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Group-based behavioral activation therapy improves depression and health- related quality of life: A parallel mediation analysis of a cluster-randomized controlled trial in Vietnam

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Research Article

Keywords: behavioral activation, depression, mediation analysis, health-related quality of life, cluster randomized controlled trial, resilient coping, Vietnam

Posted Date: November 26th, 2026

DOI: https://doi.org/10.21203/rs.3.rs-11501508/v1

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Additional Declarations: No competing interests reported.

Abstract

Background

Group-based behavioral activation therapy (GBAT) may reduce depressive symptoms in primary care, but the pathways underlying longer-term outcomes are not fully understood. We examined whether early behavioral activation and resilient coping mediated the effects of GBAT on depressive symptoms and health-related quality of life (HRQoL) in Vietnam.

Methods

We conducted parallel mediation analyses using existing data from a two-arm cluster-randomized controlled trial across six commune health stations in Thanh Hoa Province, Vietnam, from August 2024 to September 2025. Adults aged 18–65 years with Patient Health Questionnaire-9 (PHQ-9) scores ≥ 10 were enrolled in the trial. Three communes were allocated to GBAT, which comprised eight weekly sessions, and three communes were allocated to a control condition comprising psychoeducation and referral information. Behavioral activation, measured with the Behavioral Activation for Depression Scale-Short Form (BADS-SF), and resilient coping, measured with the Brief Resilient Coping Scale (BRCS-4), were assessed at 8 weeks. Distal outcomes were PHQ-9 and EQ-5D-5L utility at 9 months. Intention-to-treat analyses used multiple imputation, cluster-robust (CR2) standard errors, and Monte Carlo confidence intervals for indirect effects.

Results

The trial enrolled 242 participants (121 in each group). GBAT was associated with higher BADS-SF (B = 12.38; 95% CI, 7.66 to 17.11) and BRCS-4 scores (B = 4.31; 95% CI, 3.19 to 5.42) at 8 weeks. For PHQ-9 at 9 months, the adjusted total effect was B = − 9.97 (95% CI, − 12.10 to − 7.84). Indirect effects were observed through behavioral activation (B = − 2.12; 95% CI, − 3.39 to − 1.07; 21.3% mediated) and resilient coping (B = − 0.87; 95% CI, − 1.62 to − 0.19; 8.7% mediated). For EQ-5D-5L utility, the adjusted total effect was B = 0.386 (95% CI, 0.288 to 0.484). The indirect effect through behavioral activation was B = 0.137 (95% CI, 0.073 to 0.215; 35.5% mediated), whereas the indirect effect through resilient coping was close to zero and nonsignificant.

Conclusions

Behavioral activation was the largest measured pathway linking GBAT to improvements in depressive symptoms and HRQoL. Resilient coping may provide an additional pathway for depressive symptom improvement.

Trial registration:

ClinicalTrials.gov, NCT07527312. First submitted on 7 April 2026 and first posted on 14 April 2026; retrospectively registered. https://clinicaltrials.gov/study/NCT07527312.

Background

Depression is a common and disabling mental disorder that affects functioning, relationships, work, and community participation. Globally, an estimated 5.7% of adults experience depression, affecting approximately 332 million people [1]. Although effective psychological and pharmacological treatments are available, depression remains substantially undertreated [1]. The treatment gap is especially pronounced in low- and middle-income countries, where the supply of specialist mental health professionals is insufficient relative to population need and primary care services are often the first or only point of contact for people with depressive symptoms [1, 2]. Population-based evidence from Vietnam indicates that the public recommends a range of professional and nonprofessional treatment options for depression and highlights the need for further development of accessible mental health services [3]. This persistent treatment gap has prompted international efforts to integrate evidence-based psychological interventions into primary care and expand delivery through trained non-specialist providers [2]. In line with these efforts, Vietnam has strengthened community-based depression care through collaborative models linking commune health stations with specialist supervision and referral pathways. However, the availability of scalable, evidence-based psychological interventions that can be delivered routinely within commune health stations remains limited [4, 5].

Behavioral activation (BA) is one of the most extensively studied brief psychological interventions for adult depression. It aims to increase engagement in meaningful, healthy, and rewarding activities while reducing avoidance [6]. Systematic reviews and meta-analyses consistently indicate that BA is effective for adult depression, with outcomes comparable to those of other structured psychotherapies in some settings [7–9]. A meta-analysis of 22 randomized controlled trials reported a large effect for individual BA compared with control conditions (Hedges' g = 0.85, 95% CI 0.57–1.10); the estimated effect was moderate when analyses were restricted to studies at low risk of bias (g = 0.56, 95% CI 0.09–1.03) [8]. BA may be particularly suitable for resource-constrained primary care because it is structured, time-limited, and can be delivered by trained non-specialist providers with relatively modest training and supervision requirements [2]. Evidence from resource-constrained primary care supports its feasibility and effectiveness. In India, the six- to eight-session Healthy Activity Programme, a BA-based intervention delivered by lay counselors, reduced depressive symptom severity and increased remission compared with enhanced usual care [10]. Group delivery may further enhance feasibility by increasing service capacity and providing opportunities for peer support, shared learning, and social connection [11, 12]. These features align with recommendations to expand access to psychological care through supervised non-specialist and primary care platforms in low- and middle-income countries [2, 13].

