



OPEN The prevalence, recognition, and treatment of depression and anxiety symptoms among Chinese cardiovascular outpatients

Rong Chen^{1,2}, Yuanyuan Liu³, Shicheng Yang³, Zepeng Lin⁵, Guolong Yu⁶, Wenxing Wang⁷, Dandan Wei⁷, Wei Li⁷, Haiyan Wang⁷, Meitian Zhang⁸, Pengqiang Zhang⁹, Yunlong Zhang¹⁰, Fenghua Zhou¹¹ & Rongjing Ding⁴✉

Cardiovascular diseases (CVDs) have been the leading cause of death in China. Depression and anxiety are recognized as significant risk factors for poor prognosis and disability among Chinese CVD patients. However, these mental health conditions have received limited clinical attention in the context of CVD management. To date, comprehensive national epidemiological data on the prevalence of depression and anxiety in cardiovascular clinics (CVCs) in China are lacking. The present study aims to describe the prevalence, recognition and therapeutic inequity in CVCs so as to improve the overall health outcomes of CVD patients. A multicenter, cross-sectional study was conducted across secondary and tertiary hospitals in China (January 2021 to December 2022), enrolling 1049 CVD patients from CVCs consecutively. Depression and anxiety symptoms were assessed using the Patient Health Questionnaire-9 (PHQ-9) and Generalized Anxiety Disorder-7 (GAD-7), respectively. Sociodemographic and clinical data were collected via standardized questionnaires. Risk factors were analyzed by multivariable logistic regression, meanwhile recognition rates and treatment inequities were systematically evaluated. The pooled prevalence of depression and anxiety were 61.4% and 53.4% respectively, with 23.9% exhibiting moderate-to-severe symptoms. The multivariable logistic regression analyses disclosed that residing in South Central China, usual activities impairment, as well as experiencing pain or discomfort in daily life were associated with the presence of both depression and anxiety among patients in CVCs. Alarming, only 41.5% of depressed patients and 44.1% of anxious patients were recognized; and fewer than 50% accessed guideline-recommended interventions (psycho-education or medications). Patients residing in South Central China, having moderate or severe mental symptoms and having anxiety and depression comorbidity were more likely to be recognized and treated by cardiologists. This first national study to demonstrate the “high burden-low care” paradox in Chinese CVCs highlights systemic gaps in mental health integration. Urgent implementation of collaborative care models is warranted, prioritizing standardized screening protocols and equity-focused interventions for vulnerable subgroups. These findings provide pivotal evidence for advancing Chinese CVD clinical guidelines to address the mental health crisis in cardiology.

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Keywords Cardiovascular disease, Cardiovascular outpatient clinic, Depression, Anxiety, Epidemiological data

¹Department of Cardiology, Peking Union Medical College Hospital, Beijing 100050, China. ²Chinese Academy of Medical Sciences and Peking Union Medical College, Beijing 100730, China. ³Tianjin Chest Hospital, Tianjin 300222, China. ⁴Department of Rehabilitation, Peking Union Medical College Hospital, Beijing 100050, China. ⁵Shenzhen Sun Yat-sen Cardiovascular Hospital, Shenzhen 518000, China. ⁶Xiangya Hospital of Central South University, Changsha 410008, China. ⁷Nanjing First Hospital, Nanjing 210000, China. ⁸First Affiliated Hospital of Jinzhou Medical University, Jinzhou 121000, China. ⁹The Second Affiliated Hospital of Dalian Medical University, Dalian 116000, China. ¹⁰Lanzhou First People's Hospital, Lanzhou 730050, China. ¹¹Southern Medical University Nanfang Hospital, Guangzhou 510000, China. ✉email: drj2003@vip.163.com

Cardiovascular diseases (CVDs) remain the leading cause of global mortality, accounting for approximately 20.5 million deaths in 2021, nearly one-third of all deaths worldwide¹. Growing evidence underscores the bidirectional relationship between CVDs and mental health problems, driven by shared biological, genetic, and behavioral pathways². Since the landmark 1972 study reporting a 65% prevalence of emotional distress in ischemic heart disease patients³, subsequent research has consistently demonstrated that depression and anxiety significantly exacerbate cardiovascular risks. For instance, major depressive disorder (MDD) increases the risk of cardiovascular morbidity and mortality by ~ 80%⁴, while anxiety disorders elevate coronary heart disease (CHD) risk by 26% and cardiac mortality by 48%⁵. In China, longitudinal studies have revealed similar trends, with hazard ratios for non-fatal myocardial infarction as high as 6.33 [95% CI: 2.96 ~ 13.79] and cardiac rehospitalization as high as 14.08 [95% CI: 4.99 ~ 41.66] among depressed comorbid anxiety patients over 1-year follow-up^{6,7}. These findings highlight an urgent need to address mental health comorbidities in cardiovascular care to reduce premature mortality.

