.33)	50.33	1,120 (51.33)	50.33
Internet use				
No	1,891 (86.66)	85.84	1,891 (86.66)	85.84
Yes	291 (13.34)	14.16	291 (13.34)	14.16
Reproductive characteristics				
Age at first marriage				
<18 years	1,675 (76.76)	78.19	1,675 (76.76)	78.19
≥18 years	507 (23.24)	21.81	507 (23.24)	21.81
Age at first birth				
<18 years	1,054 (48.30)	49.03	1,069 (48.99)	49.52
≥18 years	1,080 (49.50)	48.98	1,113 (51.01)	50.48
Missing	48 (2.20)	1.99	—	—
Children ever born				
0	48 (2.20)	1.99	48 (2.20)	1.99
1	155 (7.10)	6.85	155 (7.10)	6.85
2	623 (28.55)	28.57	623 (28.55)	28.57
3	632 (28.96)	29.30	632 (28.96)	29.30
≥4	724 (33.18)	33.29	724 (33.18)	33.29
Current contraceptive use				
No method	1,531 (70.16)	69.75	1,531 (70.16)	69.75
Female-only methods	558 (25.57)	26.12	558 (25.57)	26.12
Couple/male methods	93 (4.26)	4.12	93 (4.26)	4.12
History of terminated pregnancy				
Never	1,605 (73.56)	74.13	1,605 (73.56)	74.13
Ever	577 (26.44)	25.87	577 (26.44)	25.87
Women's autonomy, attitudes, and healthcare access				
Decision-making autonomy				
Did not participate	250 (11.46)	10.79	275 (12.60)	11.85
Participated	1,711 (78.41)	78.99	1,907 (87.40)	88.15

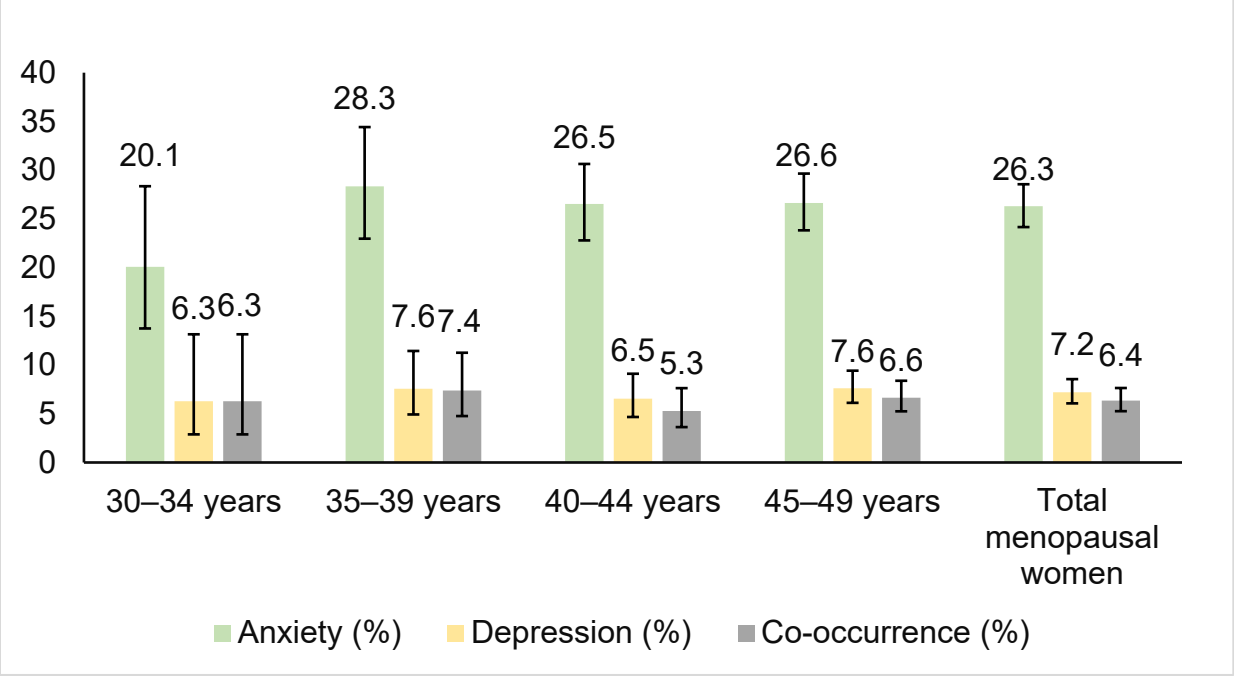
Missing	221 (10.13)	10.22	—	—
Justification of wife-beating				
Did not justify	315 (14.44)	15.21	324 (14.85)	15.57
Justified	1,824 (83.59)	82.62	1,858 (85.15)	84.43
Missing	43 (1.97)	2.17	—	—
Healthcare access problems				
No problem	697 (31.94)	32.43	697 (31.94)	32.43
Had problems	1,485 (68.06)	67.57	1,485 (68.06)	67.57
Spousal age gap				
<5 years	389 (17.83)	17.56	418 (19.16)	18.67
5-10 years	836 (38.31)	38.87	939 (43.03)	43.75
>10 years	736 (33.73)	33.35	825 (37.81)	37.58
Missing	221 (10.13)	10.22		