Understanding the mechanisms through which BA improves depression is important for identifying the components that should be preserved during scale-up, the processes that should be monitored during delivery, and appropriate responses when participants do not improve. The primary hypothesized mechanism is increased engagement in positively reinforcing and goal-directed activities, which may promote mastery, pleasure, routine, and social connection and thereby interrupt the cycle of low mood, withdrawal, and avoidance [6, 14]. Empirical studies also support behavioral activation as a treatment mechanism. In the Healthy Activity Programme trial in India, increased activation after treatment partially mediated depression outcomes at 12 months [15]. A subsequent causal mediation analysis estimated that 34% of the intervention effect on PHQ-9 scores operated through improved behavioral activation [16]. An internet-delivered BA trial similarly found that increases in activation preceded and mediated subsequent reductions in depressive symptoms [17].

Resilient coping was examined as a secondary candidate mediator. The BRCS conceptualizes resilient coping as a tendency to respond adaptively to stress and adversity [18]. Because the group-based BA program included problem solving, communication, social connection, and relapse prevention, it may strengthen participants' capacity to manage stressors after the structured sessions end. However, direct evidence that BRCS-measured resilient coping mediates the effects of BA is limited; its role as an independent mechanism therefore remains uncertain.

Depression treatment should be evaluated beyond symptom reduction because recovery also involves improvements in functioning, participation in daily life, and perceived health status. Health-related quality of life (HRQoL) is therefore an important patient-centered outcome, particularly in primary care, where successful treatment is expected to support recovery in everyday functioning and social roles [19, 20]. Although BA is designed to increase engagement in meaningful activities and improve functioning, relatively little is known about whether the mechanisms that reduce depressive symptoms also explain longer-term improvements in HRQoL. Clarifying these pathways may provide a more comprehensive account of recovery and inform optimization of BA interventions.

This study used a parallel mediation framework within a cluster-randomized controlled trial of group-based behavioral activation therapy (GBAT) delivered through commune health stations in Vietnam. We examined whether behavioral activation and resilient coping at 8 weeks mediated the effects of GBAT on depressive symptom severity and HRQoL at 9 months. We hypothesized that GBAT would improve both candidate mediators at 8 weeks; that higher behavioral activation and resilient coping would be associated with better 9-month outcomes; and that behavioral activation would be the primary pathway, with resilient coping providing a secondary pathway, particularly for depressive symptoms. By examining these mechanisms within a supervised, non-specialist, commune-based delivery model, this study aims to identify the processes that should be preserved and monitored when GBAT is scaled up in primary care.

Methods

Study design and setting

This study used existing data from a two-arm, parallel-group cluster-randomized controlled trial evaluating GBAT for adults with elevated depressive symptoms in Vietnam. The primary effectiveness results of the trial have been reported elsewhere [21]; the present study is a secondary analysis of trial mechanisms. The trial was conducted in six commune health stations in Quang Xuong District, Thanh Hoa Province, Vietnam, from August 2024 to September 2025, with three communes allocated to GBAT and three to the control condition. Assessments were conducted at baseline, 8 weeks, and 3, 6, and 9 months after randomization. The mediation analysis examined whether behavioral activation and resilient coping at 8 weeks mediated the effects of GBAT on depressive symptom severity and HRQoL at 9 months. Reporting followed CONSORT 2025 and the existing CONSORT extension for cluster-randomized trials [22, 23]. Participant recruitment, allocation, follow-up, and analysis are summarized in the CONSORT flow diagram (Additional file 1: Fig. S1), and the completed CONSORT checklist is provided in Additional file 2.

Participants

Participants were adults aged 18–65 years living in one of the six participating communes. Trained community collaborators screened 2,392 individuals using the Patient Health Questionnaire-2 (PHQ-2); 940 individuals with PHQ-2 scores ≥ 2 attended commune health stations for further assessment using the Patient Health Questionnaire-9 (PHQ-9) [24, 25]. Overall, 371 individuals had PHQ-9 scores ≥ 10 and underwent further eligibility assessment. Individuals who met the remaining eligibility criteria and agreed to participate provided written informed consent before baseline assessment. Exclusion criteria were severe physical illness; severe mental disorder; substance use disorder; epilepsy; dementia; intellectual disability; physical disability that prevented participation; psychotic symptoms; or severe suicidal ideation requiring urgent specialist referral. A total of 242 participants were enrolled, with 121 in each trial arm, in line with a prespecified recruitment target of approximately 40 participants per commune. The trial sample size (target, 240 participants) was calculated for the primary effectiveness outcome [21]; no separate sample size calculation was performed for the present mediation analysis. All enrolled participants were included in the intention-to-treat mediation analyses according to their commune-level allocation.

Randomization and blinding

Randomization was conducted at the commune level to reduce contamination among participants living in the same commune. Six communes in Quang Xuong District with broadly similar population and socioeconomic characteristics were selected and randomly allocated by one investigator (PTTH) by drawing lots using an online random wheel-spinning tool, with three communes assigned to each arm. Allocation of all six communes was completed before participant recruitment began. Allocation sought to maintain geographic separation between intervention and control communes (approximately 10 km or

more where feasible) to reduce spillover of intervention content [21]. Participants received the condition assigned to their commune. Because commune allocation preceded recruitment, staff who conducted screening and enrolment were aware of allocation; the same standardized screening and eligibility procedures were therefore applied in all six communes [21]. Owing to the nature of the intervention, participants and intervention providers could not be blinded to group assignment. Outcomes were self-reported using structured electronic forms, and data were captured using coded group labels.

