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Perceived social support mediates the relationship between self-efficacy and depression/anxiety in patients with cardiovascular disease

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This study aimed to assess the psychological characteristics of patients with cardiovascular disease (CVD), focusing on perceived social support, self-efficacy, and emotional symptoms such as depression and anxiety. Additionally, we investigated whether perceived social support mediates the relationship between self-efficacy and these mood disorders. This cross-sectional survey involved 1,144 CVD patients drawn from the 2021 China Family Health Index Survey Report. Participants completed standardized measures including a Demographic Inventory, the Perceived Social Support Scale (PSSS), the New General Self-Efficacy Scale (NGSES), the Patient Health Questionnaire-9 (PHQ-9), and the Generalized Anxiety Disorder-7 (GAD-7). Nonparametric analyses, chi-square tests, linear regression, and mediation analyses using the PROCESS macro were performed. Among Chinese CVD patients, depression and anxiety prevalence were 19.6% and 47.1%, respectively. Median scores were 60 (IQR 50–69) for perceived social support and 29 (IQR 24–32) for self-efficacy. Regression analyses showed significant negative associations between perceived social support and depression (β=-0.092, $p < 0.001$) and anxiety (β=-0.075, $p < 0.001$). Mediation models indicated associated with emotional disturbances via support perception (indirect effects: depression=-0.113, anxiety=-0.092). These findings highlight the potential relevance of psychosocial resources in managing emotional well-being among CVD patients and suggest that perceived social support may be an important target for forthcoming psychosocial interventions. However, due to the cross-sectional design, causal reasoning is avoided, and longitudinal studies are needed to confirm these associations.

Keywords Cardiovascular disease, Perceived social support, Self-efficacy, Depression, Anxiety, Mediation analysis, Cross-sectional study, Psychological comorbidity

Cardiovascular disease (CVD) is a non-specific term describing coronary artery disease, heart failure, hypertension, and other related conditions, all of which contribute to high morbidity and mortality worldwide[1]. According to WHO, CVD contributes to 31% of global deaths, with psychological comorbidities recognized as key determinants of disease progression[2]. A bidirectional association exists between CVD and mental health disturbances, where disease-related stress exacerbates symptoms of depression and anxiety in affected individuals, while persistent depression and anxiety symptoms accelerate pathological deterioration in cardiac patient.

Among many subtypes of CVD, hypertension is a common condition with well-documented psychological outcomes. For instance, research confirms strong relationships between hypertension and affective disorders, with depression and anxiety disorders being 2.69 times as frequent among hypertensive compared to normotensive people[3]. Population-based analyses reveal 21% and 41% elevated coronary heart disease risks associated with depressive and anxious states respectively, compared to psychologically healthy cohorts[4]. Clinical evaluations identify concurrent mood disturbances in 31% of individuals diagnosed with coronary artery disease[5].

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Perceived social support is the individual's subjective evaluation of support received from family, friends, and important others, and is usually been quantified by the Perceived Social Support Scale (PSSS)[6]. Perceived social support is a protective element of mental health since it serves as a buffer against stress and enhances emotional resilience. Self-efficacy describes the confidence individuals have in their ability to perform actions necessary for achieving desired outcomes[7]. Evidence from multiple studies has shown that higher self-efficacy is linked to lower levels of depression and anxiety, and longitudinal research indicates that interventions enhancing self-efficacy can help alleviate these symptoms in patients with CVD[8–10]. From the perspective of social cognitive theory, individuals with limited self-efficacy often view themselves as less capable of handling the challenges posed by illness, which in turn heightens their risk of experiencing depressive and anxiety symptoms[10]. General self-efficacy, quantified by the New General Self-Efficacy Scale (NGSES), is a measure of an individual's belief in their ability to manage a broad range of stressors, which is particularly valuable for patients with chronic diseases like CVD. People with a high level of perceived social support are more likely to experience a sense of connection, respect, and understanding, which can help foster a sense of belonging[11].