Cardiovascular clinics (CVCs), as the primary interface for CVD management, are critical hubs for early detection and intervention. There is substantial evidence indicating that patients with anxiety and depression often exhibit poor treatment adherence or responsiveness. This can result in unnecessary medical investigations and referrals, which may further exacerbate both the medical and financial burden on these patients^{8–11}. Early recognition of depression and anxiety symptoms in patients can improve outpatient cardiac rehabilitation completion rates, thereby promising a better prognosis for CVDs¹². While validated tools like the Patient Health Questionnaire-9 (PHQ-9) and Generalized Anxiety Disorder-7 (GAD-7) are recommended for routine screening of depression and anxiety symptoms^{13–17}, their adoption in China remains inconsistent, particularly in under-resourced regions. A meta-analysis of the prevalence of depression across various outpatient clinics in several countries revealed that the prevalence of depression in CVCs ranges from 19.7% to 31.0%^{18–21}. However, systematic underrecognition of depression and anxiety persists globally. In the United States, over 50% of depressed patients remain undiagnosed in outpatient settings, with screening rates as low as 3%^{22,23}. Similarly, the recognition rate of mental disorders among CVD patients in China is alarmingly low, with a depression recognition rate of 25.5% in tertiary general hospitals in a 2007 study and only 4% for depression and anxiety in primary hospitals in a 2010 study^{24,25}. Beyond recognition, psychological interventions, including pharmacotherapy, psychotherapy, and exercise, have been shown to alleviate depressive and anxious symptoms, thereby enhancing the quality of life for individuals with CVDs^{26,27}. However, even when recognized, treatment inequities persist: fewer than 11% of depressed CVD patients in U.S. cardiac units receive guideline-concordant care²⁸, and similar barriers—awareness, medication access, and provider expertise—plague China's healthcare system.

In response to these challenges, China has issued national guidelines emphasizing psycho-cardiological integration since 2010²⁹. In 2021, the mind-heart-body connection was further affirmed by the American Heart Association (AHA)³⁰. Yet, no large-scale study has quantified the current burden of depression and anxiety in Chinese CVCs. This nationwide study aims to analyze the clinical characteristics and risk factors associated with depression and anxiety symptoms within the context of CVCs and to identify factors that influence the recognition and management of these conditions from the perspective of cardiologists in China. By doing so, this study may enhance doctors' attention to depression and anxiety in outpatient settings, improve specialized training for cardiologists, and optimize the allocation of healthcare resources at both the regional and hospital levels. Ultimately, these efforts are expected to enhance the efficiency of healthcare delivery for patients with CVDs in China.

Method

Subjects and procedures

This cross-sectional study aimed to determine the prevalence of anxiety and depression among patients in CVCs. Ethical approval was granted by the ethics committees of all participating centers, and written informed consent was obtained from each participant. Initially, 1072 adults aged over 18 years visiting CVCs in secondary and tertiary hospitals were enrolled in the study. The exclusion criteria were applied to exclude individuals who met any of the following conditions: (1) Cardiogenic shock, (2) Recurrent chest pain with ECG ST-T changes, (3) A diagnosis of schizophrenia, (4) Communication impairments or dyslexia, (5) Cognitive impairment or organic brain diseases, (6) Acute left heart failure, (7) Seeking treatment unrelated to cardiovascular issues, (8) Solely seeking medication. Participants who failed to complete questionnaires, cooperate with the research, or provided inaccurate or significantly deviating survey responses were also excluded. After applying these exclusions, the final analysis included data from 1049 participants.

Investigators sequentially invited patients in the CVC awaiting consultation to participate in the survey. Written informed consent was obtained from the research subjects or their legal representatives, as well as the attending physicians, prior to the study's commencement. Each participant completed a basic patient information questionnaire, the PHQ-9, the GAD-7, and the three-level EuroQol-5D scale (EQ-5D-3 L) on-site, as well as medical information, a process that typically took approximately 10 min.

The Case Report Form (CRF) was diligently filled out by the investigators, ensuring comprehensive documentation for each enrolled case. Following completion, the CRFs were meticulously reviewed by the research team, and data entry was carefully performed after the collection of all samples.

All researchers involved in sample collection received comprehensive training on the specified collection methods. The research team regularly monitored the collected samples to ensure their accuracy and integrity. Post data entry, a random selection of forms was subjected to a rigorous examination to assess input quality, detect any potential issues, and implement necessary corrections.