Intervention and control condition

Participants in the intervention arm received GBAT in eight weekly group sessions delivered at commune health stations. Each group was co-facilitated by two commune health staff who had completed 80 hours of group BA training with competency assessment, and delivery was supervised by Thanh Hoa Psychiatric Hospital [21]. The program focused on core BA strategies, including understanding the relationship between mood and activity; increasing engagement in healthy and meaningful activities; setting goals and planning activities; solving problems; strengthening social connections; developing communication skills; and preventing relapse. Intervention fidelity was supported through video recording of all sessions, checklist-based supervision, and feedback from supervisors after sessions. The eight-week program is summarized in Additional file 1: Table S1. Participants in the control arm received psychoeducation and an informational leaflet describing depressive symptoms and referral options, including contact details for Thanh Hoa Psychiatric Hospital. Most participants in both arms did not use antidepressant medication during the trial; individuals with severe symptoms identified at screening were referred to provincial psychiatric services rather than enrolled.

Measures

Demographic characteristics

Participants reported demographic characteristics, including age, sex, education, and occupation.

Assessment of depressive symptom severity

The nine-item Patient Health Questionnaire-9 (PHQ-9) was used to assess depressive symptoms during the previous two weeks [25]. Each item is rated on a four-point scale from 0 (not at all) to 3 (nearly every day), yielding a total score from 0 to 27; higher scores indicate greater symptom severity. The PHQ-9 has been widely used and psychometrically evaluated in diverse populations, including in Vietnam [26]. The 9-month PHQ-9 score was the primary distal outcome. Internal consistency in the present sample was acceptable (Cronbach's alpha = 0.71).

Assessment of health-related quality of life

Health-related quality of life (HRQoL) was measured using the EuroQol 5-Dimension 5-Level instrument (EQ-5D-5L) [19, 20]. Each dimension is rated on a 5-point Likert scale, ranging from 1 (no problem) to 5 (extreme problem). Health states were converted to utility scores using the Vietnamese EQ-5D-5L value set [27]. Higher utility scores indicate better HRQoL. The 9-month EQ-5D-5L utility score was the secondary distal outcome.

Assessment of behavioral activation

Behavioral activation was measured using the nine-item Behavioral Activation for Depression Scale-Short Form (BADS-SF) [28]. Items are rated from 0 (not at all) to 6 (completely), yielding a total score from 0 to 54; higher scores indicate greater behavioral activation and less avoidance. The 8-week BADS-SF score was the first mediator. Internal consistency was acceptable (Cronbach's alpha = 0.70).

Assessment of resilient coping

Resilient coping was measured using the four-item Brief Resilient Coping Scale (BRCS-4) [18]. Each item is rated from 1 to 5, yielding a total score from 4 to 20; higher scores indicate greater resilient coping. A Vietnamese clinical study reported good internal consistency for the BRCS [29]. The 8-week BRCS-4 score was the second mediator. Internal consistency was good (Cronbach's alpha = 0.82).

Mediation framework and data analysis

In the trial, PHQ-9 was the primary outcome and BADS-SF, BRCS-4, and EQ-5D-5L were prespecified secondary outcomes [21]. We used a parallel mediation framework to evaluate whether BADS-SF and BRCS-4 scores at 8 weeks mediated the effect of GBAT on 9-month outcomes. Temporal ordering was specified before analysis: treatment assignment occurred at baseline, mediators were measured at 8 weeks, and distal outcomes were measured at 9 months. Separate mediation models were fitted for PHQ-9 and EQ-5D-5L utility. For each outcome, two a-path models estimated the effect of GBAT on 8-week BADS-SF and BRCS-4 scores. The outcome model included treatment assignment, both 8-week mediators, and baseline covariates, thereby estimating the b path from each mediator to the 9-month outcome and the direct effect of GBAT after adjustment for both mediators. A separate total-effect model estimated the effect of GBAT on each 9-month outcome without the mediators. The pathway-specific indirect effects were calculated as a1 × b1 for BADS-SF and a2 × b2 for BRCS-4; the total indirect effect was the sum of these two products. The proportion mediated was calculated as the indirect effect divided by the total effect. All reported path coefficients and direct, total, and indirect effects are unstandardized. Model 1 adjusted for baseline PHQ-9, EQ-5D-5L utility, BADS-SF, and BRCS-4. Model 2 additionally adjusted for age, sex, education, and occupation. Findings were interpreted as evidence consistent with mediation because mediator-outcome associations may remain susceptible to residual confounding even when treatment assignment is randomized [30].

Missing data

The primary mediation analyses followed the intention-to-treat principle. Missing mediator, outcome, and covariate data were handled using multiple imputation by chained equations under a missing-at-random assumption [31, 32]. The imputation model included treatment assignment; age, sex, education, and occupation; and repeated measurements of PHQ-9, EQ-5D-5L utility, BADS-SF, and BRCS-4. Fifty imputed datasets were generated using predictive mean matching for continuous variables, logistic regression for binary variables, and polytomous regression for occupation. Treatment assignment and commune were not imputed. Commune was retained for cluster-robust inference but was not used as an imputation predictor. Coefficients and covariance matrices were pooled across imputed datasets using Rubin's rules [31]. Baseline characteristics and time-point summaries were calculated from observed data, whereas the primary inferential analyses used the multiply imputed datasets. Missingness in key variables and baseline characteristics by 9-month outcome missingness are reported in Additional file 1: Tables S2A and S2B.