Notes: N = Numbers, % = Percentage

3.2 Prevalence of anxiety, depression, and their co-occurrence

Among menopausal women, the prevalence of anxiety was 26.3%, while depression and co-occurrence of anxiety and depression were 7.2% and 6.4%, respectively (see Fig 2.). Higher prevalence of all three outcomes was observed among widowed/divorced/separated women, with 37.4% reporting anxiety, 11.0% depression, and 9.7% co-occurrence. Anxiety prevalence was also significantly higher among women who had ever terminated a pregnancy (28.9%), participated in decision-making (27.1%), reported healthcare access problems (29.0%), or had a spousal age gap of more than 10 years (30.4%). Depression prevalence was significantly higher among women from Rangpur division (14.7%) and those married at age ≥18 years (9.1%). Similarly, the prevalence of co-occurring anxiety and depression was higher among

269 women from Rangpur division (12.4%) and those married at age ≥18 years (7.9%) (see
270 Table 2).
271
272 **Fig 2. Prevalence of anxiety, depression, and their co-occurrence among**
273 **menopausal women by age group**



274
275
276 **Table 2. Prevalence of anxiety, depression, and their co-occurrence among**
277 **menopausal women aged 30-49 years in Bangladesh**

Variables	Anxiety	Depression	Co-occurrence
	% (95% CI)	% (95% CI)	% (95% CI)
Socio-demographic characteristics			
Age (years)			
30-34	20.1 (13.8, 28.3)	6.3 (2.9, 13.2)	6.3 (2.9, 13.2)
35-39	28.3 (23.0, 34.4)	7.6 (4.9, 11.4)	7.4 (4.8, 11.3)
40-44	26.5 (22.8, 30.6)	6.5 (4.7, 9.1)	5.3 (3.6, 7.6)
45-49	26.6 (23.8, 29.6)	7.6 (6.1, 9.4)	6.6 (5.3, 8.4)
p-value	0.238	0.599	0.700