Assessment instrument

- (1) Patient Basic Information Questionnaire: A self-designed questionnaire was utilized to elicit comprehensive patient demographics and background information. Essential details encompassed initials of the name and contact information, while demographic data comprised gender, age, ethnicity, height, weight, educational background, occupational status, average monthly family income, and marital status.
- (2) Medical History and Diagnostic Medication (completed by the attending physician): This section captures pertinent patient information including their status as an outpatient or inpatient, duration of CVDs, type of CVDs, cardiac symptoms, prevalent risk factors, and lifestyle considerations. It delineates the diagnosis rendered by the physician and the corresponding prescribed medications. The previous and current diagnoses of depression or anxiety by cardiologists in CVCs were collected and compared against the findings from the current questionnaire. The recognition rate was subsequently calculated based on this comparison. Furthermore, it documents whether guidance pertaining to psycho-therapeutic interventions was imparted during this outpatient visit, with options including psycho-education, treatment with traditional Chinese medicine, Western medicine, combination of Western and Chinese medicine, and treatment not provided. The hospital level and the region in which the hospital is located were also recorded. The 20 provinces are divided into six regions: North China (Beijing, Tianjin, Hebei, Shanxi), East China (Shandong, Jiangsu, Shanghai, and Zhejiang), Central and South China (Henan, Hubei, Hunan, Guangdong, and Guangxi), Northeast China (Liaoning, Heilongjiang, and Inner Mongolia), West China (Gansu, Sichuan, Yunnan, and Chongqing).
- (3) PHQ-9: Each response is scored as follows: Not at all (0 points), Several days (1 point), More than half the days (2 points), and Nearly every day (3 points). Cumulative scores range from 0 to 27. Interpretation of scores is as follows: 0–4, absence of depression; 5–9, potential mild depression; 10–14, possible moderate depression; 15–19, potential moderate to severe depression; and 20–27, a likelihood of major depressive disorder (MDD). For the purposes of this study, we categorized both moderate to severe and MDD as indicative of severe depression symptoms¹⁵.
- (4) GAD-7: Responses are scored as follows: Not at all (0 points), Several days (1 point), More than half the days (2 points), and Nearly every day (3 points). Total scores range from 0 to 21. Interpretation of scores is as follows: 0–4, absence of anxiety; 5–9, potential mild anxiety; 10–13, possible moderate anxiety; 14–18, potential moderate to severe anxiety; and 19–21, a likelihood of severe anxiety. For the purposes of this study, we classified both moderate to severe and severe anxiety as indicative of severe anxiety¹⁴.
- (5) EQ-5D-3L Assessment: This instrument gauges the patient's health utility value. Comprising two components, the EQ-5D health description system encompasses five dimensions: mobility, self-care ability, daily activity ability, pain or discomfort, and anxiety or depression. Each dimension comprises three levels: no difficulty, some difficulty, and extreme difficulty. The EQ-5D index value is derived through the conversion of the responses into a weighted health-state index. A higher EQ-5D index represents a better health status of the patient. For this investigation, the utility value conversion specific to Japan, as provided on the official website of EQ-5D (<https://euroqol.org/>), was utilized for computation^{31,32}.

Statistical analysis

All data analyses and plots will be presented using R (version 4.3.1). Data conforming to a normal distribution will be statistically summarized using mean \pm standard deviation (SD) and 95% confidence intervals (CI). Between-group comparisons will be conducted using the t-test, while comparisons among multiple groups will be assessed using one-way analysis of variance (ANOVA). For non-normally distributed data, statistical description will be based on median and quartile distances, with inter-group comparisons evaluated via the Chi-square test for percentage. And Fisher exact probabilities were calculated when necessary. Multivariate logistic regression analyses were performed for examining risk factors of depression/anxiety. A significance level of $p < 0.05$ will be applied for all analyses.

Results

Baseline profiles of patients

A total of 1,049 consecutive patients were recruited from CVCs located in secondary- and tertiary-level hospitals across five Chinese regions. The cohort comprised 572 men (54.5%), 299 middle-aged adults (28.5%), and 659 elderly adults (62.8%), with a mean age of 62.96 ± 12.86 years. Comprehensive sociodemographic and clinical characteristics are presented in Table 1.

Overall, 61.4% of participants screened positive for depressive symptoms and 53.4% for anxiety symptoms; the majority of cases were mild in severity. Both conditions were most prevalent in Northeast China and least prevalent in East China. Patients attending tertiary hospitals demonstrated significantly higher rates of depression and anxiety than those seen in secondary hospitals ($p < 0.05$).

Chest distress was the most frequently reported symptom (87.5%), followed by chest pain (60.7%) and palpitations (52.4%). Dyspnea, although present in only 27.0% of the entire sample, was markedly over-represented among patients with depression (74.6%) and anxiety (67.1%).

Depression and anxiety were significantly more common among individuals with heart failure (HF), myocardial infarction (MI), coronary heart disease (CHD), metabolic disorders (diabetes and dyslipidemia), and cerebrovascular disease (all $p < 0.05$). The highest prevalence was observed in patients with HF (depression, 80.4%; anxiety, 66.4%), followed by those with MI (74.6% and 64.0%, respectively).