Statistical analysis

Baseline characteristics were summarized using means and standard deviations (SDs) for continuous variables and frequencies and percentages for categorical variables. Because baseline differences in a randomized trial arise by chance, baseline balance was described using standardized mean differences (SMDs) rather than significance tests [33]. Because randomization occurred at the commune level and only six clusters were available, all regression models used commune-clustered standard errors with the bias-reduced CR2 covariance estimator, which is designed to reduce small-sample bias in cluster-robust variance estimates [34]. Coefficients and CR2 covariance matrices were pooled across the 50 imputed datasets using Rubin's rules. Two-sided 95% confidence intervals for path coefficients and direct and total effects were calculated from the pooled CR2 variances using a normal approximation. Confidence intervals for indirect effects were obtained from 200,000 Monte Carlo simulations, drawing the two a-path coefficients independently from their pooled normal distributions and the two b-path coefficients jointly from their pooled covariance matrix [35, 36]. Complete-case analyses were conducted as a sensitivity analysis using participants with observed treatment assignment, commune, both 8-week mediators, the relevant 9-month outcome, and the baseline covariates required for Model 1. Analyses were conducted in R [37] using the mice and clubSandwich packages. Interpretation emphasized the magnitude, direction, and precision of total, direct, and indirect effects.

Ethics and trial registration

The trial was approved by the Research Ethics Committee of Hanoi Medical University (IRB00003121/1385/GCN-HMUIRB) and was conducted in accordance with the Declaration of Helsinki. All participants provided written informed consent before baseline assessment. The trial was retrospectively registered with ClinicalTrials.gov (NCT07527312). The registration record was first submitted on 7 April 2026 and first publicly posted on 14 April 2026. The retrospective registration resulted from an administrative delay, and the trial protocol is available in the registry record. Participants requiring specialist mental health care or urgent referral were referred to Thanh Hoa Psychiatric Hospital.

Results

Participant characteristics

All 242 enrolled participants from the six randomized communes were included in the analysis, with 121 assigned to control and 121 to GBAT (Additional file 1: Fig. S1). In the GBAT arm, 107 participants (88.4%) attended at least six of the eight sessions. Follow-up assessments were completed by 212 participants (87.6%) at 8 weeks and 208 (86.0%) at 9 months. Participants were predominantly female (93.4% in the control group and 97.5% in the GBAT group); mean age was 55.36 years (SD, 8.23) in the control group and 56.40 years (SD, 7.69) in the GBAT group. Mean baseline PHQ-9 scores were 16.79 (SD, 4.55) and 15.86 (SD, 3.68), respectively. Baseline characteristics and scale scores were generally comparable between groups (Table 1). The largest baseline imbalance was observed for occupation (SMD = 0.41), whereas SMDs for baseline mediator and outcome scores (BADS-SF, BRCS-4, PHQ-9, and EQ-5D-5L utility) ranged from 0.01 to 0.22. Cluster sizes ranged from 40 to 41 participants per commune, and baseline intracluster correlation coefficients were 0.033 for PHQ-9, 0.059 for EQ-5D-5L utility, 0.043 for BADS-SF, and 0.029 for BRCS-4 [21].

Table 1
Baseline characteristics and baseline measures

Characteristic	Control (n = 121)	GBAT (n = 121)	SMD
Age, mean (SD), years	55.36 (8.23)	56.40 (7.69)	0.130
Female sex, n (%)	113 (93.4)	118 (97.5)	0.199
≥ High school educational level, n (%)	33 (27.3)	36 (29.8)	0.055
Occupation, n (%)	-	-	0.405
Unemployed	5 (4.1)	5 (4.1)	
Worker	3 (2.5)	4 (3.3)	
Retired	3 (2.5)	0 (0.0)	
Government staff	1 (0.8)	1 (0.8)	
Farmer	79 (65.3)	89 (73.6)	
Self-employed	17 (14.0)	10 (8.3)	
Homemaker	12 (9.9)	7 (5.8)	
Other	1 (0.8)	5 (4.1)	
PHQ-9 at baseline, mean (SD)	16.79 (4.55)	15.86 (3.68)	0.224
EQ-5D-5L utility at baseline, mean (SD)	0.55 (0.20)	0.54 (0.24)	0.047
BADS-SF at baseline, mean (SD)	24.14 (7.54)	24.25 (7.95)	0.014
BRCS-4 at baseline, mean (SD)	12.02 (3.85)	12.67 (4.04)	0.166

Notes: Values are based on observed baseline data before multiple imputation. SMDs quantify between-group balance at baseline, with values closer to 0 indicating better balance. GBAT = group-based behavioral activation therapy; SMD = standardized mean difference.

Observed means and sample sizes for the mediators at 8 weeks and distal outcomes at 9 months are reported in Additional file 1: Table S3. The primary results below are based on adjusted intention-to-treat analyses using multiple imputation.

Parallel mediation results for depressive symptom severity

In the primary mediation model for PHQ-9 at 9 months, GBAT was associated with higher scores on both candidate mediators at 8 weeks (Table 2). Compared with control, the adjusted BADS-SF score was 12.383 points higher (B = 12.383; 95% CI, 7.656 to 17.110), and the adjusted BRCS-4 score was 4.306 points higher (B = 4.306; 95% CI, 3.192 to 5.420). Each one-point higher BADS-SF score at 8 weeks was associated with a 0.171-point lower PHQ-9 score at 9 months after adjustment for treatment, BRCS-4,

and baseline covariates (B = − 0.171; 95% CI, − 0.238 to − 0.104). Each one-point higher BRCS-4 score was associated with a 0.202-point lower PHQ-9 score (B = − 0.202; 95% CI, − 0.357 to − 0.046).