Marital status			
Married	25.0 (22.8, 27.4)	6.8 (5.6, 8.2)	6.0 (4.9, 7.3)
Widowed/divorced/separated	37.4 (30.2, 45.2)	11.0 (7.4, 16.1)	9.7 (6.3, 14.6)
p-value	**<0.001**	**0.003**	**0.014**
Religion			
Muslim	26.9 (24.6, 29.3)	7.4 (6.2, 8.9)	6.5 (5.3, 7.9)
Non-Muslim	20.4 (14.8, 27.5)	5.0 (2.9, 8.6)	5.0 (2.9, 8.6)
p-value	0.010	0.145	0.310
Place of residence			
Urban	24.3 (20.4, 28.6)	7.1 (5.1, 9.7)	6.4 (4.5, 9.0)
Rural	27.0 (24.5, 29.7)	7.3 (5.9, 8.9)	6.3 (5.1, 7.9)
p-value	0.287	0.682	0.534
Administrative division			
Barishal	30.5 (25.0, 36.7)	9.7 (6.4, 14.6)	8.7 (5.7, 13.1)
Chattogram	26.2 (20.0, 33.5)	5.7 (3.4, 9.4)	5.2 (3.0, 8.8)
Dhaka	24.6 (19.7, 30.2)	4.0 (2.3, 6.8)	3.1 (1.6, 5.9)
Khulna	24.4 (19.6, 29.9)	6.7 (4.4, 10.1)	6.4 (4.2, 9.6)
Mymensingh	28.2 (22.0, 35.4)	5.0 (2.6, 9.3)	4.5 (2.2, 8.9)
Rajshahi	24.8 (19.7, 30.6)	7.7 (5.1, 11.4)	6.6 (4.1, 10.4)
Rangpur	32.4 (26.9, 38.3)	14.7 (9.9, 21.2)	12.4 (7.9, 18.9)
Sylhet	22.2 (16.2, 29.6)	7.9 (4.9, 12.5)	7.9 (4.9, 12.5)
p-value	0.543	**0.006**	**0.017**
Socioeconomic characteristics			
Women's education			
No education	25.2 (16.9, 35.7)	8.9 (4.4, 17.1)	7.7 (3.7, 15.5)
Primary	24.6 (20.8, 29.0)	7.3 (5.3, 10.1)	6.8 (4.8, 9.5)
Secondary	27.3 (23.7, 31.3)	6.1 (4.5, 8.3)	5.2 (3.8, 7.2)
Higher	26.6 (23.3, 30.2)	7.9 (6.1, 10.2)	6.9 (5.2, 9.1)
p-value	0.664	0.757	0.676
Husband's education			
No education	21.1 (15.3, 28.5)	6.0 (3.6, 10.0)	5.5 (3.2, 9.2)
Primary	25.1 (21.0, 29.7)	6.4 (4.4, 9.2)	5.8 (3.9, 8.5)
Secondary	27.0 (23.0, 31.5)	7.7 (5.6, 10.5)	6.6 (4.7, 9.4)
Higher	27.6 (24.5, 31.0)	7.6 (6.0, 9.6)	6.7 (5.1, 8.7)
p-value	0.286	0.843	0.862
Women's occupation			
Not working	26.4 (23.7, 29.4)	7.1 (5.7, 8.9)	6.4 (5.0, 8.1)
Manual labor	24.6 (21.3, 28.3)	7.2 (5.3, 9.6)	6.1 (4.4, 8.4)
Professional	31.4 (21.1, 43.9)	6.9 (3.0, 15.3)	6.9 (3.0, 15.3)
Businesswoman	33.9 (23.0, 46.9)	9.4 (4.4, 18.8)	8.2 (3.6, 17.7)
p-value	0.225	0.892	0.742
Household wealth index			
Poorest	28.1 (23.7, 33.0)	8.4 (6.0, 11.7)	6.9 (4.7, 10.0)