	Total	No Depression	Depression		No Anxiety	Anxiety	
	N = 1049	N = 405 (38.6%)	N = 644 (61.4%)	p value	N = 489 (46.6%)	N = 560 (53.4%)	p value
Patient characteristics							
Age group, n (%)				0.084			0.497
Young adults	91 (8.7)	45 (49.4)	46 (50.5)		45 (49.4)	46 (50.5)	
The middle-aged	299 (28.5)	113 (37.8)	186 (62.2)		146 (48.8)	153 (51.2)	
The elderly	659 (62.8)	247 (37.5)	412 (62.5)		298 (45.2)	361 (54.8)	
Gender, n (%)				0.137			0.065
Male	572 (54.5)	233 (40.7)	339 (59.3)		282 (49.3)	290 (50.7)	
Female	477 (45.5)	172 (36.0)	305 (64.0)		207 (43.4)	270 (56.6)	
Region, n (%)				< 0.001			< 0.001
East China	361 (34.4)	176 (48.8)	185 (51.2)		210 (58.2)	151 (41.8)	
North China	175 (16.7)	72 (41.1)	103 (59.9)		92 (52.6)	83 (47.4)	
Northeast China	191 (18.2)	53 (27.7)	138 (72.3)		62 (32.5)	129 (67.5)	
South Central China	252 (24.0)	72 (28.6)	180 (71.4)		86 (34.1)	166 (65.9)	
West China	70 (6.7)	32 (45.7)	38 (54.3)		39 (55.7)	31 (44.3)	
Hospital, n (%)				< 0.001			0.016
Secondary hospital	132 (12.6)	71 (53.8)	61 (46.2)		75 (56.8)	57 (43.2)	
Tertiary hospital	917 (87.4)	334 (36.4)	583 (63.6)		414 (45.1)	503 (54.9)	
BMI, mean ± SD	24.0 ± 3.2	24.0 ± 3.2	24.0 ± 3.2	0.885	24.1 ± 3.2	23.9 ± 3.2	0.241
Education background, n (%)				< 0.001			0.040
Primary school and below	230 (21.9)	69 (30.0)	161 (70.0)		94 (40.9)	136 (59.1)	
High school	510 (48.6)	189 (37.0)	321 (63.0)		235 (46.1)	275 (53.9)	
University or above	309 (29.5)	147 (47.6)	162 (52.4)		160 (51.8)	149 (48.2)	
Occupational status, n (%)				0.145			0.137
Employed	300 (28.6)	129 (43.0)	171 (57.0)		152 (50.7)	148 (49.3)	
Unemployed	231 (22.0)	81 (35.1)	150 (64.9)		97 (42.0)	134 (58.0)	
Retired	518 (49.4)	195 (37.6)	323 (62.4)		240 (46.3)	278 (53.7)	
Family monthly income, n (%)				0.030			0.398
Less than 4000	260 (24.8)	91 (35.0)	169 (65.0)		124 (47.7)	136 (52.3)	
4000–7999	425 (40.5)	151 (35.5)	274 (64.5)		185 (43.5)	240 (56.5)	
8000–12,000	243 (23.2)	109 (44.8)	134 (55.2)		121 (49.8)	122 (50.2)	
More than 12,000	121 (11.5)	54 (44.6)	67 (55.4)		59 (48.8)	62 (51.2)	
Marital status, n (%)				0.210			0.035
Married	914 (87.1)	360 (39.4)	554 (60.6)		438 (47.9)	476 (52.1)	
Other	135 (12.9)	45 (33.3)	90 (66.7)		51 (37.8)	84 (62.2)	
Severity of depression or anxiety, n (%)				-			-
Mild			427 (40.7)			421 (40.1)	
Moderate			158 (15.1)			92 (8.8)	
Severe			59 (5.6)			47 (4.5)	
Cardiovascular diseases							
Coronary heart disease, n (%)	861 (82.1)	315 (36.6)	546 (63.4)	0.005	389 (45.2)	472 (54.8)	0.056
Post-CABG, n (%)	39 (3.7)	17 (43.6)	22 (56.4)	0.629	15 (38.5)	24 (61.5)	0.381
Post-PCI, n (%)	338 (32.2)	132 (39.0)	206 (61.0)	0.892	155 (45.8)	183 (54.2)	0.785
Myocardial infarction, n (%)	114 (10.9)	29 (25.4)	85 (74.6)	0.003	41 (36.0)	73 (64.0)	0.021
Hypertension, n (%)	666 (63.5)	253 (38.0)	413 (62.0)	0.632	300 (45.0)	366 (55.0)	0.200
Arrhythmia, n (%)	292 (27.8)	106 (36.3)	186 (63.7)	0.378	128 (43.8)	164 (56.2)	0.293
Heart failure, n (%)	107 (10.2)	21 (19.6)	86 (80.4)	< 0.001	36 (33.6)	71 (66.4)	0.006
Undiagnosed heart disease, n (%)	60 (5.7)	23 (38.3)	37 (61.7)	1.000	21 (35.0)	39 (65.0)	0.085
Duration of CVD/years, median [Q1, Q3]	5.0 [2.0, 8.0]	5.0 [2.0, 8.0]	5.0 [2.0, 9.0]	0.412	5.0 [2.0, 8.0]	4.0 [2.0, 8.2]	0.773
Discomfort symptoms							
Chest pain, n (%)	637 (60.7)	229 (35.9)	408 (64.1)	0.033	275 (43.2)	362 (56.8)	0.007
Chest distress, n (%)	918 (87.5)	337 (36.7)	581 (63.3)	0.001	407 (44.3)	511 (55.7)	< 0.001
Dyspnea, n (%)	283 (27.0)	72 (25.4)	211 (74.6)	< 0.001	93 (32.9)	190 (67.1)	< 0.001
Dizzy, n (%)	391 (37.3)	142 (36.3)	249 (63.7)	0.267	163 (41.7)	228 (58.3)	0.016
Fatigue, n (%)	495 (47.2)	153 (30.9)	342 (69.1)	< 0.001	196 (39.6)	299 (60.4)	< 0.001
Palpitation, n (%)	550 (52.4)	195 (35.4)	355 (64.6)	0.032	220 (40.0)	330 (60.0)	< 0.001
Continued							