Empirical evidence has consistently shown that subjective social support functions as a buffer to stress and is inversely related with depression and anxiety symptoms in CVD populations[12]. Interventions aimed at enhancing social support have also shown benefits in reducing depression and anxiety symptoms in CVD patients[13]. As such, perceived social support acts as an external resource, reducing psychological burden and alleviating depression and anxiety symptoms. Furthermore, evidence suggests social support can enhance self-efficacy, thereby indirectly mitigating depression and anxiety symptoms[14]. Despite these established associations, large-scale studies examining perceived social support as a mediator between self-efficacy and depression and anxiety symptoms in CVD patients remain scarce.This study uses data from the 2021 China Family Health Index Survey Report, a large, nationally representative sample of 23 provinces, 5 autonomous regions, and 4 municipalities in mainland China which comprised. Stratified quota sampling based on national census data ensured demographic and geographic representativeness. Focusing on 1,144 CVD adults, this study applies a mediation model to test the mediating role of perceived social support in self-efficacy and depression and anxiety symptoms. While earlier studies have explored associations between psychosocial variables and emotional symptoms in CVD patients, they are mostly based on Western samples and limited in scale, and few have explicitly examined the mediating mechanism linking self-efficacy, perceived social support, and emotional outcomes. To address this gap, the current study utilizes a large, nationally representative sample from China to investigate whether perceived social support mediates the association between self-efficacy and symptoms of depression and anxiety in patients with CVD. In doing so, it offers new insight into culturally generalizable psychosocial mechanisms underlying mental health in chronic illness contexts. To our knowledge, this is among the first study to utilize rich, nationally representative data from China to uncover psychosocial mechanisms influencing mental health in CVD patients, thereby providing novel insights with strong generalizability beyond Western populations.

Due to the cross-sectional design of this study, we could not differentiate between primary anxiety (arising independently) and secondary anxiety (resulting from a medical condition). The focus was on recent severity of anxiety symptoms, regardless of etiology, to identify its associations with psychosocial constructs such as self-efficacy and perceived social support. All participants reported a self-reported diagnosis of CVD, but the nature and cause of anxiety symptoms were not differentiated. Though we did not differentiate anxiety by its etiology, previous research shows that both primary and secondary anxiety in the chronic illness contexts respond similarly to psychosocial interventions[15]. Correspondingly, perceived social support and self-efficacy then would have equivalent protective effects regardless of the origin of anxiety symptoms. These protective effects may act through several psychological mechanisms, including enhanced emotional regulation, increased perceived control, and more adaptive coping strategies. These pathways have been implicated in both the emergence and alleviation of depression and anxiety symptoms in patients with chronic illnesses. In addition, a previous history of depression or anxiety was not employed as an exclusion criterion, to enroll a broad and ecologically valid spectrum of psychological experiences among CVD patients, aligned with the study's aim to reflect real-world clinical populations[16]. Whereas the anxiety scale used in this study specifically assesses generalized anxiety disorder, previous evidence indicates that it is capturing central anxiety symptomatology that substantially overlaps with other anxiety disorders in chronic illness contexts. These design choices, while enhancing generalizability, are acknowledged as methodological limitations, and are discussed in detail in the Discussion section. The following hypotheses to be tested are as follows: (1) Higher self-efficacy is associated with lower depression and anxiety symptoms; (2) Perceived social support mediates the relationship between self-efficacy and depression symptoms; (3) Perceived social support mediates the relationship between self-efficacy and anxiety symptoms; (4) Both mediation effects remain significant after controlling for sociodemographic variables.

