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Shared and distinct social correlates of depressive and anxiety symptoms among reproductive-age women in Bangladesh: a structural equation modelling study

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Abstract

Background

Depressive and anxiety symptoms among women in low- and middle-income countries are commonly attributed to the same social conditions, yet whether a given condition relates equally to both syndromes has seldom been tested. This study identified shared and distinct social correlates of the two syndromes among reproductive-age women in Bangladesh.

Methods

We analysed 16,500 ever-married women aged 15–49 years from the 2022 Bangladesh Demographic and Health Survey. Latent depressive (PHQ-9) and anxiety (GAD-7) symptoms were regressed simultaneously on four latent social constructs (socioeconomic resources, household decision-making autonomy, attitudes justifying wife-beating and barriers to reaching health care) and six reproductive and demographic covariates, using weighted least squares with mean and variance adjustment. Wald tests compared each association across the two outcomes.

Results

The structural model fitted well (CFI = 0.977; RMSEA = 0.021). The two syndromes were strongly correlated (0.871), yet a two-factor model fitted better than a one-factor model. Barriers to health care showed the largest associations with both anxiety (β = 0.108) and depression (β = 0.101), which did not differ. Socioeconomic resources, decision-making autonomy and attitudes justifying wife-beating were more strongly associated with anxiety than with depression after Bonferroni correction, and greater autonomy was associated with more, not fewer, anxiety symptoms (β = 0.077). Age, pregnancy loss and child death related equally to both.

Conclusions

Constrained access to care is a shared, transdiagnostic correlate, whereas social position, household agency and gender norms relate mainly to anxiety. Programmes addressing these conditions should measure anxiety and depression separately.

1 Introduction

Depressive and anxiety disorders are the largest contributors to the global burden of mental illness: in 2021, 359.2 million people lived with an anxiety disorder and 332.4 million with a depressive disorder, accounting for 63.1% of mental disorders and 9.1% of all diseases [1]. Women carry a higher burden than men, and middle- and low-sociodemographic-index settings contribute most cases [1]. Among women of

childbearing age, anxiety and depressive disorders account for more than 70% of the 343.2 million prevalent mental disorders [2].

Maternal mental disorders before and during pregnancy are associated with a moderately increased risk of stillbirth and infant mortality [3], and perinatal mental disorders contribute to maternal mortality and to adverse neonatal, infant and child outcomes [4]. In Bangladesh, psychiatric disorders affect 18.7% of adults, more women than men (21.5% versus 15.7%), with depressive and anxiety disorders the most common diagnoses [5]. About 90% of affected adults do not seek care [6]; only 3.9% of those with generalised anxiety disorder and 4.1% of those with depressive disorders obtain professional help [7, 8], and fewer than one in five symptomatic women in the 2022 Bangladesh Demographic and Health Survey (BDHS) sought any help [9]. Scarce services, workforce shortages, stigma, low mental health literacy and cost sustain this gap [10, 11], so evidence on correlates is one of the few means of directing resources towards women unlikely to present for care.

Women's mental health is shaped not only by individual characteristics but also by the social conditions in which women live. A review of reviews organised the social determinants of mental disorders into demographic, economic, neighbourhood, environmental-event and social and cultural domains, and linked each to targets of the Sustainable Development Goals [12]. In Bangladesh, several of these domains converge in women's daily lives: material deprivation, household roles that confer responsibility without control over resources, norms that tolerate intimate partner violence and social restrictions on mobility that make reaching a health facility difficult. Whether these conditions bear equally on depression and anxiety, however, has rarely been examined.

The 2022 BDHS was the first round to administer the Patient Health Questionnaire-9 (PHQ-9) and the Generalized Anxiety Disorder-7 (GAD-7) scale to ever-married women aged 15–49 years [13]. Secondary analyses of these data have multiplied, examining women's empowerment [14, 15], household environmental conditions [16] and the symptom network linking the two scales [17], but their findings on social gradients disagree: one found age and division predictive but not education, wealth or autonomy [18], whereas others reported clear socioeconomic gradients [19, 20]. Reported prevalence ranges from 4.0% to 19.5% for anxiety and from 1.3% to 10.4% for depression [14, 18, 19, 21, 22], largely because studies applied different thresholds and scoring conventions.

Evidence on women's empowerment is similarly unsettled. Attitudes accepting wife-beating are consistently associated with more symptoms [14, 19, 22], but greater decision-making authority has been associated with higher odds of anxiety and depression in Nepal [23] and Bangladesh [19, 21], with no adjusted association in other analyses [14, 15, 20], and with a nominal, imprecisely estimated U-shaped relationship in rural Pakistan [24]. Empowerment gains unmatched by a supportive environment may therefore act as stressors [20], which can be tested only by estimating socioeconomic resources, autonomy and normative attitudes simultaneously rather than as a single index.

Three further domains remain under-examined. First, perceived barriers to health care are common among South Asian women and patterned by poverty and rural residence [25]; usually analysed as

determinants of service use, they may also act as chronic stressors where women's mobility is socially regulated. Second, perinatal loss roughly doubles the risk of depressive disorders and raises that of anxiety disorders by three-quarters [26], pregnancy termination carries an elevated long-term risk of common mental disorders [27], and pregnancy loss predicts both outcomes in Bangladesh [22, 28], but whether these associations survive simultaneous adjustment for socioeconomic, normative and access-related constructs is untested. Third, symptom burden is higher in the Khulna, Rangpur and Sylhet divisions [18, 19, 21], and flooding is associated with depression and anxiety nationally [29], yet how divisional and rural–urban variation combine, and whether they coincide across the two outcomes, has not been described.

A methodological gap underlies these substantive ones. Most BDHS analyses have applied logistic regression to dichotomised scores, with predictors entered as single items or unweighted indices. Dichotomisation discards information and imposes study-specific thresholds [30], and treating latent constructs as error-free variables leaves attenuation from measurement error uncorrected [31, 32]. Separate models for each outcome also preclude a formal test of whether a correlate is more strongly associated with one syndrome. Several analyses have reported associations with one outcome but not the other, such as poor household environmental conditions with depression but not anxiety [16], yet such contrasts were drawn by comparing separate models, and a difference in statistical significance is not itself evidence of a significant difference [33]. This matters because depression and anxiety share a general distress component but retain specific features [34, 35]: a correlate acting on the shared component calls for transdiagnostic intervention, whereas one acting on a specific component calls for a disorder-specific response.

Structural equation modelling (SEM) addresses these limitations by defining latent constructs with explicit measurement error, retaining ordinal information, estimating both outcomes jointly and permitting equality tests on corresponding paths [31, 36]. The closest South Asian SEM analyses do not exploit these features: one applied maximum likelihood to predominantly dichotomous predictors and summed scores in Nepal [37], and a Bangladeshi path model of 2,388 women treated depression and anxiety as two summed-score indicators of a single distress factor [38], which cannot separate the syndromes. A more recent path analysis of the same survey examined anxiety alone [39]. No study of Bangladeshi national data has, to our knowledge, modelled the two syndromes as distinct latent outcomes with an ordinal, weighted estimator and formally tested differential associations.

Framed by a social-determinants perspective, this study therefore aimed to (i) evaluate a measurement model for both syndromes and four social constructs; (ii) estimate their associations jointly with an estimator suited to ordinal, weighted data; (iii) test whether each social condition is differentially associated with anxiety and depression; and (iv) describe divisional and rural–urban variation in prevalence. Extended background and the research questions are given in Supplementary Note S1 of the Supplementary Information (SI; Electronic Supplementary Material, ESM 1).