	Total	No Depression	Depression		No Anxiety	Anxiety	
	N = 1049	N = 405 (38.6%)	N = 644 (61.4%)	p value	N = 489 (46.6%)	N = 560 (53.4%)	p value
Other clinical comorbidities							
Diabetes, n (%)	340 (32.4)	110 (32.4)	230 (67.6)	0.005	140 (41.2)	200 (58.8)	0.017
Dyslipidemia, n (%)	626 (59.7)	205 (32.7)	421 (67.3)	<0.001	269 (43.0)	357 (57.0)	0.005
Cerebrovascular disease, n (%)	262 (25.0)	84 (32.1)	178 (67.9)	0.015	101 (38.5)	161 (61.5)	0.003
EQ-5D-3 L							
Mobility, n (%)				<0.001			<0.001
Level 1	733 (69.9)	349 (47.6)	384 (52.4)		399 (54.4)	334 (45.6)	
Level 2 or 3	316 (30.1)	56 (17.7)	260 (82.3)		90 (28.5)	226 (71.5)	
Self-care, n (%)				<0.001			<0.001
Level 1	840 (80.1)	377 (44.9)	463 (55.1)		441 (52.5)	399 (47.5)	
Level 2 or 3	209 (19.9)	28 (13.4)	181 (86.6)		48 (23.0)	161 (77.0)	
Usual activities, n (%)				<0.001			<0.001
Level 1	653 (62.2)	333 (51.0)	320 (49.0)		376 (57.6)	277 (42.4)	
Level 2 or 3	396 (37.8)	72 (18.2)	324 (81.8)		113 (28.5)	283 (71.5)	
Pain/Discomfort, n (%)				<0.001			<0.001
Level 1	315 (30.0)	202 (64.1)	113 (35.9)		232 (73.6)	83 (26.4)	
Level 2 or 3	734 (70.0)	203 (27.6)	531 (72.4)		257 (35.0)	477 (65.0)	
Anxiety or depression, n (%)				<0.001			<0.001
Level 1	443 (42.2)	276 (62.3)	167 (37.7)		330 (74.5)	113 (25.5)	
Level 2 or 3	606 (57.8)	129 (21.3)	477 (78.7)		159 (26.2)	447 (73.8)	
Health state utility index, [Q1, Q3]	0.71 [0.63, 0.79]	0.77 [0.71, 1.00]	0.67 [0.59, 0.73]	<0.001	0.77 [0.71, 1.00]	0.67 [0.57, 0.71]	<0.001

Table 1. Baseline characteristics of studied population, $N = 1049$. Plus-minus values are means \pm SD; Body-mass index (BMI) is the weight in kilograms divided by the square of the height in meters; Duration of CVD means the number of years between the start of CVD and the time the patient completed the questionnaire; PCI, percutaneous coronary intervention; CABG, coronary artery bypass grafting; Q1, first quartile, Q3, third quartile; SD, standard difference; PHQ-9 score: 0–4, no depression; 5–9, mild depression; 10–14, moderate depression; 15–27, severe depression; GAD-7 score: 0–4, no anxiety; 5–9, mild anxiety; 10–13, moderate anxiety; 14–21, severe anxiety. On the European Quality of Life-5 Dimensions (EQ-5D) visual analogue scale, level 1 for “no difficulty”, 2 for “some difficulty”, and 3 for “extreme difficulty”; The health state utility index of EQ-5D-3L reflects the patient’s quality of life, with higher index indicating better quality of life.

Risk factors of depression or anxiety in patients attending CVCs

Advanced age conferred a modest but significant protective effect against depression (OR = 0.71; 95% CI, 0.52–0.98; $p = 0.037$), whereas female sex was associated with a higher risk of anxiety (OR = 1.35; 95% CI, 1.00–1.82; $p = 0.048$). Unemployment was associated with an 84% elevation in anxiety risk (OR = 1.84; 95% CI, 1.09–3.14; $p = 0.023$).

Relative to East China, residence in South Central China was associated with a 2.08-fold increase in depression risk and a 2.45-fold increase in anxiety risk. Residence in Northeast China conferred a nearly two-fold elevation in anxiety risk only (OR = 1.99; 95% CI, 1.28–3.11; $p = 0.002$). Attending tertiary hospitals was associated with a 2.15-fold increase in depression risk compared with attending secondary hospitals (OR = 2.15; 95% CI, 1.33–3.49; $p = 0.002$).

Among quality-of-life dimensions, impaired mobility increased the odds of depression (OR = 1.76; 95% CI, 1.12–2.80; $p = 0.016$), whereas limitations in usual activities heightened the risk of both depression (OR = 1.92; 95% CI, 1.27–2.92; $p = 0.002$) and anxiety (OR = 1.52; 95% CI, 1.03–2.24; $p = 0.034$). Self-reported pain or discomfort emerged as the strongest predictor for both depression (OR = 2.62; 95% CI, 1.89–3.65; $p < 0.001$) and anxiety (OR = 3.33; 95% CI, 2.38–4.69; $p < 0.001$).