The adjusted total effect of GBAT on PHQ-9 at 9 months was B = − 9.967 points (95% CI, − 12.097 to − 7.837) (Table 2). After both mediators were included, the adjusted direct effect was B = − 6.983 points (95% CI, − 9.159 to − 4.807). The pathway-specific indirect effect through BADS-SF was B = − 2.119 points (95% CI, − 3.392 to − 1.069), corresponding to 21.3% of the total effect. The indirect effect through BRCS-4 was B = − 0.868 points (95% CI, − 1.615 to − 0.191), corresponding to 8.7% of the total effect. The total indirect effect was B = − 2.987 points (95% CI, − 4.299 to − 1.839), accounting for 30.0% of the total effect. Model 1 estimates are shown in Figs. 1 and 2. Model 2 produced estimates in the same direction, and both indirect-effect confidence intervals excluded zero (Table 2). Complete-case analyses yielded similar conclusions, with both pathway-specific indirect effects supported for PHQ-9 (Additional file 1: Table S4).

Table 2
Parallel mediation results for depressive symptom severity at 9 months

Effect	Model 1		Model 2	
	Estimate	95% CI	Estimate	95% CI
a1: Treatment → BADS-SF (8 weeks)	12.383	7.656 to 17.110	12.414	7.547 17.282
a2: Treatment → BRCS-4 (8 weeks)	4.306	3.192 to 5.420	4.116	3.153 to 5.079
b1: BADS-SF (8 weeks) → PHQ-9 (9 months)	-0.171	-0.238 to -0.104	-0.167	-0.240 to -0.094
b2: BRCS-4 (8 weeks) → PHQ-9 (9 months)	-0.202	-0.357 to -0.046	-0.238	-0.390 to -0.086
c: Total effect Treatment → PHQ-9 (9 months)	-9.967	-12.097 to -7.837	-10.018	-12.257 to -7.779
c': Direct effect Treatment → PHQ-9 (9 months)	-6.983	-9.159 to -4.807	-6.970	-9.217 to -4.724
Indirect via BADS-SF (a1 × b1)	-2.119	-3.392 to -1.069	-2.070	-3.428 to -0.977
Indirect via BRCS-4 (a2 × b2)	-0.868	-1.615 to -0.191	-0.979	-1.685 to -0.342
Total indirect (a1 × b1 + a2 × b2)	-2.987	-4.299 to -1.839	-3.050	-4.462 to -1.845
Proportion mediated via BADS-SF (%)	21.3%	-	20.7%	-
Proportion mediated via BRCS-4 (%)	8.7%	-	9.8%	-
Total proportion mediated (%)	30.0%	-	30.5%	-

Notes: Estimates are unstandardized regression coefficients from intention-to-treat analyses using 50 multiply imputed datasets. The treatment indicator compared group-based behavioral activation therapy (GBAT) with control. Treatment coefficients represent adjusted between-group differences in the follow-up measure and should not be interpreted as raw within-person change scores. Model 1 adjusted for baseline PHQ-9, EQ-5D-5L utility, BADS-SF, and BRCS-4. Model 2 additionally adjusted for age, sex, education, and occupation. Confidence intervals for path, direct, and total coefficients were based on pooled CR2 variances and a normal approximation; indirect-effect confidence intervals were obtained by Monte Carlo simulation. BADS-SF = Behavioral Activation for Depression Scale-Short Form; BRCS-4 = Brief Resilient Coping Scale; CI = confidence interval; EQ-5D-5L = EuroQol 5-Dimension 5-Level; PHQ-9 = Patient Health Questionnaire-9.

Mediation results for health-related quality of life

For EQ-5D-5L utility at 9 months, GBAT was associated with higher behavioral activation and resilient coping scores at 8 weeks. Each one-point higher BADS-SF score at 8 weeks was associated with a

0.011-unit higher EQ-5D-5L utility score at 9 months (B = 0.011; 95% CI, 0.007 to 0.015), after adjustment for treatment, BRCS-4, and baseline covariates. The corresponding association for BRCS-4 was close to zero and imprecise (B = − 0.001; 95% CI, − 0.008 to 0.007).

The adjusted total effect of GBAT on EQ-5D-5L utility at 9 months was B = 0.386 (95% CI, 0.288 to 0.484). After both mediators were included, the adjusted direct effect was B = 0.252 (95% CI, 0.162 to 0.342). The pathway-specific indirect effect through BADS-SF was B = 0.137 (95% CI, 0.073 to 0.215), corresponding to 35.5% of the total effect. The indirect effect through BRCS-4 was B = − 0.003 (95% CI, − 0.037 to 0.031), corresponding to − 0.8% of the total effect; its confidence interval included zero. The total indirect effect was B = 0.134 (95% CI, 0.066 to 0.213), accounting for 34.8% of the total effect and arising primarily through BADS-SF. Model 1 estimates are shown in Figs. 1 and 2. Model 2 also supported an indirect pathway through BADS-SF, with little evidence of mediation through BRCS-4 (Table 3). Complete-case analyses yielded the same qualitative conclusion (Additional file 1: Table S4).

Table 3
Parallel mediation results for health-related quality of life at 9 months

Effect	Model 1		Model 2	
	Estimate	95% CI	Estimate	95% CI
a1: Treatment → BADS-SF (8 weeks)	12.383	7.656 to 17.110	12.414	7.547 to 17.282
a2: Treatment → BRCS-4 (8 weeks)	4.306	3.192 to 5.420	4.116	3.153 to 5.079
b1: BADS-SF (8 weeks) → EQ-5D-5L utility (9 months)	0.011	0.007 to 0.015	0.009	0.005 to 0.013
b2: BRCS-4 (8 weeks) → EQ-5D-5L utility (9 months)	-0.001	-0.008 to 0.007	0.000	-0.008 to 0.009
c: Total effect Treatment → EQ-5D-5L utility (9 months)	0.386	0.288 to 0.484	0.394	0.315 to 0.473
c': Direct effect Treatment → EQ-5D-5L utility (9 months)	0.252	0.162 to 0.342	0.277	0.196 to 0.358
Indirect via BADS-SF (a1 × b1)	0.137	0.073 to 0.215	0.117	0.056 to 0.191
Indirect via BRCS-4 (a2 × b2)	-0.003	-0.037 to 0.031	0.000	-0.035 to 0.036
Total indirect (a1 × b1 + a2 × b2)	0.134	0.066 to 0.213	0.117	0.051 to 0.193
Proportion mediated via BADS-SF (%)	35.5%	-	29.7%	-
Proportion mediated via BRCS-4 (%)	-0.8%	-	0.0%	-
Total proportion mediated (%)	34.8%	-	29.7%	-