1.1 Conceptual framework and hypotheses

The analytic model formalises a social-determinants account [12] in which symptom burden arises from material position, normative environment, structural access to services and reproductive history (Fig. 1). Socioeconomic resources represent material and informational advantage; decision-making autonomy represents household agency, which may function as responsibility rather than protection when resources are lacking; attitudes justifying intimate partner violence represent internalised gender norms; and perceived barriers to health care represent structurally constrained mobility, treated here as a chronic stressor. Consistent with the tripartite model [34], depressive and anxiety symptoms are correlated but distinguishable outcomes, so a correlate acting on shared distress should show equivalent associations with both, whereas one acting on a syndrome-specific component should not. Because age, parity and reproductive history also shape socioeconomic position, household role and exposure to gender norms, the six covariates were specified as predictors of the four latent constructs as well as of the two outcomes, so that every structural coefficient is mutually adjusted.

We hypothesised that (H1) socioeconomic resources would be inversely associated with both outcomes; (H2) health-care access barriers and attitudes justifying wife-beating would be positively associated with both; (H3) decision-making autonomy would show a positive rather than a protective association; and (H4) reproductive adversity would retain independent associations after full adjustment. The equality tests were exploratory, and no directional hypothesis was specified for them.

2 Methods

2.1 Data source and analytic sample

This cross-sectional study analysed the 2022 BDHS, implemented by the National Institute of Population Research and Training (NIPORT) with technical assistance from ICF through the Demographic and Health Surveys (DHS) Program and funding from the United States Agency for International Development [13]. The survey used a stratified two-stage cluster design representative nationally, for each of the eight divisions and for rural and urban areas: 674 enumeration areas (237 urban, 437 rural) were selected with probability proportional to size, and households were then selected systematically. All ever-married women aged 15–49 years in selected households were eligible for interview. Reporting follows the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guideline [40], and the workflow is summarised in Supplementary Fig. S2.

Of 30,078 ever-married women in the Individual Recode file, 19,987 received the mental health module. We excluded women with any missing GAD-7 or PHQ-9 item (n = 2,931) or any missing or non-substantive model indicator (n = 556), leaving 16,500 (Supplementary Fig. S1). "Do not know", "refused" and the corresponding DHS codes (8, 9, 98 and 99) were treated as missing rather than recoded into a substantive category. Complete-case analysis was preferred to imputation because pairwise deletion can yield non-positive-definite polychoric matrices and imputation congenial with a latent-response model introduces poorly characterised approximations (Supplementary Methods S1).

2.2 Outcome measures

Depressive symptoms were assessed with the PHQ-9 [41] and anxiety symptoms with the GAD-7 [42], both referring to the preceding two weeks on a four-point frequency scale and both showing acceptable reliability and validity in Bangladeshi samples [43, 44]. Items are listed in Supplementary Appendix D; Cronbach's α was 0.82 for the GAD-7 and 0.81 for the PHQ-9.

In the structural model each syndrome was a continuous latent variable indicated by its items, which retains ordinal information and avoids threshold dependence [30]. Dichotomised scores were used only for descriptive prevalence and maps (Fig. 2), with anxiety defined as GAD-7 > 5 and depression as PHQ-9 > 9, following the banding of a previous national analysis of the same survey [18]; because other analyses used GAD-7 ≥ 10 [28], anxiety prevalence is not directly comparable across studies. No structural coefficient derives from a dichotomised outcome.

2.3 Latent social constructs and covariates

Four psychosocial constructs were specified as reflective latent constructs: (i) socioeconomic resources (household wealth, the woman's and her husband's education, internet use and newspaper readership); (ii) decision-making autonomy (participation, alone or jointly, in decisions on earnings or major purchases, family visits and her own health care); (iii) attitudes justifying intimate partner violence (five wife-beating items), interpreted as a marker of internalised gender norms rather than of violence exposure [22, 45]; and (iv) health-care access barriers (distance to a facility and not wanting to go alone reported as big problems). The two-indicator barriers factor is identified because it correlates with, and is regressed on, other variables in the model [36] (Supplementary Methods S5). The two items were modelled as indicators of one construct rather than as separate predictors because, when entered separately, the item on going alone reversed sign once distance was controlled, a suppression effect produced by their shared variance (phi coefficient 0.529; implied tetrachoric correlation 0.75).

Six covariates were entered as observed predictors: age (standardised), children ever born (log-transformed and standardised), death of a son or daughter, terminated pregnancy, current pregnancy and infecund or menopausal status (the DHS exposure category "infecund, menopausal"; Supplementary Table S1). Place of residence was used only to stratify the geographic analysis. Coding is detailed in Supplementary Table S1.

2.4 Model specification and estimation

Both latent outcomes were regressed simultaneously on the four latent constructs and six covariates (Figs. 1 and 3), with their residual covariance freely estimated so that each path is net of shared distress [35]. The four latent constructs were also regressed on the six covariates, with their residual covariances freely estimated, so that every coefficient is adjusted for all other predictors; omitting these paths would constrain age, parity and reproductive history to be unrelated to socioeconomic resources, autonomy, attitudes and access barriers. The structural part of the model is therefore saturated: its 15 relations among the six latent variables correspond one-to-one to the 15 factor correlations of the measurement model, so the structural paths impose no restriction beyond the measurement model itself. Eight residual covariances among symptom items were specified a priori from overlapping content;

modification indices were inspected but not used [36] (Supplementary Methods S3). Latent variances were fixed to one, and the delta parameterisation was used.

Each ordinal or binary response was treated as a coarse categorisation of a continuous latent response [46]. Thresholds and polychoric correlations were estimated from weighted proportions and contingency tables, so the weights enter the first estimation stage and parameters describe the national population [47]. The model was estimated by diagonally weighted least squares with mean- and variance-adjusted statistics and a scaled-and-shifted test statistic (WLSMV) [48], which, unlike maximum likelihood, does not attenuate loadings or distort fit statistics with ordinal indicators [49, 50] and so addresses a limitation acknowledged by the closest antecedent study [37]. Equations are given in Supplementary Methods S4.

Design-based standard errors for clustering and stratification are not implemented for WLSMV in lavaan (Supplementary Methods S4). We therefore adopted a conservative inferential criterion: an association was regarded as robust only if it would remain significant at $P < 0.05$ with its standard error doubled, which corresponds to a design effect of 4 and requires $|z| \geq 3.92$. Associations significant at $P < 0.05$ that failed this criterion are reported as tentative. As a further sensitivity analysis, the structural model was re-estimated without weights.

2.5 Evaluation of the measurement model

A confirmatory factor analysis of all six constructs preceded the structural model. A comparative fit index (CFI) and Tucker–Lewis index (TLI) ≥ 0.95, a root mean square error of approximation (RMSEA) ≤ 0.06 and a standardised root mean square residual (SRMR) ≤ 0.08 indicated good fit [51] and CFI and TLI ≥ 0.90 acceptable fit, treated as heuristics because these cut-offs behave differently under least-squares estimation [52]; χ^2 was not used as a criterion given the sample size. The two-factor specification was compared with a nested one-factor model by a scaled χ^2 difference test [53]. Because the structural model includes observed covariates, it is fitted to thresholds, polychoric correlations and indicator–covariate slopes conditional on the covariates; its degrees of freedom are therefore not comparable with those of the measurement model, and its fit is summarised with scaled rather than robust indices. The goodness-of-fit index (GFI), adjusted GFI (AGFI), normed fit index (NFI) and incremental fit index (IFI) are reported as supplementary descriptives only, because they are inflated under least-squares estimation (Supplementary Table S7).