Poorer	27.9 (23.5, 32.7)	7.7 (5.5, 10.8)	7.1 (4.9, 10.2)
Middle	25.3 (21.1, 30.0)	5.7 (3.9, 8.4)	4.9 (3.2, 7.4)
Richer	27.6 (22.9, 32.9)	6.4 (4.2, 9.7)	5.5 (3.5, 8.5)
Richest	22.4 (18.2, 27.1)	8.0 (5.6, 11.3)	7.6 (5.2, 10.9)
p-value	0.074	0.372	0.336
Mass media exposure			
No	25.7 (22.9, 28.7)	6.6 (5.2, 8.2)	5.7 (4.5, 7.3)
Yes	26.9 (23.9, 30.1)	7.8 (6.2, 9.9)	7.0 (5.4, 9.0)
p-value	0.758	0.970	0.999
Internet use			
No	26.5 (24.2, 28.9)	6.9 (5.8, 8.3)	6.1 (5.0, 7.4)
Yes	25.2 (19.8, 31.4)	8.9 (6.0, 13.1)	8.0 (5.2, 12.1)
p-value	0.480	0.186	0.136
Reproductive characteristics			
Age at first marriage			
≥18 years	24.2 (20.0, 29.0)	9.1 (6.7, 12.2)	7.9 (5.7, 10.9)
<18 years	26.9 (24.5, 29.3)	6.7 (5.5, 8.2)	5.9 (4.7, 7.3)
p-value	0.812	0.023	0.026
Age at first birth			
≥18 years	24.6 (21.8, 27.5)	6.6 (5.2, 8.3)	5.7 (4.4, 7.2)
<18 years	28.1 (25.1, 31.2)	7.8 (6.2, 9.9)	7.0 (5.4, 9.1)
p-value	0.137	0.360	0.351
Children ever born			
0	29.1 (17.1, 44.9)	9.6 (3.4, 24.2)	6.0 (1.8, 18.3)
1	24.1 (17.5, 32.2)	4.5 (2.2, 9.2)	4.5 (2.2, 9.2)
2	23.7 (20.0, 27.8)	6.6 (4.7, 9.1)	6.3 (4.6, 8.7)
3	25.8 (22.2, 29.9)	8.3 (6.3, 10.9)	6.5 (4.7, 8.9)
≥4	29.2 (25.8, 33.0)	7.2 (5.3, 9.6)	6.7 (4.8, 9.1)
p-value	0.224	0.823	0.999
Current contraceptive use			
No method	27.5 (24.9, 30.3)	7.4 (6.2, 8.9)	6.5 (5.3, 7.9)
Female-only methods	23.9 (20.1, 28.2)	6.4 (4.4, 9.2)	5.9 (4.0, 8.7)
Couple/male methods	20.7 (13.4, 30.6)	8.6 (4.3, 16.6)	6.9 (3.1, 14.8)
p-value	0.063	0.166	0.407
History of terminated pregnancy			
Never	25.4 (23.0, 27.9)	7.0 (5.7, 8.5)	6.1 (5.0, 7.6)
Ever	28.9 (24.7, 33.5)	7.8 (5.5, 11.0)	7.0 (4.8, 10.1)
p-value	**0.043**	0.231	0.224
Women's autonomy, attitudes, and healthcare access			
Decision-making autonomy			
Did not participate	20.3 (15.3, 26.3)	5.2 (3.0, 8.9)	4.7 (2.7, 8.2)
Participated	27.1 (24.8, 29.5)	7.5 (6.2, 8.9)	6.6 (5.4, 8.0)
p-value	**0.006**	0.135	0.211
Justification of wife beating			

Did not justify	28.2 (23.0, 34.0)	7.8 (5.4, 11.1)	7.3 (5.0, 10.5)
Justified	25.9 (23.6, 28.4)	7.1 (5.9, 8.6)	6.2 (5.0, 7.6)
p-value	0.159	0.254	0.109
Healthcare access problems			
No problem	20.7 (17.4, 24.4)	6.4 (4.6, 8.7)	5.9 (4.2, 8.2)
Had problems	29.0 (26.3, 31.8)	7.6 (6.2, 9.3)	6.6 (5.3, 8.1)
p-value	**0.001**	0.646	0.868
Spousal age gap			
<5 years	25.2 (20.7, 30.2)	8.2 (5.8, 11.5)	6.6 (4.5, 9.7)
5-10 years	23.3 (20.5, 26.4)	5.7 (4.3, 7.5)	5.5 (4.1, 7.2)
>10 years	30.4 (26.8, 34.2)	8.4 (6.5, 10.8)	7.3 (5.5, 9.5)
p-value	**0.015**	0.245	0.593

Notes: Estimates are design-adjusted percentages with 95% confidence intervals. P-values are from chi-square test. % = Percentage, CI = Confidence interval

3.3 Factors associated with anxiety, depression, and co-occurrence

Table 3 represents the results of multivariable logistic regression identifying the factors associated with anxiety, depression, and their co-occurrence. Marital status was consistently associated with all three outcomes. Compared with married women, widowed/divorced/separated women had higher odds of anxiety (AOR: 1.63, 95% CI: 1.14-2.31; *p*=0.007), depression (AOR: 1.78, 95% CI: 1.07-2.98; *p*=0.027), and their co-occurrence (AOR: 1.77, 95% CI: 1.02-3.06; *p*=0.041). For anxiety, women reporting problems accessing healthcare had 52% higher odds of anxiety than those reporting no problems (AOR: 1.52, 95% CI: 1.17-1.97; *p*=0.002). Women who participated in household decision-making also had higher odds of anxiety (AOR: 1.57, 95% CI: 1.10-2.25; *p*=0.014). Several outcome-specific associations were also observed. Non-Muslim women had lower odds of depression than Muslim women (AOR: 0.54, 95% CI: 0.29-0.99; *p*=0.047). Women who used the internet had higher odds of depression (AOR: 1.63, 95% CI: 1.02-2.60; *p*=0.040) and co-occurring anxiety and depression (AOR: 1.72,