Objects and methods
Objects
From July 10 to September 15, 2021, a cross-sectional survey was carried out throughout mainland China, including the capital cities of 23 provinces, 5 autonomous regions, and 4 municipalities directly governed by the central government. Multi-level sampling technique was employed, with 2–6 urban centers randomly chosen from each non-provincial prefecture-level division, ultimately comprising 120 surveyed cities. Demographic-stratified quota sampling was implemented according to the 20th National Population Census data to ensure collected samples matched gender ratios, age groups, and urban-rural distributions aligned with census-reported population parameters[17,18]. Following informed consent acquisition, electronic questionnaires were administered through personalized interviews using Questionnaire Star platform. Investigators facilitated digital responses via internet-accessible links while substituting participants lacking sufficient cognitive capacity to independently

complete surveys, despite possessing basic comprehension abilities. Eligible participants comprised Chinese nationals meeting these criteria: (1) Individuals aged above 18 years; (2) Permanent mainland residents (annual absence duration ≤ 1 month); (3) Voluntary engagement with signed consent documentation; (4) Capacity for independent or assisted digital questionnaire completion; (5) Full comprehension of survey items. Exclusion conditions included: 1) Subjects with diagnosed cognitive disorders (e.g., dementia) or psychotic conditions (e.g., schizophrenia);2) Current participation in psychological intervention trials; 3) non-cooperative participants. Ethical approval was granted by Shaanxi Provincial Research Center for Health Culture (JKWH-2021-01). Participants provided informed consent not only for participation but also for the secondary analysis of their data, including psychological assessments, ensuring ethical compliance with data usage.

The survey initiative administered 11,709 questionnaires, achieving 11,031 completed responses with 90.34% validity rate. Among these, 9,966 participants aged ≥ 18 years met inclusion criteria, comprising 4,591 (46.1%) male and 5,375 (53.9%) female respondents, exhibiting mean participant age of 38.02 years. Screening based on self-reported diagnoses of coronary artery disease and hypertension identified 1,144 individuals with CVD, including 658 males (57.5%) and 486 females (42.5%).

Methods
Research instruments

(i) Demographic Survey: A self-report demographic instrument captured socioeconomic parameters encompassing gender, age, BMI, tobacco/alcohol use, marital status, employment status, household income, and insurance coverage.

(ii) PSSS: Zimit and colleagues initially introduced this Scale in 1987 to quantify perceived external assistance across familial and community dimensions[19]. This 12-item tool comprises two subscales comprises two subscales: Family Support (items 3, 4, 8, 11) and Friend/Other Support (items 1, 2, 5, 6, 7, 9, 10, 12), reflecting a two-factor structure commonly confirmed in psychometric analyses. Each item employs a 7-point Likert scale. Cumulative scores < 50 indicate suboptimal support levels. Psychometric evaluations demonstrated excellent reliability in this study (total α = 0.922; family α = 0.851; external α = 0.913).

(iii) NGSES: Chen et al.'s (2001) scale incorporates eight items utilizing 5-point Likert metrics (maximum = 40). Higher scores reflect greater self-efficacy[20]. The scale showed good internal consistency (α = 0.85–0.90) and temporal stability (r = 0.62–0.65) in validation studies.

(iv) Patient Health Questionnaire-9 (PHQ-9): This validated instrument screens for depression severity based on DSM-IV criteria using nine items scored 0–3 (total range: 0–27). Thresholds categorize severity: mild (10–14), moderate (15–19), and severe (20–27) based on two-week symptom profiles[21]. A score ≥ 10 was used to indicate clinically relevant depression.

(v) Generalized Anxiety Disorder-7 (GAD-7): Anxiety symptoms were measured with this 7-item questionnaire, using a 4-point frequency scale ranging from "never" (0) to "nearly every day" (3)[22]. A total score of 5 or higher indicates the presence of anxiety. The scale showed high internal reliability in this study (α = 0.912).

Quality assurance
Protocols incorporated personalized in-person interviews to maximize data validity and reliability. Exclusion parameters comprised: (i) questionnaires completed in less than 240 s, which was determined as the minimum reasonable time to thoughtfully complete the survey, thereby ensuring data quality; (ii) inconsistent response patterns detected through internal consistency verification; (iii) missing critical data fields; (iv) duplicated response sets; (v) patterned selection sequences. Missing data were handled using listwise deletion; questionnaires with incomplete or missing critical variable responses were excluded from the analysis.