Reliability was assessed by Cronbach's α, composite reliability and residual-adjusted ordinal omega [54], and convergent validity by the average variance extracted (AVE ≥ 0.50) [55]. Discriminant validity was assessed with the Fornell–Larcker criterion and the heterotrait–monotrait (HTMT) ratio (< 0.85), the latter because the former has limited sensitivity in configurations such as this [56]. Computational forms are given in Supplementary Methods S6.

2.6 Structural model and equality tests

The structural model yielded standardised coefficients with 95% confidence intervals (CIs). Whether a predictor was differentially associated with anxiety relative to depression was tested for each predictor *k* with a Wald test of parameter equality:

(1)

where γ_{Ak} and γ_{Dk} are the unstandardised coefficients linking predictor *k* to anxiety and depression, a test possible only because both outcomes are estimated in one model. Tests were two-sided ($\alpha = 0.05$); because they were exploratory, differences surviving a Bonferroni-adjusted threshold ($P < 0.005$) are also reported. Holm-adjusted P values and the unstandardised coefficients are reported in Supplementary Table S9.

2.7 Descriptive analysis and software

All estimates except the HTMT ratios and the sensitivity analysis used the women's individual sampling weights (v005/1,000,000). Characteristics are reported as unweighted counts with weighted percentages (Table 1), and weighted prevalence was estimated for each division within rural and urban strata and mapped (Fig. 2).

Data were prepared in Stata 17 and analysed in R 4.4.3 [57] with lavaan 0.6–21 [48], semTools 0.5-9, dplyr 1.2.1 and haven 2.5.4 (Supplementary Methods S7). Claude (Anthropic) was used to improve language clarity and to assist in drafting and debugging the R code for model estimation and figure rendering; the authors ran and verified all code, checked every reported estimate against the software output, and made all analytic decisions and interpretations.

3 Results

3.1 Sample characteristics

Table 1 summarises the 16,500 women. In weighted estimates, 71.5% lived in rural areas, 47.9% had secondary education and 37.7% belonged to the two poorest wealth quintiles. Participation in each household decision exceeded 70%, whereas endorsement of wife-beating did not exceed 9% in any scenario. Distance to a facility (46.4%) and not wanting to go alone (40.0%) were common barriers, and 22.9% of women reported a terminated pregnancy.

Table 1
Characteristics of the analytic sample of ever-married women aged 15–49 years, Bangladesh Demographic and Health Survey 2022 (N = 16,500)

Characteristic	Category	Unweighted n	Weighted %
Sociodemographic characteristics			
Age group (years)	15–19	1,339	8.6
	20–29	5,958	36.3
	30–39	5,674	34.1
	40–49	3,529	21.0
Place of residence	Rural	10,706	71.5
	Urban	5,794	28.5
Religion	Islam	14,755	90.2
	Hindu/other	1,745	9.8
Sex of household head	Female	2,004	12.7
Woman's education	None	1,966	12.2
	Primary	4,192	25.4
	Secondary	7,751	47.9
	Higher	2,591	14.5
Husband's education	None	3,370	20.9
	Primary	4,599	28.2
	Secondary	5,341	32.6
	Higher	3,190	18.2
Household wealth	Poorest/poorer	6,121	37.7
	Middle	3,262	20.5
	Richer/richest	7,117	41.8
Uses the internet	Yes	4,968	31.0
Reads a newspaper	Yes	1,210	6.8

Note: Counts are unweighted; percentages are weighted with the women's individual sampling weights and represent national population estimates. For binary indicators only the "Yes" category is shown. Percentages may not sum to 100 because of rounding. Age entered the structural model as a continuous standardized score. Place of residence, religion and sex of household head are descriptive only and were not included in the structural model.

Characteristic	Category	Unweighted n	Weighted %
Decision-making autonomy (participates alone or jointly)			
Own earnings or major purchases	Yes	11,461	70.8
Visits to family or relatives	Yes	12,379	75.8
Own health care	Yes	12,360	76.1
Wife-beating justified if the wife…			
Goes out without telling him	Yes	894	5.8
Neglects the children	Yes	1,142	7.4
Argues with him	Yes	1,363	8.9
Refuses sex with him	Yes	462	3.1
Burns the food	Yes	210	1.3
Big problem in obtaining medical care			
Distance to a health facility	Yes	7,512	46.4
Not wanting to go alone	Yes	6,481	40.0
Reproductive history			
Death of a son or daughter	Yes	1,807	10.8
Ever had a terminated pregnancy	Yes	3,867	22.9
Currently pregnant	Yes	1,045	6.3
Infecund or menopausal	Yes	2,643	15.8

Note: Counts are unweighted; percentages are weighted with the women's individual sampling weights and represent national population estimates. For binary indicators only the "Yes" category is shown. Percentages may not sum to 100 because of rounding. Age entered the structural model as a continuous standardized score. Place of residence, religion and sex of household head are descriptive only and were not included in the structural model.

3.2 Prevalence and geographic distribution of symptoms

Weighted prevalence was 18.1% for anxiety and 4.4% for depressive symptoms (Supplementary Figs. S3 and S4). Anxiety was three to six times more prevalent than depression in every division and stratum, and the two geographic gradients did not coincide (Fig. 2). Rural anxiety peaked in Rangpur (23.3%) and urban anxiety in Khulna (21.2%). Rural prevalence exceeded urban prevalence in six divisions but not in Khulna (18.5% versus 21.2%) or Sylhet (17.8% versus 19.0%). Depressive symptoms were most prevalent

in Khulna among both rural (6.2%) and urban (6.8%) women, with rural Rangpur and Sylhet also elevated (6.0% each).

3.3 Measurement model and dimensionality

All 31 standardised loadings were positive and significant ($P < 0.001$; Supplementary Table S2), ranging from 0.602 to 0.833 for anxiety and from 0.608 to 0.787 for depression, where thoughts of self-harm and psychomotor change loaded most strongly. The socioeconomic factor was dominated by education ($\lambda = 0.845$ and 0.819) rather than wealth ($\lambda = 0.581$), and the autonomy factor by the health-care decision ($\lambda = 0.913$). In the barriers factor, distance loaded at 0.986, so the factor is carried predominantly by distance.

The two-factor measurement model fitted acceptably (Table 2; CFI = 0.923, TLI = 0.913, RMSEA = 0.060, SRMR = 0.038), whereas a one-factor alternative fitted worse on every index (CFI = 0.906, TLI = 0.895, RMSEA = 0.066, SRMR = 0.041; $\Delta\chi^2 = 539.73$, d.f. = 5, $P < 0.001$; ΔCFI = 0.017). The weighted structural model fitted well (scaled $\chi^2 = 4628.74$, d.f. = 561; CFI = 0.977, TLI = 0.981, RMSEA = 0.021, 90% CI 0.020–0.022; SRMR = 0.036). TLI exceeded CFI because the model degrees of freedom (561) exceeded those of the baseline model (465), an arithmetic property of the two indices rather than evidence of misspecification. The solution was admissible, with no negative variances, no standardised loading above one and a positive-definite parameter covariance matrix (Supplementary Table S7).