With respect to somatic symptoms, fatigue was significantly associated with depression (OR = 1.52; 95% CI, 1.11–2.10; $p = 0.010$), whereas chest distress (OR = 1.59; 95% CI, 1.02–2.50; $p = 0.042$) and palpitations (OR = 1.68; 95% CI, 1.24–2.28; $p < 0.001$) were independently associated with anxiety. Among comorbidities, dyslipidemia conferred a significant increase in depression risk (OR = 1.42; 95% CI, 1.02–1.96; $p = 0.034$), and previously undiagnosed cardiovascular disease was associated with a 2.43-fold elevation in anxiety risk (OR = 2.43; 95% CI, 1.14–5.27; $p = 0.029$). Complete multivariable effect estimates are presented in Table 2.

Recognition of anxiety/depression symptoms in CVCs

Only 41.5% of patients with depression and 44.1% of those with anxiety were formally identified. Recognition varied markedly by region: South Central China achieved the highest rates (depression, 56.1%; anxiety, 58.4%), whereas East China recorded the lowest (depression, 25.4%; anxiety, 25.2%). Tertiary hospitals under-performed secondary hospitals in detecting both conditions (depression, 40.0% vs. 55.7%, $p = 0.025$; anxiety, 42.0% vs. 63.2%, $p = 0.004$). Comprehensive recognition rates across regions and hospital levels are provided in Suppl.

Model for Depression			
Variables		OR (95%CI)	P value
Age group	Young adults	Ref.	
	The elderly	0.71 (0.52 ~ 0.98)	0.037
Region	East China	Ref.	
	South Central China	2.08 (1.36 ~ 3.21)	<0.001
Hospital	Secondary hospital	Ref.	
	Tertiary hospital	2.15 (1.33 ~ 3.49)	0.002
EQ-5D-3 L Mobility	Level 1	Ref.	
	Level 2 or 3	1.76 (1.12 ~ 2.80)	0.016
EQ-5D-3 L Usual activities	Level 1	Ref.	
	Level 2 or 3	1.92 (1.27 ~ 2.92)	0.002
EQ-5D-3 L Pain/Discomfort	Level 1	Ref.	
	Level 2 or 3	2.62 (1.89 ~ 3.65)	<0.001
Fatigue	No	Ref.	
	Yes	1.52 (1.11 ~ 2.10)	0.010
Dyslipidemia	No	Ref.	
	Yes	1.42 (1.02 ~ 1.96)	0.034
Model for Anxiety			
Variables		OR (95%CI)	P value
Gender	Male	Ref.	
	Female	1.35 (1.00 ~ 1.82)	0.048
Region	East China	Ref.	
	Northeast China	1.99 (1.28 ~ 3.11)	0.002
	South Central China	2.45 (1.63 ~ 3.71)	<0.001
Occupational status	Employed	Ref.	
	Unemployed	1.84 (1.09 ~ 3.14)	0.023
EQ-5D-3 L Usual activities	Level 1	Ref.	
	Level 2 or 3	1.52 (1.03 ~ 2.24)	0.034
EQ-5D-3 L Pain/Discomfort	Level 1	Ref.	
	Level 2 or 3	3.33 (2.38 ~ 4.69)	<0.001
Undiagnosed heart disease	No	Ref.	
	Yes	2.43 (1.14 ~ 5.27)	0.029
Chest distress	No	Ref.	
	Yes	1.59 (1.02 ~ 2.50)	0.042
Palpitation	No	Ref.	
	Yes	1.68 (1.24 ~ 2.28)	<0.001

Table 2. Factors associated with anxiety/depression symptom in CVCs adjusted by logistic regression models. Model for depression/anxiety: depression/anxiety-age (young adult vs. middle aged vs. elderly), gender, region of China, BMI, education background, occupational status, family monthly income, marital status, levels of hospital, European Quality of Life-5 Dimensions (EQ-5D) visual analogue scale (level 1 for “no difficulty”, 2 for “some difficulty”, and 3 for “extreme difficulty”), cardiovascular diseases (coronary heart disease, post CABG, post PCI, myocardial infarction, hypertension, arrhythmia, heart failure, and undiagnosed heart diseases), duration of CVD, discomfort symptoms (chest pain, chest distress, dyspnea, dizzy and fatigue), diabetes, dyslipidemia, and cerebrovascular disease. OR, odd ratio; CI, confidence interval; $p < 0.05$ means statistic significant.

Tables S1 and S2. Recognition increased monotonically with symptom severity ($p < 0.001$). Notably, the co-occurrence of depression and anxiety was more readily identified (46.6%) than either symptom in isolation (isolated depression, 24.7%; isolated anxiety, 25.8%; $p < 0.001$). Detailed data are presented in Table 3.

Treatment of anxiety/depression symptoms in CVCs

Overall, 44.3% of patients with depressive symptoms and 45.5% of those with anxiety symptoms received any treatment (Table 4). The specific modalities were psycho-education (8.5%), traditional Chinese medicine (17.6%), Western medicine (4.2%), and combined Chinese-Western medicine (6.7%).