Statistical processing
Statistical analyses were conducted using SPSS 26.0, Normally distributed continuous variables satisfying χ^2 assumptions were presented as mean ± standard deviation (SD), while non-normally distributed continuous variables were reported as median (interquartile range: Q1–Q3). For variables following a normal distribution, between-group comparisons were carried out using independent t-tests for two-group analyses and ANOVA for comparisons involving more than two groups. When data did not follow a normal distribution, non-parametric tests were used, including the Mann–Whitney U test for comparisons between two groups and the Kruskal–Wallis H test for comparisons among multiple groups. Categorical variables were expressed as frequencies and percentages, and group differences were evaluated using the χ^2 test. Associations between multiple variables were evaluated using linear regression models. Mediation effects were analyzed with the PROCESS macro (version 4.0), employing 5,000 bootstrap resamples to obtain 95% bias-corrected confidence intervals[23].

Results
Sample characteristics and prevalence
Among the 1,144 Chinese CVD patients, the prevalence rates of comorbid depression (PHQ-9 ≥ 10) and anxiety (GAD-7 ≥ 5) were 19.6% and 47.1%, respectively. Measurements revealed median scores of 60 (IQR:50–69) for perceived social support and 29 (IQR:24–32) for self-efficacy metrics. Comparative analysis of perceived social support scores across demographic subgroups indicated non-significant variations by gender, age, or alcohol consumption history (all $p > 0.05$). However, statistically significant differences emerged for place of residence, per capita household income, educational attainment, marital status, employment status, type of

health insurance, smoking history, and body mass index classifications ($p < 0.05$). Comprehensive comparative data are presented in Table 1.

Factors influencing perceived social support

Logistic regression analysis was performed to predict high perceived social support (PSSS ≥ 50; reference: low support, PSSS < 50). The model incorporated nine explanatory factors: gender, age, BMI category, smoking history, alcohol consumption frequency, employment status, marital status, health insurance type, and per capita household income. Statistical significance was set at α = 0.05 (two-tailed). Detailed regression coefficients and odds ratios (OR) are presented in Table 2.

Mediation analysis: self-efficacy, perceived social support, and depression

Regression models

Hierarchical linear regression modeling was conducted in three steps. The initial model regressing depression on self-efficacy identified self-efficacy as a significant negative predictor (β = −0.101, $p = 0.001$). The second model regressing perceived social support on self-efficacy revealed a significant positive association (β = 1.223, $p < 0.001$). The final model regressing depression on both self-efficacy and perceived social support showed