Table 2
Fit indices for the measurement and structural models

Model	Indices	χ^2	df	CFI	TLI	RMSEA	SRMR
Measurement, two-factor	Robust	3675.94	411	0.923	0.913	0.060	0.038
Measurement, one-factor	Robust	4739.16	416	0.906	0.895	0.066	0.041
Structural, weighted	Scaled	4628.74	561	0.977	0.981	0.021	0.036
Structural, unweighted	Scaled	5924.78	561	0.976	0.980	0.024	0.037

Note: CFI, comparative fit index; TLI, Tucker–Lewis index; RMSEA, root mean square error of approximation; SRMR, standardised root mean square residual. Robust indices are reported for the measurement models. For the structural models, which include observed covariates, robust indices are undefined under WLSMV and scaled indices are reported; these models are fitted to statistics conditional on the covariates, so their degrees of freedom are not directly comparable with those of the measurement models. The unweighted structural model is a sensitivity analysis. The one-factor model fitted significantly worse than the two-factor specification, $\Delta\chi^2(5) = 539.73$, $P < 0.001$. GFI, AGFI, NFI and IFI are given in Supplementary Table S7.

3.4 Reliability and validity

Composite reliability and ordinal omega ranged from 0.840 to 0.946 (Supplementary Table S3). AVE exceeded 0.50 for all constructs except depression (0.488), whose composite reliability (0.895)

nonetheless supported convergent validity [55]. All construct pairs met the Fornell–Larcker criterion except anxiety and depression, whose latent correlation (0.871) exceeded the square roots of their AVEs (0.738 and 0.699), and their HTMT ratio (0.864) lay just above 0.85, whereas all other ratios were 0.227 or lower (Supplementary Tables S4 and S5). Because the one-factor model was rejected and three correlates were differentially associated with the two outcomes after Bonferroni correction, we interpret this correlation as strong comorbidity rather than measurement redundancy, while recognising that the discriminant evidence is borderline.

3.5 Structural associations

The weighted structural model (Table 3; Fig. 3) explained 7.2% of the variance in anxiety and 3.7% in depression, so interpretation rests on the direction, magnitude and relative pattern of paths.

Health-care access barriers showed the largest coefficients for both anxiety (β = 0.108, 95% CI 0.082–0.134) and depression (β = 0.101, 95% CI 0.074–0.127), supporting H2. Socioeconomic resources were inversely associated with both, more strongly with anxiety (β = −0.104 versus − 0.063), supporting H1, and age was positively associated with both (β = 0.097 and 0.080; all $P < 0.001$). Consistent with H3, decision-making autonomy showed a positive association with anxiety (β = 0.077, $P < 0.001$) but not with depression (β = 0.027, $P = 0.054$). Attitudes justifying wife-beating were associated with anxiety (β = 0.074, $P < 0.001$) and, tentatively, with depression (β = 0.035, $P = 0.048$). All ten associations with $P < 0.001$ had $|z| \geq 4.09$ and therefore met the robustness criterion.

Consistent with H4, previous pregnancy loss was associated with anxiety (β = 0.064) and depression (β = 0.053; both $P < 0.001$) after full adjustment. Death of a child showed near-identical, tentative coefficients for both outcomes (β = 0.022 and 0.023; $P = 0.033$ and 0.031). Current pregnancy (β = 0.027, $P = 0.009$) and infecund or menopausal status (β = 0.033, $P = 0.003$) were associated with depression but not anxiety, although neither met the robustness criterion. Children ever born was not associated with either outcome once its relation with socioeconomic resources was modelled (β = 0.012 and − 0.013; $P \geq 0.37$); parity was the strongest covariate predictor of socioeconomic resources (β = −0.381, $P < 0.001$; Supplementary Table S8). Without weights, no coefficient changed by more than 0.019; the only change in significance was for decision-making autonomy and depression, which was significant unweighted (β = 0.039, $P = 0.002$) (Supplementary Table S6).

Table 3
Standardised structural coefficients for anxiety and depressive symptoms from the weighted structural equation model (N = 16,500)

Predictor	Anxiety (GAD-7)			Depression (PHQ-9)		
	β	95% CI	p	β	95% CI	p
Socioeconomic resources	−0.104	−0.130, −0.077	< 0.001	−0.063	−0.090, −0.036	< 0.001
Decision-making autonomy	0.077	0.051, 0.104	< 0.001	0.027	0.000, 0.054	0.054
Attitudes toward wife-beating	0.074	0.038, 0.109	< 0.001	0.035	0.000, 0.070	0.048
Healthcare barriers	0.108	0.082, 0.134	< 0.001	0.101	0.074, 0.127	< 0.001
Woman’s age	0.097	0.070, 0.123	< 0.001	0.080	0.052, 0.107	< 0.001
Children ever born	0.012	−0.016, 0.040	0.408	−0.013	−0.043, 0.016	0.372
Death of a child	0.022	0.002, 0.042	0.033	0.023	0.002, 0.044	0.031
Previous pregnancy loss	0.064	0.045, 0.083	< 0.001	0.053	0.033, 0.073	< 0.001
Currently pregnant	0.009	−0.012, 0.030	0.425	0.027	0.007, 0.048	0.009
Infecund or menopausal	0.015	−0.006, 0.036	0.160	0.033	0.011, 0.055	0.003

Note: β, standardised coefficient; CI, confidence interval. *P* values are from two-sided Wald *z*-tests.

Woman's age and children ever born were standardised before estimation, and children ever born was log-transformed. Explained variance: $R^2 = 0.072$ for anxiety and 0.037 for depression. All coefficients are mutually adjusted; the four latent constructs were additionally regressed on the six covariates (Supplementary Table S8). Confidence intervals do not account for clustering and stratification; associations with $|z| < 3.92$ are interpreted as tentative (see Section 2.4).

3.6 Differential associations across outcomes

Three of ten predictors differed significantly between outcomes after Bonferroni correction, each more strongly associated with anxiety (Table 4): decision-making autonomy (Wald $\chi^2 = 21.38$, $P < 0.001$), whose association with anxiety was nearly three times that with depression, socioeconomic resources (Wald $\chi^2 = 13.87$, $P < 0.001$) and attitudes toward wife-beating (Wald $\chi^2 = 7.93$, $P = 0.0049$); all three also survived Holm adjustment. These differences would remain significant at $P < 0.05$ even if the sampling

variance of each estimate were doubled (Wald χ^2 = 10.69, 6.94 and 3.97). Three further differences were nominal and did not survive correction: children ever born (P = 0.030), whose two coefficients were near zero and of opposite sign, and current pregnancy (P = 0.030) and infecund or menopausal status (P = 0.050), both more strongly associated with depression. Health-care barriers (Wald χ^2 = 0.76, P = 0.384), age (P = 0.105), previous pregnancy loss (P = 0.151) and death of a child (P = 0.920) were associated equally with both outcomes. Correlates reflecting social position, household agency and the normative environment were thus preferentially associated with anxiety, whereas barriers to care, age and reproductive loss were associated comparably with both syndromes.

Table 4
Wald tests of equality of structural coefficients between anxiety and depressive symptoms

Predictor	β GAD-7	β PHQ-9	Wald	p
Decision-making autonomy	0.077	0.027	21.38	< 0.001
Socioeconomic resources	−0.104	−0.063	13.87	< 0.001
Attitudes toward wife-beating	0.074	0.035	7.93	0.0049
Children ever born	0.012	−0.013	4.72	0.030
Currently pregnant	0.009	0.027	4.70	0.030
Infecund or menopausal	0.015	0.033	3.85	0.050
Woman's age	0.097	0.080	2.63	0.105
Previous pregnancy loss	0.064	0.053	2.06	0.151
Healthcare barriers	0.108	0.101	0.76	0.384
Death of a child	0.022	0.023	0.01	0.920

Note: Each row tests the null hypothesis that the unstandardised coefficient linking the predictor to anxiety equals the coefficient linking it to depression (two-sided, 1 degree of freedom). Standardised coefficients are shown for interpretation. The differences for decision-making autonomy, socioeconomic resources and attitudes toward wife-beating remain significant at the Bonferroni-adjusted threshold for ten tests (P < 0.005) and after Holm adjustment (P = 0.00004, 0.0018 and 0.039, respectively); the remaining nominal differences do not. Unstandardised coefficients are given in Supplementary Table S9.