Notes: Estimates are unstandardized regression coefficients from intention-to-treat analyses using 50 multiply imputed datasets. The treatment indicator compared group-based behavioral activation therapy (GBAT) with control. Treatment coefficients represent adjusted between-group differences in the follow-up measure and should not be interpreted as raw within-person change scores. Model 1 adjusted for baseline PHQ-9, EQ-5D-5L utility, BADS-SF, and BRCS-4. Model 2 additionally adjusted for age, sex, education, and occupation. Confidence intervals for path, direct, and total coefficients were based on pooled CR2 variances and a normal approximation; indirect-effect confidence intervals were obtained by Monte Carlo simulation. BADS-SF = Behavioral Activation for Depression Scale-Short Form; BRCS-4 = Brief Resilient Coping Scale; CI = confidence interval; EQ-5D-5L = EuroQol 5-Dimension 5-Level; PHQ-9 = Patient Health Questionnaire-9.

Summary of mediation findings

Overall, behavioral activation accounted for the largest measured indirect pathway from GBAT to both 9-month outcomes. For depressive symptom severity, behavioral activation and resilient coping together

accounted for approximately 30% of the total effect. For HRQoL, the indirect effect arose primarily through behavioral activation, with no clear evidence of an independent pathway through resilient coping.

Discussion

To our knowledge, this is the first study in Vietnam to examine the mechanisms underlying the effects of GBAT. In this parallel mediation analysis of a cluster-randomized trial, GBAT improved both candidate mediators at 8 weeks and was associated with substantial improvements in depressive symptom severity and HRQoL at 9 months. Behavioral activation and resilient coping together accounted for approximately one-third of the total effect on PHQ-9, whereas the indirect effect on EQ-5D-5L utility arose mainly through behavioral activation.

These findings contribute mechanistic evidence to the global mental health literature, which emphasizes psychological care delivered through primary care and community platforms, particularly where specialist workforce capacity is constrained [2, 13].

The prominent role of behavioral activation is consistent with BA theory and prior mechanistic evidence. BA is intended to interrupt the cycle in which low mood, avoidance, and withdrawal reduce exposure to rewarding and meaningful activities, thereby maintaining depressive symptoms [6, 7, 14]. In the Healthy Activity Programme, increased activation partially mediated 12-month depression outcomes [15], and a subsequent causal mediation analysis estimated that 34% of the PHQ-9 treatment effect operated through behavioral activation [16]. An internet-delivered BA trial also found that increased activation preceded and mediated later symptom reduction [17]. The pathway-specific proportion mediated through BADS-SF in the present study was 21.3%. Cross-study comparisons should be interpreted cautiously because intervention format, mediator timing, outcome measures, and analytic methods differed. More broadly, the findings are consistent with evidence supporting group-based BA [12] and with the COBRA trial, which found BA to be non-inferior to cognitive behavioral therapy and potentially less costly to deliver in routine services [38].

Resilient coping was associated with a numerically smaller indirect effect on PHQ-9 than behavioral activation (B = − 0.87 versus − 2.12 points; 8.7% versus 21.3% of the total effect). These values are unstandardized indirect effects and proportions mediated, not standardized effect sizes. Because the contrast between the two indirect effects was not formally tested, the comparison is descriptive. The BRCS-4 pathway is nevertheless clinically plausible because GBAT included problem solving, social connection, communication skills, and relapse prevention, which may help participants respond more adaptively to stressors after the structured sessions end. Resilience, coping, and social support have been described as protective processes in the stress-depression pathway [39–41]. However, direct evidence that resilient coping mediates BA effects remains limited, and this finding should be considered preliminary.

The HRQoL findings further clarify the measured pathways of GBAT. EQ-5D-5L utility improved substantially, but the indirect effect was accounted for primarily by BADS-SF rather than BRCS-4. Improved quality of life may reflect restored daily functioning, participation in usual activities, and reduced avoidance, which align with both the domains captured by EQ-5D-5L and the core aims of BA [19, 20, 27]. The near-zero BRCS-4 indirect effect should be interpreted in the context of a simultaneous model that also included behavioral activation. Thus, the measured HRQoL pathway was more closely associated with re-engagement in activities than with resilient coping.

These results have implications for implementation in Vietnamese commune health stations. Population-based evidence has highlighted the need for accessible professional care and continued development of the Vietnamese mental health system [3], while prior community-based depression programs in Vietnam have demonstrated the feasibility of linking commune-level delivery with specialist supervision and referral pathways [4, 5]. Scale-up should preserve core GBAT components closely linked to behavioral activation, including activity monitoring, goal setting, activity scheduling, problem solving, social connection, and relapse prevention. Monitoring BADS-SF during implementation may help providers assess whether the intervention is changing its intended process alongside changes in symptoms.