Demographic characteristic		Constituent ratio [n(%)]	M(P25,P75)	Z/H	P-value
Place of residence	Urban	768(67.1%)	60(52,70)	−2.512	0.012
	Rural	376(32.9%)	59(48,68)		
Per capita income	≤3000	375(32.8%)	59(48,68)	17.678	0.001
	3001–6000	461(40.3%)	60(50.5,68)		
	6001–9000	192(16.8%)	63(55,72)		
	≥9001	116(10.1%)	61(50.25,72)		
Gender	Male	658(57.5%)	60(50,69)	−1.609	0.108
	Female	486(42.5%)	60(51,70)		
Age	≤30	29(2.5%)	48(44.5,70.5)	6.409	0.093
	31–50	357(31.2%)	60(49.5,68.5)		
	51–70	445(38.9%)	60(51,69)		
	≥71	313(27.4%)	60(52,70)		
Education level	Primary school and below/Junior middle school/Secondary vocational school	672(58.7%)	59(48,68)	11.791	0.003
	High school/Junior college	263(23%)	60(54,69)		
	Bachelor/Master/Doctor	209(18.3%)	62(52.5,71)		
Marital status	Unmarried	45(3.9%)	55(48,69.5)	9.563	0.023
	Married	960(83.9%)	60(51,69)		
	Divorced	28(2.4%)	55(44.25,60.75)		
	Widowed	111(9.7%)	60(48,68)		
Professional status	Student	26(2.3%)	49(45.25,73)	16.039	0.001
	In-survice	370(32.3%)	61(53,70)		
	No fixed occupation	383(33.5%)	59(48,67)		
	Retirement	365(31.9%)	60(52,70.5)		
Type of insurance	Residents' health insurance	617(53.9%)	60(50,69)	29.462	0.000
	Employee medical insurance	335(29.3%)	62(54,71)		
	Commercial medical insurance	33(2.9%)	60(50.5,66.5)		
	Public expense	22(1.9%)	60.5(46.75,69)		
	Private expense	137(12%)	54(48,64.5)		
Smoking history	Smoking	227(19.8%)	59(48,68)	9.143	0.010
	Smoking cessation	226(19.8%)	59(48,67.25)		
	Never	691(60.4%)	60(51,70)		
Drinking history	Drink in the past 30 days	365(31.9%)	60(50,69)	0.121	0.941
	Drink before the last 30 days	160(14%)	60(49.25,68.75)		
	Never	619(54.1%)	60(51,69)		
BMI (kg/m²)	<18.5	107(9.4%)	58(48,69)	8.443	0.038
	18.5–24.9	674(58.9%)	60(49.75,68)		
	25-29.9	349(30.5%)	62(52.5,72)		
	≥30	14(1.2%)	56(50,72)		

Table 1. Difference analysis of perceived social support scores across populations. M(P25, P75) = Median (25th percentile, 75th percentile); Z = Mann-Whitney U Z-score; H = Kruskal-Wallis H statistic.

Variable	B	SE	Wald	df	P-value	OR	95% CI for OR Lower limit	Upper limit
Place of residence (Reference group = Urban)	−0.097	0.174	0.312	1	0.576	0.907	0.645	1.277
Per capita income (Reference group = ≤ 3000)			2.552	3	0.466			
3001–6000	0.031	0.171	0.032	1	0.857	1.031	0.738	1.441
6001–9000	0.367	0.245	2.237	1	0.135	1.444	0.892	2.336
≥ 9001	0.052	0.289	0.032	1	0.858	1.053	0.597	1.857
Education level (Reference group = Primary school and below/Junior middle school/Secondary vocational school)			4.748	2	0.093			
High school/Junior college	0.433	0.205	4.446	1	0.035	1.541	1.031	2.304
Bachelor/Master/Doctor	0.333	0.254	1.720	1	0.190	1.395	0.848	2.292
Marital status (Reference group = Unmarried)			1.447	3	0.695			
Married	0.135	0.388	0.121	1	0.728	1.144	0.535	2.448
Divorced	−0.356	0.548	0.421	1	0.517	0.701	0.239	2.052
Widowed	0.075	0.450	0.028	1	0.868	1.078	0.446	2.604
Professional status (Reference group = Student)			6.689	3	0.082			
In-service	1.087	0.479	5.145	1	0.023	2.965	1.159	7.583
No fixed occupation	1.189	0.477	6.216	1	0.013	3.284	1.290	8.362
Retirement	1.230	0.483	6.474	1	0.011	3.421	1.326	8.822
Type of insurance (Reference group = Residents' medical insurance)			13.486	4	0.009			
Employee medical insurance	0.179	0.209	0.728	1	0.393	1.196	0.793	1.802
Commercial medical insurance	0.186	0.456	0.166	1	0.684	1.204	0.492	2.944
Public expense	−0.409	0.493	0.689	1	0.407	0.664	0.252	1.746
Private expense	−0.668	0.208	10.353	1	0.001	0.513	0.341	0.770
Smoking history (Reference group = smoking)			3.218	2	0.200			
Smoking cessation	0.175	0.224	0.610	1	0.435	1.191	0.768	1.846
Never smoking	0.323	0.183	3.109	1	0.078	1.381	0.965	1.976
BMI (Reference group = < 18.5)			2.657	3	0.448			
18.5–24.9	0.046	0.248	0.034	1	0.854	1.047	0.644	1.701
25-29.9	0.286	0.269	1.131	1	0.288	1.331	0.786	2.253
≥ 30	0.603	0.814	0.548	1	0.459	1.827	0.371	9.002
Constant	−0.547	0.550	0.990	1	0.320	0.579		