4 Discussion

Read through a social-determinants lens, this study yielded four principal findings. Barriers to reaching health care showed the largest associations with both syndromes, with indistinguishable strength. Decision-making autonomy was associated with more rather than fewer symptoms, predominantly anxiety. Socioeconomic resources, autonomy and acceptance of wife-beating were preferentially associated with anxiety, whereas age, pregnancy loss and bereavement were associated equally with both syndromes. Finally, although highly correlated, the two syndromes were empirically separable.

The latent correlation (0.871) and HTMT ratio (0.864) lie at the boundary of accepted discriminant validity, but three observations argue against a single distress dimension: the one-factor model was rejected (ΔCFI = 0.017); depression was anchored by thoughts of self-harm and depressed mood rather than somatic items (λ = 0.787 and 0.761); and three correlates were unequally associated with the two outcomes after correction for multiple testing, a pattern unlikely if the two factors indexed the same construct. Differential associations could in principle also arise from overlapping item content, and a bifactor specification separating general from specific distress [35] would provide a stronger test. A symptom-network analysis of the same survey likewise found dense within-scale connectivity alongside a small set of bridge symptoms linking the two scales [17]. The findings nonetheless accord with the tripartite model [34] and imply that transdiagnostic and syndrome-specific approaches are each warranted, depending on the correlate targeted.

Access barriers, usually analysed as predictors of service use, also warrant attention as psychosocial exposures: where women's mobility is socially regulated, distance and reluctance to travel alone mark a chronic constraint on agency, closely patterned by poverty and rural residence [25]. Directionality is the main interpretive difficulty, because symptomatic women may appraise a given distance as more burdensome and both were reported in one interview, although the items concern medical care in general rather than mental health care. Even under a bidirectional reading, these women carry a greater symptom burden and are least likely to be reached by facility-based screening, placing them within Bangladesh's treatment gap [6, 9].

The dominance of education over wealth suggests that schooling, through health literacy and coping resources, anchors socioeconomic position in relation to mental health, consistent with Bangladeshi evidence linking lower education to both syndromes [7, 8, 20]. If anxiety is shaped more by chronic uncertainty and depression by discrete adverse events, resources that make the future predictable should attenuate anxiety more, as observed.

The positive association between decision-making autonomy and anxiety contradicts the expectation that agency protects mental health, yet replicates a regional pattern [19, 21, 23]. Decisional responsibility without material or social support may be a burden: a woman deciding on health-care spending in a poor household exercises authority over scarcity, a load more likely to be expressed as worry than anhedonia. Sole decision-making also often follows spousal absence through migration, illness or widowhood, and the items pool sole and joint decisions and record who decides, not whether the arrangement was negotiated or imposed, so these explanations could not be separated here. A recent analysis using a composite empowerment index found no association between its decision-making domain and symptoms [15]; modelling autonomy separately from resources and norms, as here, may reveal associations that composite indices average away. The finding is not an argument against advancing women's agency; rather, the decision-making domain is a poor stand-alone proxy for wellbeing, and empowerment may act as a stressor without supportive environments [20].

Endorsement of wife-beating was associated with anxiety and, tentatively, with depression, as in previous Bangladeshi analyses [14, 22]. Internalised acceptance of subordination entails lower perceived control and self-blame, both tied to anxious apprehension, and because endorsement is shaped by community norms [45], the measure may also index an environment in which violence is normalised. Experience of intimate partner violence, strongly associated with depression [58], was not modelled and remains a plausible confounder.

Symptoms increased with age for both outcomes, with no difference between them, as in earlier analyses of this survey [18, 21], whereas the global disability burden of anxiety disorders among women peaks at 20–44 years [59], suggesting accumulating demands across the reproductive years in this setting. Children ever born was not independently associated with either outcome; its association with anxiety reported elsewhere [20] appears to operate through socioeconomic disadvantage, because higher parity was the strongest covariate predictor of fewer socioeconomic resources. Pregnancy loss was associated with both outcomes after full adjustment, consistent with meta-analytic [26] and Bangladeshi evidence [22, 28]. Near-identical coefficients for child death suggest that bereavement acts on the shared distress core, although this association was tentative. Current pregnancy was associated with depression but not anxiety, consistent with the substantial burden of perinatal depression in low- and middle-income countries [60]. Women classified as infecund or menopausal also reported more depressive, but not anxiety, symptoms independently of age, which may reflect the menopausal transition or the distress of involuntary infecundity where fertility is socially valued; the data cannot separate these explanations, and neither difference survived correction for multiple testing.

These divisional patterns are descriptive and unadjusted and were not formally tested, so they indicate where burden is concentrated rather than why. Divisional patterns differed by outcome, broadly replicating previous analyses [19, 21, 28]. Rangpur, Khulna and Sylhet face chronic environmental and economic stressors, including seasonal deprivation and riverbank erosion, coastal salinity and cyclones, and flash flooding. Flood exposure has been associated with depression and anxiety and higher temperature with anxiety [29]. The reversed rural–urban anxiety gradient in Khulna and Sylhet may reflect displacement into peri-urban settlements or migration of husbands, although the design cannot distinguish these explanations.

The three- to six-fold excess of anxiety over depression has also been reported with the same instruments in Nepal [23] and Bangladesh [18]. It largely reflects the lower anxiety cut-point (GAD-7 > 5, as used by Amin et al. [18], versus PHQ-9 > 9) and possibly cultural expression: across South Asia, distress is commonly articulated as "tension" [61], a term that spans mild worry through to severe symptoms. If worry is the socially sanctioned vocabulary of suffering, GAD-7 items may capture a broader range of experience, and locally calibrated thresholds are a research priority.

4.1 Implications for policy and practice

Four implications follow, each proportionate to associations that are modest in size (Fig. 4). First, because access barriers showed the largest associations with both syndromes, facility-based screening alone is likely to under-reach women who report difficulty reaching care; outreach through community health workers, satellite clinics and transport or escort support could address a correlate and the treatment gap together, and brief psychological interventions delivered by non-specialist workers are effective in low-resource settings [62, 63]. Second, current pregnancy and infecund or menopausal status were associated with depression rather than anxiety, so brief validated depression screening and referral within antenatal care, and within primary care for women beyond their childbearing years, offers a practical entry point. Third, interventions addressing socioeconomic position, decisional burden and gender norms should report anxiety outcomes specifically, whereas those addressing access and bereavement warrant transdiagnostic evaluation. Fourth, the descriptive concentration of symptoms in Rangpur, Khulna and Sylhet supports their consideration in planning, ideally through existing climate-adaptation and livelihood programmes, once confirmed with adjusted, design-based estimates. Because these recommendations rest on cross-sectional associations, they should be evaluated prospectively.