Marked regional heterogeneity was evident: South Central China recorded the highest treatment rates (50.8%), whereas East China reported the lowest (22.4%) (Suppl. Figure S1). Treatment modality varied by age group; psycho-education was most common in young adults (17.6%), declining to 9.7% in middle-aged and

	Depression, N (%)		p value	Anxiety, N (%)		p value
	No	Yes		No	Yes	
	N = 377 (58.5)	N = 267 (41.5)		N = 313 (55.9)	N = 247 (44.1)	
Region, n (%)			<0.001			<0.001
East China	138 (74.6)	47 (25.4)		113 (74.8)	38 (25.2)	
North China	59 (57.3)	44 (42.7)		42 (50.6)	41 (49.4)	
Northeast China	73 (52.9)	65 (47.1)		69 (53.5)	60 (46.5)	
South Central China	79 (43.9)	101 (56.1)		69 (41.6)	97 (58.4)	
West China	28 (73.7)	10 (26.3)		20 (64.5)	11 (35.5)	
Gender, n (%)			0.265			0.920
Male	191 (56.3)	148 (43.7)		161 (55.5)	129 (44.5)	
Female	186 (62.0)	119 (38.0)		152 (56.3)	118 (43.7)	
Age group, n (%)			0.309			0.482
Young adults	29 (63.0)	17 (37.0)		27 (58.7)	19 (41.3)	
Middle-aged	116 (62.4)	70 (37.6)		91 (59.5)	62 (40.5)	
Elderly	232 (56.3)	180 (43.7)		195 (54.2)	166 (45.8)	
Hospital, n (%)			0.025			0.004
Secondary Hospital	27 (44.3)	34 (55.7)		21 (36.8)	36 (63.2)	
Tertiary Hospital	350 (60.0)	233 (40.0)		292 (58.0)	211 (42.0)	
Severity of depression, n (%)			<0.001			<0.001
Normal	-	-		49 (74.2)	17 (25.8)	
Mild	283 (66.3)	144 (33.7)		178 (62.2)	108 (37.8)	
Moderate	69 (43.7)	89 (56.3)		62 (41.3)	88 (58.7)	
Severe	25 (42.4)	34 (57.6)		24 (41.4)	34 (58.6)	
Severity of anxiety, n (%)			<0.001			<0.001
Normal	113 (75.3)	37 (24.7)		-	-	
Mild	214 (60.0)	143 (40.0)		262 (62.2)	159 (37.8)	
Moderate	31 (34.1)	60 (65.9)		32 (34.8)	60 (65.2)	
Severe	19 (41.3)	27 (58.7)		19 (40.4)	28 (59.6)	
Comorbid or not, n (%)			<0.001			0.002
Only depression/anxiety	113 (75.3)	37 (24.7)		49 (74.2)	17 (25.8)	
Comorbidity	264 (53.4)	230 (46.6)		264 (53.4)	230 (46.6)	

Table 3. Recognition of depression/anxiety symptom among patients attending CVCs.

6.7% in elderly participants. Conversely, use of traditional Chinese medicine increased with age (young adults, 7.7%; middle-aged, 19.1%; elderly, 18.4%).

Patients with comorbid depression and anxiety were more likely to receive treatment than those with isolated depression or anxiety (47.4% versus 34.0% and 31.8%, respectively; $p < 0.001$). Across all diagnostic subgroups, traditional Chinese medicine was preferred to Western pharmacotherapy (only depression: 19.3% vs. 6.0%; only anxiety: 10.6% vs. 3.0%; comorbidity: 23.7% vs. 9.3%; $p < 0.001$). Treatment rates did not differ significantly between tertiary and secondary hospitals (Suppl. Figure S2).

Discussion

This study delivers an updated, nationally representative profile of depression and anxiety among Chinese CVCs, integrating contemporary prevalence estimates, risk factors, and recognition and treatment patterns, while providing direct comparisons across different regions and hospital levels. The observed prevalence of depressive symptoms (61.4%) and anxiety symptoms (53.4%) substantially exceeds the rates reported in earlier investigations^{33–36}, underscoring an escalating burden of affective disorders in this population. Regional heterogeneity persists: the highest prevalence of both depression and anxiety was documented in Northeast and South Central China, whereas East and West China exhibited comparatively lower rates. This temporal increase may be attributed to rapid socioeconomic transformation, urbanization, and concomitant psychosocial stressors^{24,37}; the additional psychological sequelae of the COVID-19 pandemic warrant dedicated investigation. Moreover, prior research has demonstrated that affective symptoms were significantly more prevalent among outpatients than inpatients²⁴, emphasizing the imperative to prioritize mental-health assessment and intervention within CVCs.

Previous investigations have examined depression and anxiety separately among patients with CHD, MI, hypertension, and those undergoing percutaneous coronary intervention (PCI) or coronary artery bypass grafting (CABG)^{38,39}. However, data comparing the prevalence of these affective disorders across the entire spectrum of CVD remain scarce, particularly in China. The present study addresses this evidence gap by demonstrating a high prevalence of comorbid depression and anxiety in CVD, exceeding 60% in patients with HF or MI.