Table 2. Logistic regression analysis of factors associated with high perceived social support. B = Regression Coefficient; SE = Standard Error; df = Degree of freedom; OR = Odds Ratio; CI = Confidence Interval.

Step	Dependent variable	Independent variable	β	SE	t value	R^2	R^2 variation
Step1	Depression	Self-efficacy	−0.101	0.030	−3.397**	0.010	0.010
Step2	Perceived social support	Self-efficacy	1.223	0.059	20.717***	0.273	0.273
Step3	Depression	Self-efficacy	0.012	0.034	0.337	0.043	0.043
		Perceived social support	−0.092	0.015	−6.278***		

Table 3. Cross-sectional associations between self-efficacy and depression as with mediation by perceived social support. ** $P < 0.01$; *** $P < 0.001$.

that self-efficacy was no longer a significant predictor (β = 0.012, $p = 0.736$), while perceived social support maintained a significant negative predictor (β = −0.092, $p < 0.001$). Modeling parameters are presented in Table 3.

Mediation effect test
The hypothesized competence-support-depression pathway was analyzed through mediation procedures using SPSS's PROCESS macro (Model 4) with 5000 bootstrap resamples. The indirect effect was significant, as evidenced by a 95% bias-corrected bootstrap confidence interval excluding zero (point estimate = −0.113, SE = 0.021, CI [−0.156, −0.074]). This confirms the mediating role of perceived social support. Complete mediation statistics are detailed in Table 4 Fig. 1.

| Effect relationship | Effect value | Boot SE | 95% CI | |
			Lower limit	Upper limit
Total effect	−0.101	0.030	−0.160	−0.043
Direct effect	0.012	0.034	−0.056	0.079
Indirect effect	−0.113	0.021	−0.156	−0.074

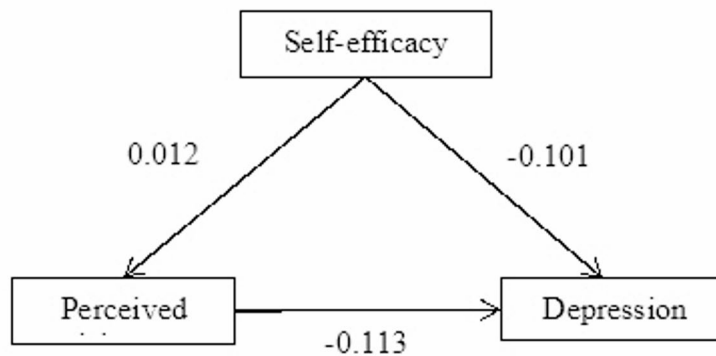**Table 4**. Mediating effect of perceived social support on the relationship between self-efficacy and depression.

Fig. 1. Diagram illustrating the mediating effect of perceived social support on the relationship between self-efficacy and depression.

Step	Dependent variable	Independent variable	β	SE	t value	R^2	R^2 variation
Step1	Anxiety	Self-efficacy	−0.120	0.025	−4.865***	0.020	0.020
Step2	Perceived social support	Self-efficacy	1.223	0.059	20.717***	0.273	0.273
Step3	Anxiety	Self-efficacy	−0.028	0.028	−0.984	0.052	0.052
		Perceived social support	−0.075	0.012	−6.180***		

Table 5. Hierarchical regression models for anxiety with Self-efficacy and perceived social support.

| Effect relationship | Effect value | Boot SE | 95% CI | |
			Lower limit	Upper limit
Total effect	−0.120	0.025	−0.168	−0.071
Direct effect	−0.028	0.028	−0.084	0.028
Indirect effect	−0.092	0.016	−0.124	−0.062

Table 6. Mediating effect of perceived social support on the relationship between Self-efficacy and anxiet*y*.