β, standardised coefficient from the weighted structural model; regional prevalence figures are descriptive. The associations are cross-sectional, so the actions follow from association together with mechanistic plausibility rather than from causal estimates. The positive association between decision-making autonomy and anxiety is not an argument against advancing women's agency; it indicates that decisional responsibility without matching resources may carry psychological costs. Evidence for task-shifting is cited in the text [62, 63]. Infecund, women classified by the DHS as infecund or menopausal

4.2 Significance for health and future research

For health, the findings indicate that the social conditions most often targeted by empowerment and poverty-reduction programmes, namely socioeconomic position, household decision-making and gender norms, are linked more closely with anxiety than with depression, whereas restricted access to care relates to both. Evaluations that measure only depression, or a single combined distress score, may therefore miss benefits or harms concentrated in one syndrome. For future research, three priorities follow. Longitudinal data are needed to establish whether access barriers and decisional burden precede symptoms or follow them. Measurement invariance of the PHQ-9 and GAD-7 across residence, age and reproductive stage should be tested, and locally calibrated thresholds developed. Finally, when two correlated outcomes are analysed, joint modelling with formal equality tests should replace comparisons across separate models, which cannot show whether a social condition differs in its association with each outcome.

4.3 Strengths and limitations

Strengths include national representativeness, weighted estimation, an ordinal estimator, explicit measurement error, mutual adjustment of all latent and observed predictors and formal equality tests. Several limitations apply. The cross-sectional design precludes temporal ordering, particularly for access barriers and autonomy, which are plausibly reciprocal with symptoms, and single-interview reporting

permits common-method variance. Design-based standard errors for clustering and stratification were unavailable for the estimator, so confidence intervals are likely too narrow; we therefore treated only associations with $|z| \geq 3.92$ as robust and reported the remainder as tentative. The PHQ-9 and GAD-7 measure symptom dimensions rather than diagnoses, have been validated in general Bangladeshi adult samples rather than specifically in rural or perinatal women, and were not tested for measurement invariance across residence or age. The descriptive prevalence estimates used asymmetric cut-points (GAD-7 > 5 and PHQ-9 > 9), which inflate the ratio of anxiety to depression, and divisional differences were not formally tested. Findings do not extend to never-married women, and complete-case restriction excluded 3,487 screened women (17.4%), so selection bias cannot be excluded. The decision-making items pooled sole and joint decisions, and unmeasured factors, including experienced intimate partner violence, social support, husband's migration and food insecurity, may cause residual confounding and partly explain the modest variance explained. Finally, the barriers factor is carried mainly by distance, the anxiety–depression HTMT ratio marginally exceeded its threshold, and the depression AVE fell just below 0.50 (Supplementary Note S2).

5 Conclusions

Depressive and anxiety symptoms among reproductive-age Bangladeshi women are strongly comorbid yet have partly distinct social correlates. Barriers to reaching health care showed the largest associations with both and are the clearest transdiagnostic target, whereas socioeconomic position, decisional burden and normative acceptance of violence were associated preferentially with anxiety, and age and pregnancy loss with both syndromes equally. Joint modelling with equality tests shows where a single intervention logic may serve both syndromes and where it may not, a distinction that separate single-outcome models cannot recover and that can inform the design and evaluation of mental health programmes for women in Bangladesh.

Declarations

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Data availability

The 2022 BDHS datasets are publicly available from the DHS Program (https://dhsprogram.com) upon registration and approval of a data request.

Code availability

Data were prepared in Stata 17, and R code used for model estimation and figure production is available from the corresponding author on reasonable request.

Ethics approval and consent to participate

The 2022 BDHS protocol, including the mental health module, was reviewed and approved by the ICF Institutional Review Board and the Bangladesh Medical Research Council. Informed consent was obtained from all survey participants by the BDHS fieldwork teams before interview, with parental or guardian consent and the respondent's assent for women younger than 18 years [13]. This study analysed de-identified, publicly available secondary data obtained from The DHS Program under an approved data request and involved no contact with participants; no additional ethical approval was

therefore required. All methods were performed in accordance with the relevant guidelines and regulations, including the Declaration of Helsinki.

Clinical trial number

Clinical trial number: not applicable. This study is a secondary analysis of de-identified, cross-sectional data from the 2022 Bangladesh Demographic and Health Survey, a nationally representative household survey. It involved no intervention and no prospective assignment of participants to health-related interventions, and therefore does not meet the definition of a clinical trial.

Consent for publication

Informed consent was obtained from all survey participants by the BDHS 2022 fieldwork teams before interview, with parental or guardian consent and the respondent's assent for women younger than 18 years.

Competing interests

Not applicable. The manuscript contains no individual-level identifiable data, images or personal details.