95% CI: 1.07-2.76; *p*=0.024) than non-users. Women who married before age 18 years had higher odds of depression (AOR: 1.58, 95% CI: 1.06-2.34; *p*=0.024). In addition, substantial geographical variation remained after adjustment; compared with women from Barishal, those from Dhaka had lower odds of depression (AOR: 0.33, 95% CI: 0.16-0.68; *p*=0.003) and co-occurrence (AOR: 0.29, 95% CI: 0.13-0.63; *p*=0.002).

Table 3. Multivariable logistic regression examining socio-demographic factors associated with anxiety, depression, and their co-occurrence among menopausal women aged 30-49 years in Bangladesh.

Factors	Anxiety	*p*-value	Depression	*p*-value	Co-occurrence	*p*-value
	AOR (95% CI)		AOR (95% CI)		AOR (95% CI)	
Marital status (Ref: Married)						
Widowed/divorced/separated	**1.63 (1.14–2.31)**	**0.007**	**1.78 (1.07–2.98)**	**0.027**	**1.77 (1.02–3.06)**	**0.041**
Religion (Ref: Muslim)						
Non-Muslim	—	—	**0.54 (0.29–0.99)**	**0.047**	—	—
Decision-making autonomy (Ref: No)						
Yes	**1.57 (1.10–2.25)**	**0.014**	—	—	—	—
Healthcare access problems (Ref: No)						
Yes	**1.52 (1.17–1.97)**	**0.002**	—	—	—	—
Division (Ref: Barishal)						
Dhaka	—	—	**0.33 (0.16–0.68)**	**0.003**	**0.29 (0.13–0.63)**	**0.002**
Internet use (Ref: No)						
Yes	—	—	**1.63 (1.02–2.60)**	**0.040**	**1.72 (1.07–2.76)**	**0.024**
Age at first marriage (Ref: ≥18 years)						
<18 years	—	—	**1.58 (1.06–2.34)**	**0.024**	—	—

Notes: Values are adjusted odds ratios (AORs) with 95% confidence intervals (CIs) from survey-design-adjusted multivariable logistic regression models. Ref denotes reference category. Only statistically significant associations ($p < 0.05$) are presented. Complete regression results, including non-significant associations, are provided in Supplementary Table 2. Dashes (—) indicate no statistically significant association in the corresponding model.

4 Discussion

This study is, to our knowledge, the first to use nationally representative data to estimate the prevalence and correlates of anxiety, depression, and their co-occurrence

specifically among menopausal women in Bangladesh. The anxiety prevalence observed here sits toward the upper end of recent BDHS-based estimates for Bangladeshi women of reproductive age more broadly, which have ranged from roughly one-fifth to just over one-quarter depending on the specific cutoff applied [7, 16], while the depression prevalence is more modest and broadly consistent with national estimates in the 5%-8% range [12]. However, according to a previous community-based study reported higher prevalence of anxiety and depressive symptoms [8]. At the same time, both figures are considerably lower than pooled global estimates of depression among menopausal women, which converge around one-third of women affected [22, 23]. This gap is unlikely to reflect a genuinely lower biological burden of menopausal mood disturbance in Bangladesh; rather, it more plausibly reflects differences in measurement (a single-timepoint GAD-7/PHQ-9 screen versus clinical or longitudinal ascertainment), instrument cutoffs, and the possibility that psychological distress in this setting is expressed and reported differently, including through somatic idioms that a symptom checklist may not fully capture [1]. It may also reflect genuine underdiagnosis linked to Bangladesh's limited mental health literacy and treatment infrastructure, which likely suppresses both symptom recognition and help-seeking rather than the underlying burden itself [24]. Additionally, in this study, marital dissolution emerged as the single most consistent correlate of all three outcomes, while several other associations — particularly those involving decision-making autonomy, internet use, and age at marriage — ran counter to what a straightforward risk-factor model would predict. These findings both extend and complicate the existing literature on menopausal mental health in South Asia.