Mediation analysis: self-efficacy, perceived social support, and anxiety

Regression models

A similar three-phase hierarchical linear regression approach was used for anxiety. The initial model showed self-efficacy as a significant negative predictor of anxiety (β = −0.120, $p < 0.001$). The second model confirmed the positive associations between self-efficacy and perceived social support (β = 1.223, $p < 0.001$). In the final model, the effect of self-efficacy on anxiety was no longer statistically significant (β = −0.028, $p = 0.325$), whereas perceived social support continued to act as a significant negative predictor (β = −0.075, $p < 0.001$). Full regression results are detailed in Table 5.

Mediation effect test

The mediation effect was tested using SPSS PROCESS macro (Model 4) with 5,000 bootstrap resamples. The indirect effect was significant (β = −0.095, SE = 0.023, 95% CI [−0.142, −0.052]), as the confidence interval did not include zero. Full mediation results are presented in Table 6; Fig. 2.
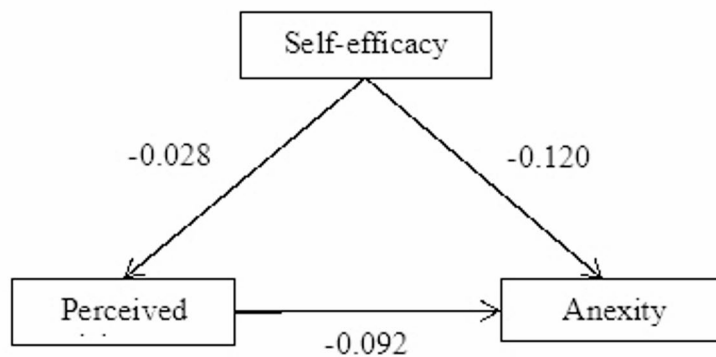
Fig. 2. Diagram illustrating the mediating role of perceived social support in the relationship between self-efficacy and anxiety.

Discussion

Current clinical models of cardiovascular care overemphasize biometric monitoring and clinical outcomes and underrepresent psychological comorbid conditions. Three principal results arose from this multicenter study of 1,144 CVD patients: (1) High rates of psychological comorbidity (depression: 19.6%, anxiety: 47.1%); (2) Significant negative associations between perceived support/self-efficacy and emotional symptoms; (3) Perceived social support mediated 90.4% of self-efficacy's association with depression.

Earlier studies have shown that social support can boost self-efficacy and improve mental health outcomes[24]. Expanding on this evidence, our research demonstrates that perceived social support serves as a mediator between self-efficacy and symptoms of depression and anxiety. In particular, higher levels of perceived social support were linked to greater self-efficacy and lower levels of both depressive and anxiety symptoms. Our findings extend previous research by (1) quantifying the mediation effect of perceived support in a large CVD cohort; (2) proving social support to be a stronger mechanism, accounting for 90.4% of the self-efficacy–depression association; (3) providing effect size estimates for the design of future intervention studies.

These results provide evidence for the incorporation of routine psychological assessment and psychosocial evaluation into cardiovascular management of particularly low self-efficacy patients. Clinicians should consider introducing specific interventions for enhancing self-efficacy and social support networks to promote emotional well-being and treatment adherence. Based on the median scores reported for self-efficacy and perceived social support, our participants recorded a median NGSES score of 29 (IQR: 24–32), representing a moderate level of self-efficacy consistent with previous findings in similar adult populations[20]. The median perceived social support score was 60 (IQR: 50–69), in excess of the commonly used clinical cutoff of 50, reflecting overall adequate support in this cohort. However, subgroup analyses revealed significant disparities in perceived support by demographic factors such as residence, income, education, and marital status. These findings underscore the importance of the creation of targeted psychosocial interventions responsive to particular needs within diverse demographic groups.