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Figures

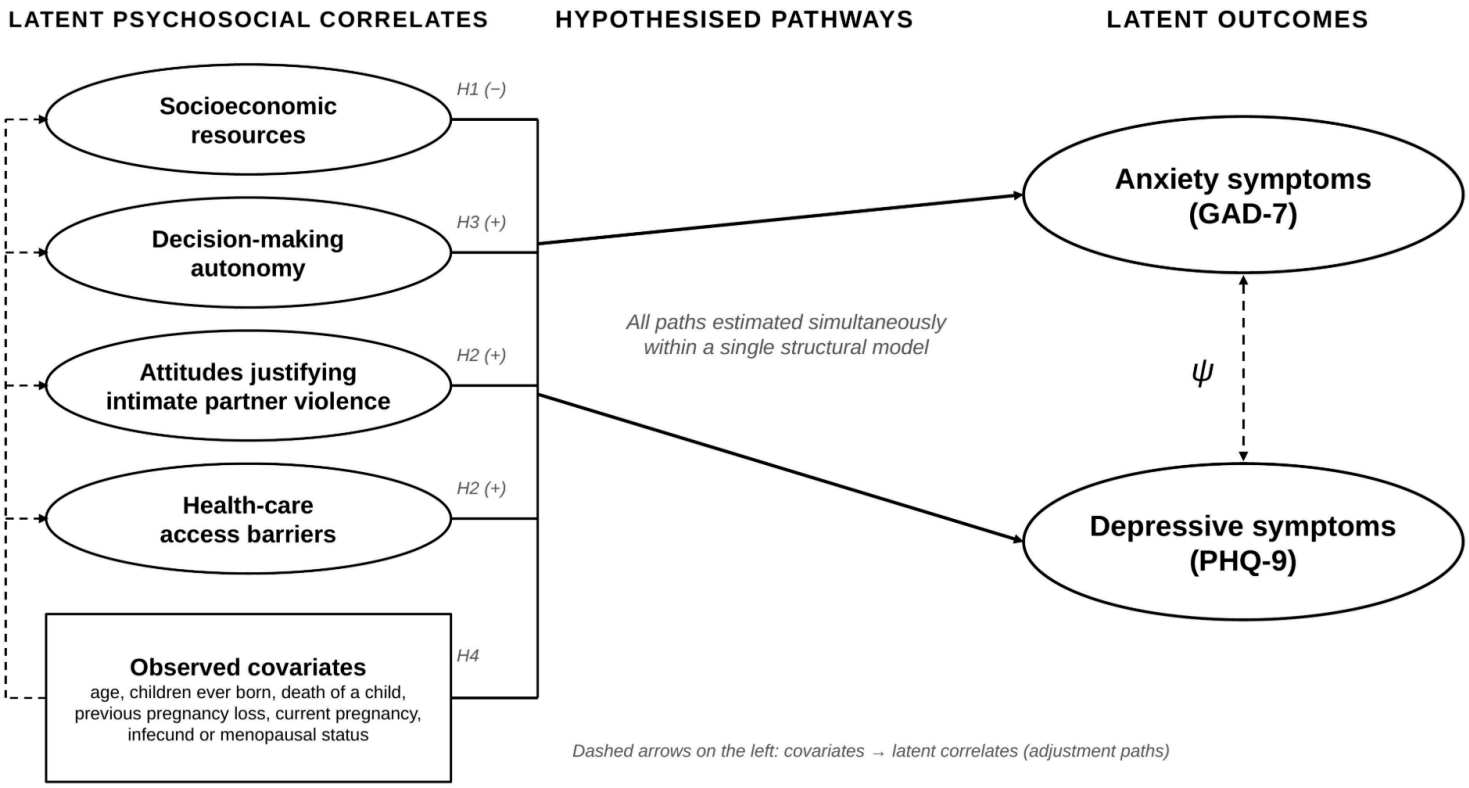


Figure 1

Conceptual framework of psychosocial correlates of depressive and anxiety symptoms. Ellipses denote latent constructs and the rectangle the six observed covariates (age, children ever born, death of a child, previous pregnancy loss, current pregnancy and infecund or menopausal status). Single-headed solid arrows denote hypothesised structural paths, all estimated simultaneously; dashed arrows on the left denote regressions of the four latent constructs on the six covariates (adjustment paths); the dashed double-headed arrow (ψ) denotes the freely estimated residual covariance between the two outcomes. Indicators: socioeconomic resources (household wealth, woman's education, husband's education, internet use, newspaper readership); decision-making autonomy (own earnings or large purchases, family visits, own health care); attitudes justifying intimate partner violence (five wife-beating justification items); health-care access barriers (distance to facility, not wanting to go alone). H1–H4 denote the hypotheses stated in the text. GAD-7, Generalized Anxiety Disorder-7; PHQ-9, Patient Health Questionnaire-9.

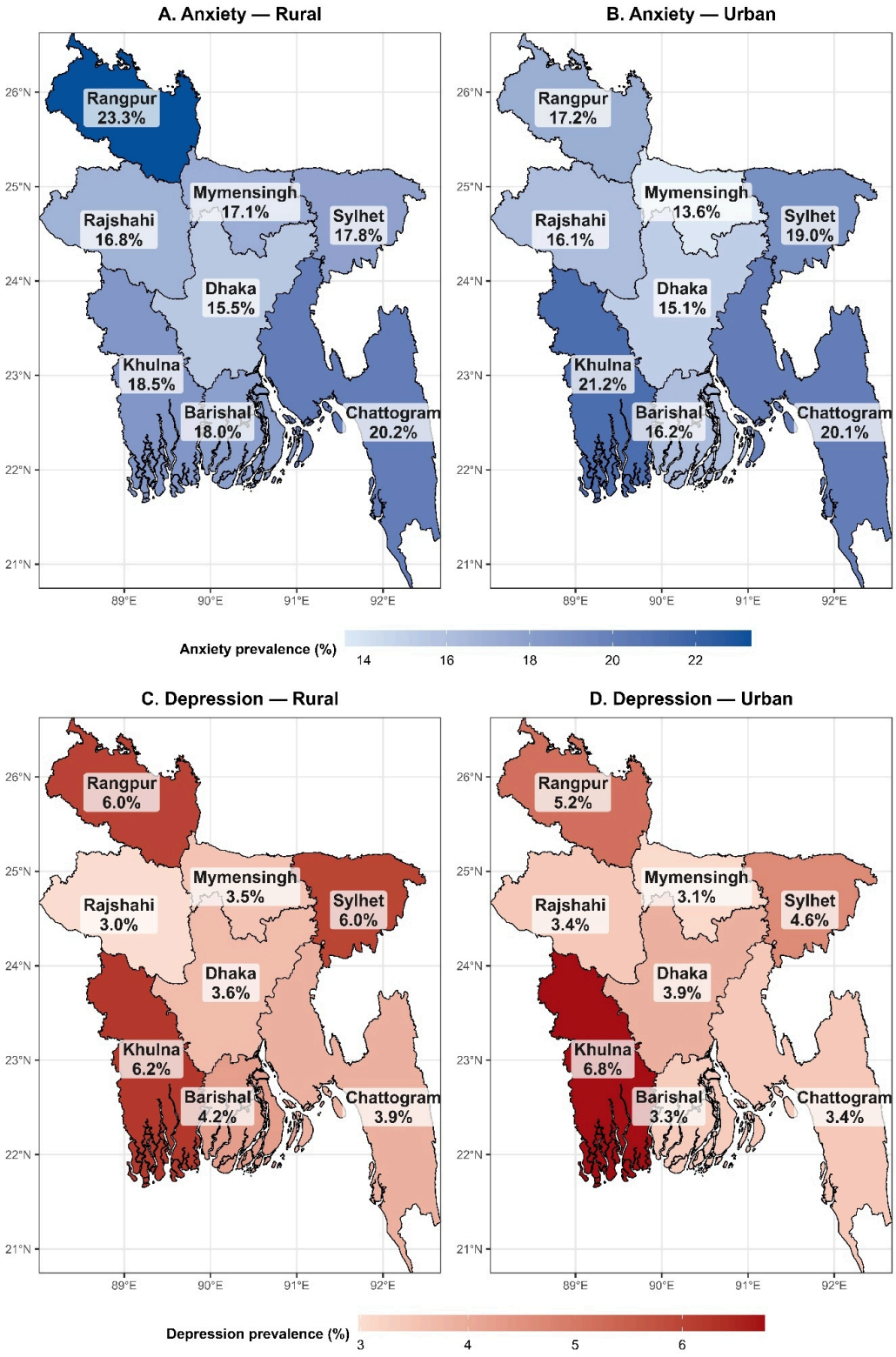


Figure 2

Prevalence of anxiety and depressive symptoms across the eight administrative divisions of Bangladesh by place of residence. Ever-married women aged 15–49 years (N = 16,500). (**a**) Anxiety symptoms among rural women. (**b**) Anxiety symptoms among urban women. (**c**) Depressive symptoms among rural women. (**d**) Depressive symptoms among urban women. All prevalence estimates are weighted. Anxiety symptoms were defined as GAD-7 > 5 and depressive symptoms as PHQ-9 > 9. Colour intensity is scaled

separately for anxiety (blue) and depression (red); labels give division-specific prevalence. Maps were drawn in R using division-level administrative boundary shapefiles.