Women who were widowed, divorced, or separated had markedly higher adjusted odds of anxiety, depression, and their co-occurrence than currently married women, a pattern that held even after adjustment for age, socioeconomic status, and reproductive history. This finding is consistent with previous studies in Bangladesh [10], and in China [25]. Marital dissolution to poorer mental health across diverse settings, largely through mechanisms of lost social and economic support, disrupted identity, and unresolved relational stress [26, 27]. In the Bangladeshi context, where marriage remains central to women's social position, economic security, and household standing, the loss of a spousal relationship — through death, divorce, or separation — is likely to carry a more concentrated psychological toll than it would in settings with stronger alternative sources of social protection for unmarried women [14]. This association persisted specifically within the analytic window of the menopausal transition suggests that marital status may compound, rather than merely coincide with, the psychological vulnerability associated with this life stage.

In this study, women who participated in household decisions had higher adjusted odds of anxiety than those who did not. While counterintuitive on its face, this pattern echoes recent Bangladesh-specific findings that women's empowerment indicators are not uniformly protective and can be associated with a heavier, rather than lighter, mental health burden [12, 13]. One plausible explanation is that decision-making participation in this setting often reflects an expansion of responsibility — for finances, children's welfare, or health decisions — layered on top of, rather than substituting for, women's existing domestic obligations, producing a form of role overload rather than genuine empowerment [13]. This stands in contrast to evidence from other low- and

middle-income settings, where greater autonomy has been more consistently protective [28], and suggests that the mental health returns to autonomy may depend heavily on whether that autonomy is accompanied by a redistribution, rather than simply an addition, of household burdens.

Nom-Muslim women reported lower odds of depression than Muslims in this study. This association may also reflect cultural perceptions of menopause in predominantly Muslim settings. Studies from Saudi Arabia and Iran suggest that menopause may be viewed as a period of loss, ageing, and reduced femininity, while stigma and limited discussion can contribute to emotional distress [29, 30]. Such cultural perceptions may partly shape psychological well-being during menopause. Moreover, early marriage was also independently associated with higher odds of depression. This finding is consistent with recent evidence from Bangladesh and India showing that early marriage is associated with poorer psychological health and greater depressive symptoms later in life [16, 31, 32]. Early marriage may restrict education, economic opportunities, autonomy, and decision-making power and increase exposure to marital and family stressors. These cumulative disadvantages may persist across the life course and contribute to depression during the menopausal years.

Internet use was associated with higher odds of depression and co-occurring anxiety and depression in our study. Although internet use can facilitate access to health information and social support, recent evidence suggests that the type and framing of online content may also influence psychological well-being. Exposure to negatively framed menopause-related social media content has been shown to increase worry, confusion, and anxiety [33], 2026), while social comparison and problematic social

media use have been linked to anxiety and depressive symptoms among perimenopausal women [34]. Thus, the observed association may partly reflect the content and purpose of internet use rather than internet access itself.

Women reporting problems accessing healthcare had substantially higher odds of anxiety, an association that likely runs in both directions: limited access to care may leave anxiety symptoms unaddressed and worsening, while anxious women may also perceive or experience greater difficulty navigating health services [24]. The pronounced divisional variation in depression and co-occurrence — with Dhaka showing consistently lower odds than Barishal and other divisions — mirrors broader geographic disparities in healthcare infrastructure, urbanization, and economic opportunity across Bangladesh, and is consistent with prior BDHS-based work documenting similar divisional gradients in women's mental health outcomes [7]. Notably, religious minority status (non-Muslim) was associated with lower odds of depression, a finding that warrants cautious interpretation given the relatively small non-Muslim subsample and the absence of information on community-level social support, which may buffer minority status in ways not captured by individual-level covariates.