Strengths and limitations

This study has several strengths. It used data from a cluster-randomized trial conducted in routine commune health stations, specified temporal ordering from treatment assignment to 8-week mediators and 9-month outcomes, and examined both depressive symptoms and HRQoL. The analysis followed the intention-to-treat principle, used multiple imputation for missing mediator, outcome, and covariate data, and applied commune-level cluster-robust inference with a bias-reduced CR2 adjustment. The parallel mediation model estimated the independent pathways through behavioral activation and resilient coping simultaneously.

Several limitations should be considered. Although treatment assignment was randomized, mediator-outcome associations were observational and may remain affected by residual confounding; the results therefore indicate patterns consistent with mediation rather than definitive causal mechanisms [30]. The trial included only six communes. CR2 reduces small-sample bias in cluster-robust variance estimates but cannot eliminate the imprecision and fragility of inference with so few clusters, and the trial sample size did not incorporate a design effect [21]. In addition, confidence intervals for path, direct, and total effects were based on a normal approximation rather than small-sample degrees of freedom; they are therefore narrower than the corresponding intervals reported in the primary trial analysis [21] and should be interpreted cautiously. Participants and intervention providers could not be blinded, and expectancy effects cannot be excluded. Because communes were allocated before recruitment, staff who enrolled participants were aware of allocation, which may have introduced recruitment bias despite the use of standardized screening procedures in all communes. Mediators and outcomes were self-reported and may have been influenced by social desirability or awareness of treatment allocation [18, 19, 25, 28]. The

predominantly female, middle-aged sample limits inference for men, younger adults, and more diverse populations [42]. Generalizability of the findings may also be limited to rural primary care settings in Vietnam or similar low-resource health systems where psychological interventions are delivered by trained non-specialist providers under specialist supervision. Future studies should evaluate the intervention in more diverse populations and health care settings, examine additional mediating mechanisms, and assess implementation outcomes, sustainability, and cost-effectiveness to inform wider integration into routine primary mental health care in Vietnam.

Conclusions

In this parallel mediation analysis of a cluster-randomized trial in Vietnam, early improvements in behavioral activation and resilient coping accounted for a meaningful proportion of the effect of GBAT on 9-month depressive symptoms, whereas the indirect effect on HRQoL arose mainly through behavioral activation. Behavioral activation was the largest measured pathway, and resilient coping may represent an additional pathway for depressive symptom improvement. Scale-up of GBAT in commune health stations should preserve core behavioral activation components and use supervision systems that protect intervention fidelity.

Abbreviations

BA
Behavioral activation
BADS-SF
Behavioral Activation for Depression Scale-Short Form
BRCS-4
Brief Resilient Coping Scale
CI
Confidence interval
CONSORT
Consolidated Standards of Reporting Trials
CR2
Bias-reduced cluster-robust covariance estimator
EQ-5D-5L
EuroQol 5-Dimension 5-Level
GBAT
Group-based behavioral activation therapy
HRQoL
Health-related quality of life
PHQ-2
Patient Health Questionnaire-2
PHQ-9

Patient Health Questionnaire-9
SD
Standard deviation
SMD
Standardized mean difference

Declarations

Ethics approval and consent to participate

The trial was approved by the Research Ethics Committee of Hanoi Medical University (IRB00003121/1385/GCN-HMUIRB). The intervention curriculum and program documents were approved by Hanoi Medical University (decision number 1170/QD-DHYHN, April 2024). The study was conducted in accordance with the Declaration of Helsinki. Written informed consent was obtained from all participants before baseline assessment.

Consent for publication

Not applicable.

Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

Funding

This study was supported by the BasicNeeds Vietnam project, funded by the Johnson & Johnson Foundation and managed by Myriad USA. The funders had no role in the design of the study; the collection, analysis, and interpretation of data; or the writing of the manuscript.

Authors' contributions

PTMT: data curation, formal analysis, writing – original draft, writing – review and editing; PTTH: conceptualization, methodology, investigation, data curation, formal analysis, writing – original draft, writing – review and editing, supervision, funding acquisition; NTT: conceptualization, methodology, investigation, writing – review and editing, supervision, funding acquisition; LBT: data curation, formal analysis, writing – original draft, writing – review and editing, supervision; DTN: data curation, formal analysis, writing – review and editing; NMH: data curation, formal analysis, writing – review and editing; JN: data curation, formal analysis, writing – review and editing; HLN: data curation, formal

analysis, writing – review and editing; NTH: data curation, formal analysis, writing – review and editing; CYW: data curation, formal analysis, writing – review and editing; LCA: data curation, formal analysis, writing – review and editing. All authors read and approved the final manuscript.

Acknowledgements

The authors thank all participants and the primary healthcare providers who supported data collection.

Clinical trial number

ClinicalTrials.gov NCT07527312; registered retrospectively on 14 April 2026.