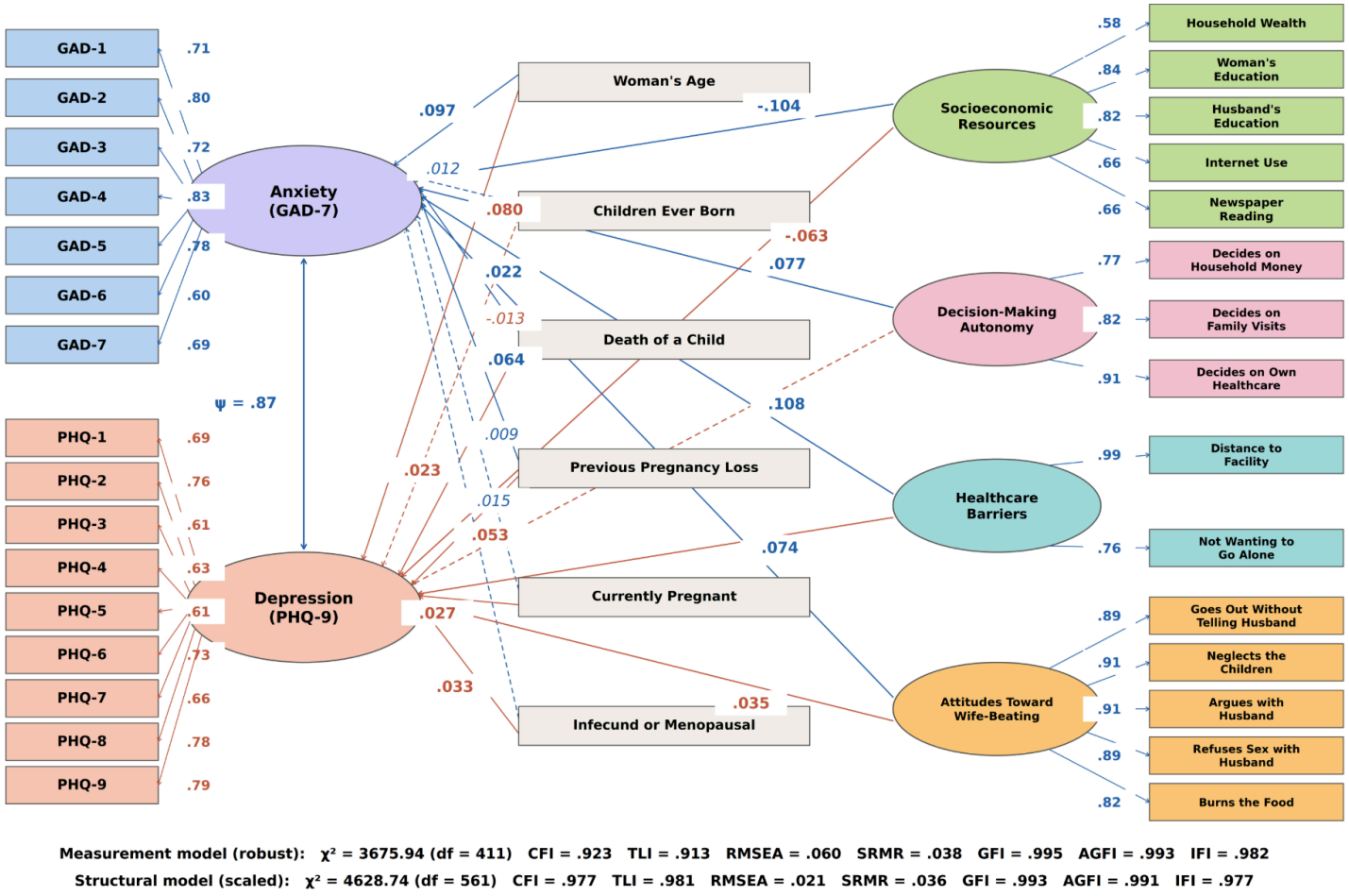


Figure 3

Structural equation model of anxiety (GAD-7) and depressive (PHQ-9) symptoms among ever-married women aged 15–49 years, Bangladesh Demographic and Health Survey 2022 (N = 16,500). Ellipses represent latent constructs and rectangles observed indicators or covariates; values beside indicator arrows are standardised factor loadings from the measurement model (Supplementary Table S2). Values on structural paths are standardised coefficients; blue denotes paths to anxiety and red paths to depression; solid lines with upright values are significant at $P < 0.05$, and dashed lines with italic values are not. ψ denotes the residual correlation between the two latent outcomes (0.869). Regressions of the four latent constructs on the six covariates and the eight a priori residual covariances among symptom items were estimated but are omitted for clarity (Supplementary Table S8; Supplementary Methods S3). Fit statistics are shown beneath the diagram; GFI and AGFI are descriptive only.

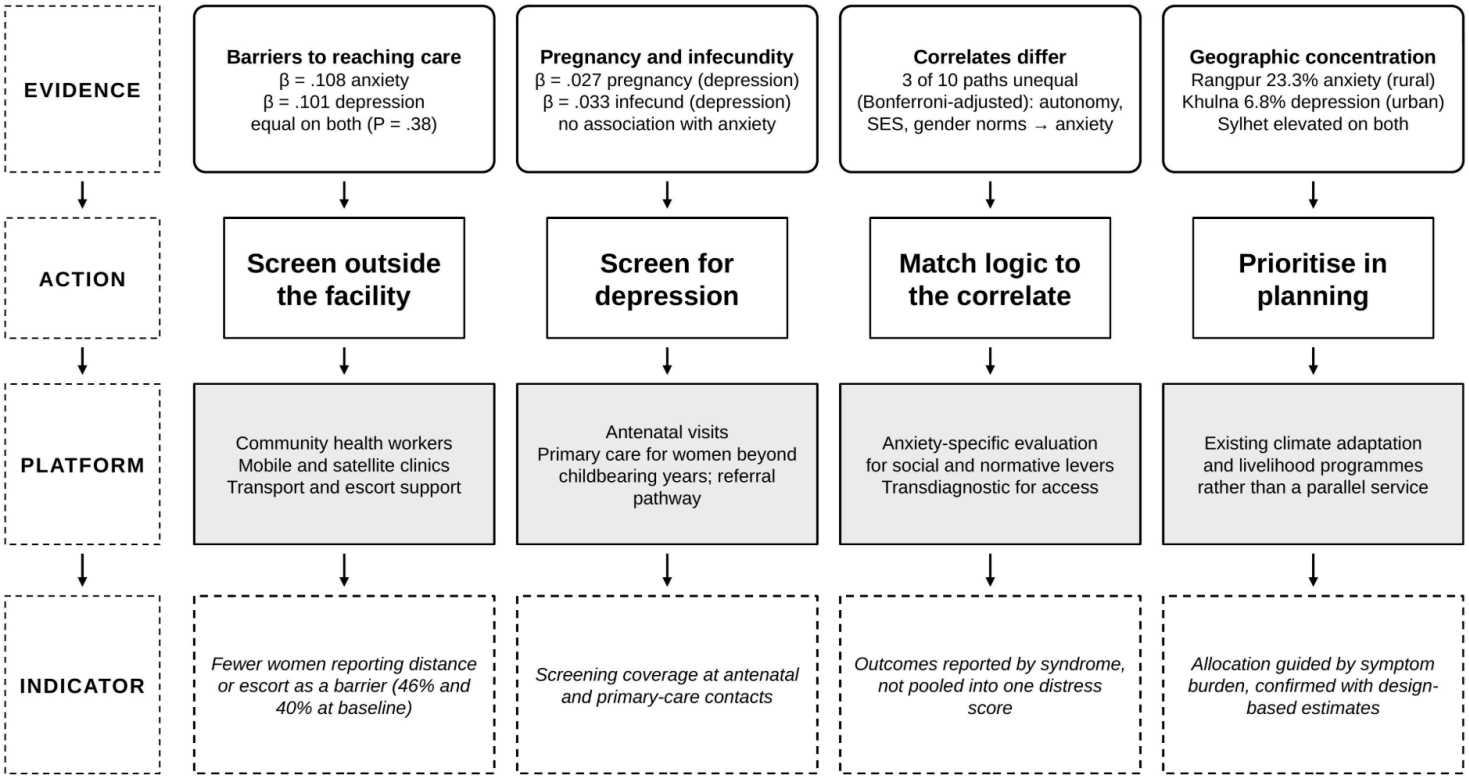


Figure 4

Policy implementation pathway linking the principal findings to actions, delivery platforms and monitoring indicators. Each column carries one model finding (evidence, top row) through a recommended action, a delivery platform and a measurable indicator (bottom row). Solid boxes denote recommended actions, shaded boxes delivery platforms and dashed boxes monitoring indicators.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- ESM1.docx