The pathophysiological link between mental health and cardiovascular disease is probably bidirectional through a variety of mechanisms. Chronic psychological distress may activate the renin-angiotensin system, increase oxidative stress, and accelerate atherosclerosis[25]. Our findings agreed with earlier research that showed social support to moderate the effect of psychological distress in patients with chronic illness[26,27]. Importantly, our study is among the first to demonstrate that perceived social support mediates the influence of self-efficacy on the emotional symptoms of CVD patients, thus emphasizing the clinical importance of psychosocial factors among this population.

Despite these contributions, there are some limitations worth mentioning. The cross-sectional design of our research makes it impossible to infer causality. According to Maxwell & Cole, mediation analyses based on cross-sectional data may not replicate under longitudinal designs due to temporal ambiguity[28]. Future research should verify these relationships using prospective designs with time-sequenced assessments.

In addition, our models explained only a small percentage of the variance in depression and anxiety symptomatology, indicating the potential for unmeasured psychological or contextual influences. All assessments were based on self-report, therefore risking the likelihood of recall and reporting biases. Furthermore, our research also did not distinguish between CVD subtypes, potentially obscuring subtype-specific psychosocial patterns. Cultural factors may also influence the interpretation of constructs like social support and self-efficacy, limiting the external validity of our findings beyond Chinese populations. Notably, we did not screen our participants for current anxiety or depression, which may have been influencing current symptom levels This approach was intentional in capturing a broad and ecologically valid spectrum of psychological experiences among CVD patients, thereby enhancing the external validity of our results. In addition, assessment of anxiety only measured generalized anxiety disorder, potentially missing other forms of anxiety (e.g., panic disorder, social anxiety). Despite these limitations, our results have broad importance for the management of cardiovascular care. These findings highlight pragmatic implications for clinicians, demonstrating the need for routine psychosocial assessments and tailored interventions that can be effectively integrated into existing cardiovascular care pathways to improve patient well-being and adherence. Considering the considerable psychological symptoms

observed in this population, routine screening for depression, anxiety, and psychosocial factors such as perceived social support and self-efficacy could promote improved patient outcomes. Interventions aimed at strengthening social support systems could serve as effective adjuncts to conventional treatment, potentially improving patients' psychological resilience and treatment adherence.

Conclusion

This research revealed elevated emotional symptoms among patients with cardiovascular disease and showed that both perceived social support and self-efficacy had negative associations with depression and anxiety. Notably, perceived social support was found to play a strong moderating role in the link between self-efficacy and emotional symptoms, explaining a substantial portion of its association with depression. To our knowledge, this is the first study to evaluate this mediation effect in a large cohort of patients with cardiovascular disease, offering new perspectives on the psychosocial pathways contributing to emotional distress in this group. The results suggest that strengthening perceived social support could be a promising intervention strategy for improving emotional well-being in CVD patients. Nevertheless, the cross-sectional nature of the study precludes causal inference, and the directionality of the observed relationships remains unclear. Furthermore, reliance on self-reported measures and the absence of analyses stratified by CVD subtype may restrict the generalizability of the conclusions. Future longitudinal and interventional studies are needed to confirm these findings and determine whether increasing perceived social support can directly improve emotional outcomes in this population.

Data availability

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

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Author contributions

MD: Writing – original draft, Writing – review & editing.BW: Writing – review & editing. HH: Writing – review & editing.Data availability ：The datasets used or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Competing interests

The authors declare no competing interests.

Ethical approval and consent to participate

Ethical clearance for this study was granted by the Ethics Committee of the Shaanxi Provincial Research Center for Health Culture (approval number: JKWH-2021-01). Written informed consent was obtained from every participant prior to data collection. All study procedures complied with the ethical standards set forth in the Declaration of Helsinki of the World Medical Association.

Additional information

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