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Figures

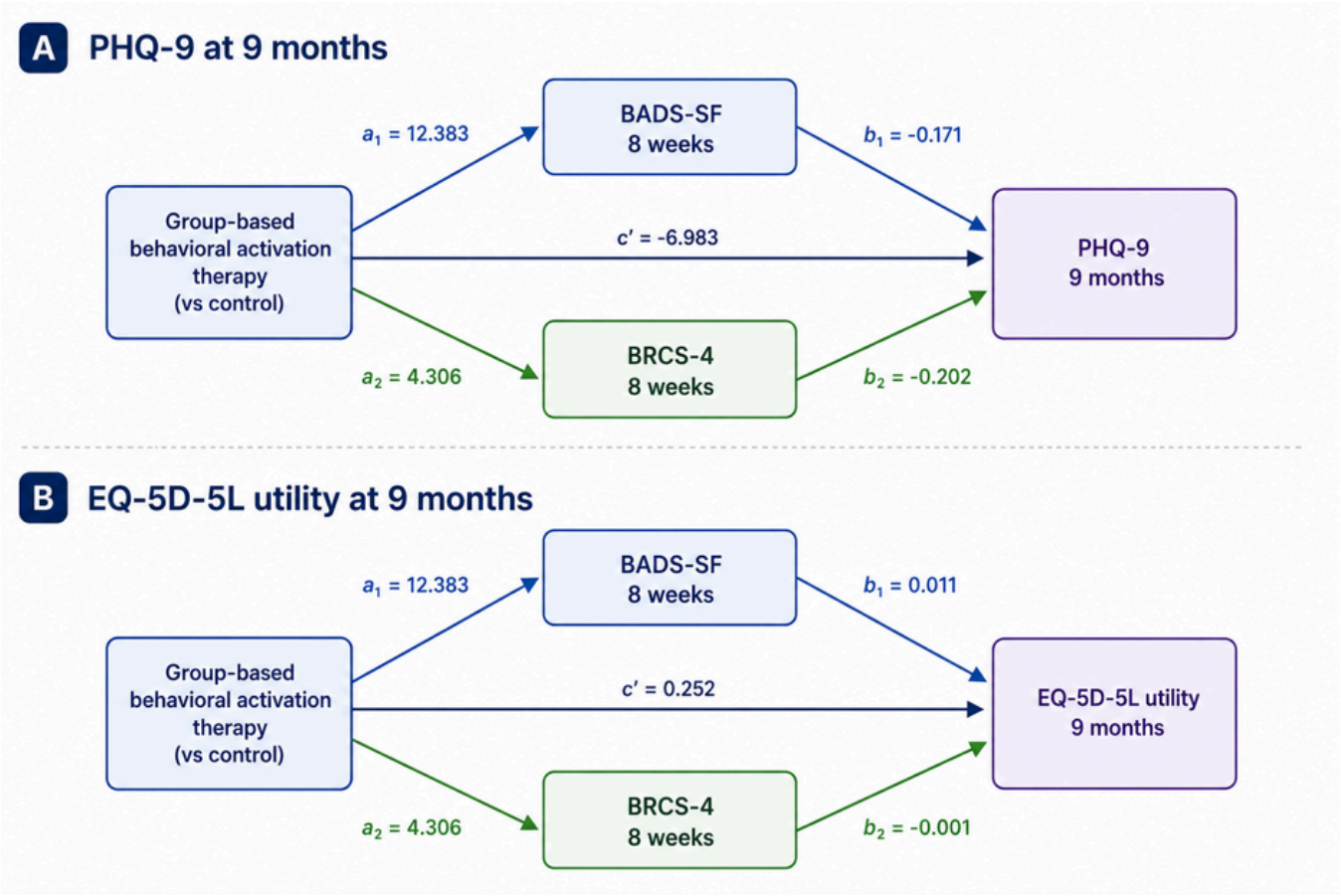


Figure 1

Parallel mediation models linking group-based behavioral activation therapy to 9-month depressive symptoms and health-related quality of life.

Notes: Estimates are from the primary model (Model 1). Panel A shows PHQ-9 at 9 months, and Panel B shows EQ-5D-5L utility at 9 months. Model 1 adjusted for baseline PHQ-9, EQ-5D-5L utility, BADS-SF, and BRCS-4. c' denotes the direct effect after adjustment for both mediators. GBAT = group-based behavioral activation therapy; HRQoL = health-related quality of life.

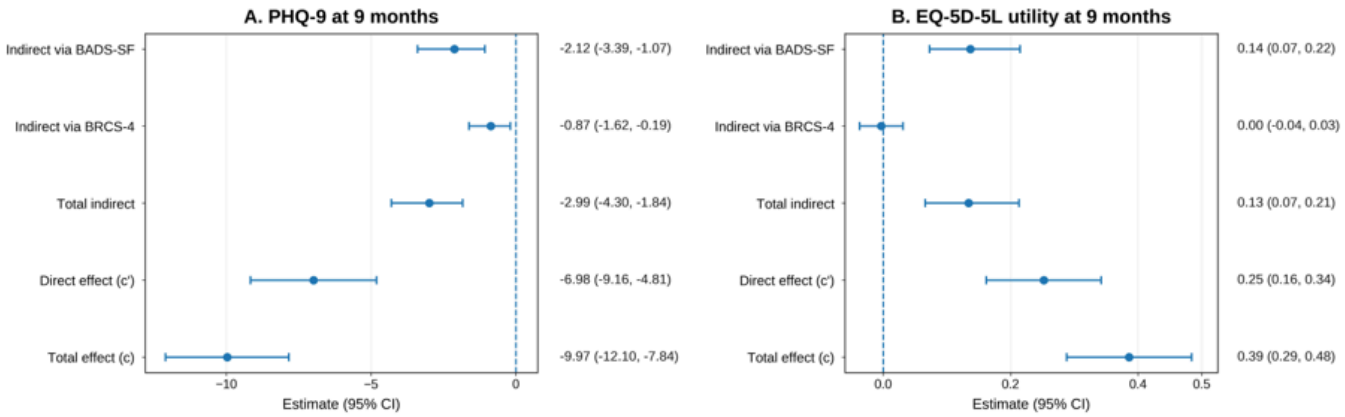


Figure 2

Estimated direct and indirect effects from the primary parallel mediation models.

Notes: Point estimates are shown with 95% confidence intervals (CIs). Panel A shows effects on PHQ-9 at 9 months, and Panel B shows effects on EQ-5D-5L utility at 9 months. Estimates correspond to Model 1. Indirect-effect CIs were obtained using Monte Carlo simulation.

Supplementary Files

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