4.1 Strength and limitations

This study's principal strengths are its use of a nationally representative sample with validated screening instruments, design-adjusted analyses accounting for the survey's complex sampling structure, and its explicit focus on the menopausal subgroup rather than the broader reproductive-age population typically examined in BDHS-based research. Several limitations nonetheless warrant caution in interpretation. First, the

cross-sectional design precludes causal inference; associations such as those for decision-making autonomy and healthcare access are equally consistent with reverse causation as with the interpretations offered above. Second, menopausal status was derived from proxy indicators within the survey's fertility module rather than direct self-report of menopause, which may have introduced some misclassification. Third, the GAD-7 and PHQ-9 are screening instruments rather than diagnostic tools, and their somatic items may be particularly susceptible to overlap with menopausal physical symptoms, potentially inflating apparent prevalence independent of true psychiatric caseness. Finally, sensitive measures such as justification of wife-beating and healthcare access difficulties are subject to social desirability bias, which may have attenuated their observed associations.

4.2 Implications

These findings suggest that mental health screening for menopausal-aged Bangladeshi women should not be organized solely around chronological age or reproductive staging, but should give particular attention to women experiencing marital dissolution and those reporting difficulty accessing care — two of the most consistent and actionable correlates identified here. The counterintuitive associations involving autonomy and internet use further suggest that empowerment-oriented interventions in this setting should be designed with attention to the total burden they place on women, rather than assuming that expanded decision-making authority is inherently protective. Future longitudinal and mixed-methods research will be needed to clarify the

directionality of these associations and to better distinguish genuine menopause-related mood disturbance from symptom overlap with the physical changes of this transition.

5 Conclusion

This nationally representative study found that anxiety symptoms affect roughly one in four menopausal-aged women in Bangladesh — a rate several times higher than that of depression — and that nearly all identified risk factors cut across conventional expectations about vulnerability. Marital dissolution stood out as the only characteristic independently linked to anxiety, depression, and their co-occurrence, underscoring the mental health toll of losing spousal support in a society where marriage remains central to women's social and economic security. Counterintuitive associations — higher odds of anxiety among women who participate in household decision-making, and higher odds of depression among internet users and among those who married later — suggest that exposure to broader responsibilities, social comparison, and changing gender expectations can carry a psychological cost that a simple empowerment narrative does not capture. That age itself was not independently associated with any outcome further suggests that, within this already-menopausal population, contextual and structural factors — rather than the biological process of menopause per se — are the primary drivers of mental health risk. These findings point to the need for mental health screening integrated into routine primary care for midlife women, with particular outreach to those who are widowed, divorced, or separated, and for further longitudinal and qualitative research to clarify the mechanisms behind the autonomy and internet-use associations identified here.

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Ethical approval and consent to participate The present analysis is based entirely on secondary data and did not involve any direct contact with study participants by the authors, who played no part in the original data collection. The dataset was obtained from the Demographic and Health Surveys (DHS) Program repository (https://dhsprogram.com/data/available-datasets.cfm), where it is made freely available

to researchers who register and submit a request for access. Given this public-access status, no additional institutional ethics review was necessary for the current study. Ethical oversight of the underlying 2022 Bangladesh Demographic and Health Survey (BDHS) itself, however, was provided at the time of data collection: the survey protocol was reviewed and cleared by the ethics committee of the Bangladesh Medical Research Council as well as by ICF's Institutional Review Board (approval reference 2022-135-ICF), with the latter's approval grounded in the ethical principles set out in the Declaration of Helsinki (1964). Throughout data collection, the DHS Program's standard ethical safeguards were followed, including obtaining informed consent from respondents and protecting their privacy and the confidentiality of their responses. Before release, all records were stripped of identifying information by the DHS Program to protect respondent anonymity, and the present study was conducted in keeping with these established ethical protections. Further details on the DHS Program's data-protection practices are available on its official website.

Competing interests The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability The data for this study came from the 2022 Bangladesh Demographic and Health Survey (BDHS). The data are available at https://dhsprogram.com/data/dataset/Bangladesh_Standard-DHS_2022.cfm?flag=0, and the report is available at https://dhsprogram.com/pubs/pdf/PR149/PR149.pdf

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