	Treatment, N (%)					p value
	No treatment 661 (63.0)	Psycho-education 89 (8.5)	Medication treatment 299 (28.5)			
			Chinese medicine 185 (17.6)	Western medicine 44 (4.2)	Combined medicine 70 (6.7)	
Gender, n (%)						0.198
Male	359 (62.8)	48 (8.4)	112 (19.6)	19 (3.3)	34 (5.9)	
Female	302 (63.3)	41 (8.6)	73 (15.3)	25 (5.2)	36 (7.5)	
Age group, n (%)						0.004
Young adult	58 (63.7)	16 (17.6)	7 (7.7)	2 (2.2)	8 (8.8)	
Middle-aged	188 (62.9)	29 (9.7)	57 (19.1)	8 (2.7)	17 (5.7)	
Elderly	415 (63.0)	44 (6.7)	121 (18.4)	34 (5.2)	45 (6.8)	
Region, n (%)						<0.001
East China	280 (77.6)	27 (7.5)	34 (9.4)	17 (4.7)	3 (0.8)	
North China	116 (66.3)	14 (8.0)	35 (20.0)	2 (1.1)	8 (4.6)	
Northeast China	96 (50.0)	8 (4.2)	46 (24.0)	12 (6.2)	30 (15.6)	
South Central China	124 (49.2)	26 (10.3)	66 (26.2)	12 (4.8)	24 (9.5)	
West China	45 (64.3)	14 (20.0)	5 (7.1)	1 (1.4)	5 (7.1)	
Hospital, n (%)						0.382
Secondary Hospital	83 (62.9)	8 (6.1)	30 (22.7)	4 (3.0)	7 (5.3)	
Tertiary Hospital	578 (63.0)	81 (8.8)	155 (16.9)	40 (4.4)	63 (6.9)	
Severity of depression, n (%)						<0.001
Mild	257 (60.2)	37 (8.7)	93 (21.8)	16 (3.7)	24 (5.6)	
Moderate	77 (48.7)	7 (4.4)	42 (26.6)	12 (7.6)	20 (12.7)	
Severe	25 (42.4)	8 (13.6)	11 (18.6)	7 (11.9)	8 (13.6)	
Total	359 (55.7)	52 (8.1)	146 (22.7)	35 (5.4)	52 (8.1)	
Severity of anxiety, n (%)						<0.001
Mild	251 (59.6)	37 (8.8)	89 (21.1)	16 (3.8)	28 (6.7)	
Moderate	32 (34.8)	11 (12.0)	28 (30.4)	11 (12.0)	10 (10.9)	
Severe	22 (46.8)	6 (12.8)	7 (14.9)	1 (2.1)	11 (23.4)	
Total	305 (54.5)	54 (9.6)	124 (22.1)	28 (5.0)	49 (8.8)	
Depression or Anxiety, n (%)						<0.001
Only depression	99 (66.0)	7 (4.7)	29 (19.3)	9 (6.0)	6 (4.0)	
Only anxiety	45 (68.2)	9 (13.6)	7 (10.6)	2 (3.0)	3 (4.5)	
Comorbidity	260 (52.6)	45 (9.1)	117 (23.7)	26 (5.3)	46 (9.3)	

Table 4. Treatment of depression and anxiety symptoms among patients attending CVCs.

Undiagnosed cardiovascular disease independently predicted anxiety, corroborating earlier findings that fear of an unknown cardiac condition substantially elevates anxiety levels⁴⁰. Consistent with prior observations—where 42% of chest-pain patients in CVCs reported anxiety and 31% reported depression¹⁹—our results indicate that specific somatic symptoms exhibit distinct associations with affective disorders. Fatigue was more strongly linked to depression, whereas chest distress and palpitations were more indicative of anxiety, thereby clarifying the relationship between typical cardiac symptoms and psychiatric morbidity. Individuals with depression engage less frequently in physical activity (e.g., walking, gardening, strenuous exercise)^{41–44}, a behavioral pattern that may predispose to dyslipidemia. Consequently, dyslipidemia emerged as a clinically accessible marker for depression in this population. Together, these findings equip cardiologists with an evidence-based framework for the early recognition of affective disorders in CVD patients, especially in those presenting with multiple or atypical symptoms.

Prior North American studies have reported recognition rates for depression and anxiety in CVCs ranging from 20% to 40%^{45–47}. In 2008, a study conducted in six general hospitals in Guangzhou, China, identified only 9.7% of depressed and 12.6% of anxious patients⁴⁸. In the present nationwide cohort, recognition has improved markedly—to 41.5% for depression and 44.1% for anxiety—reflecting substantial advances in Chinese psychocardiology over the past two decades. This progress is plausibly attributable to the nationwide dissemination of expert consensus statements and the systematic implementation of “double-heart” training programs for cardiologists⁴⁹. Notwithstanding these gains, recognition remains suboptimal in tertiary hospitals, possibly because their clinical priorities favour complex cardiovascular interventions over routine mental-health screening. Substantial regional inequities also persist: South Central China consistently outperforms other regions, underscoring the influence of socioeconomic and cultural determinants on care delivery. These findings emphasize the urgent need for targeted capacity-building initiatives that encompass all hospital levels and

economically disadvantaged regions to ensure uniform, effective identification and management of depression and anxiety in CVD patients.

Psychological interventions in CVCs encompass psycho-education, behavioral management, traditional Chinese medicine, and antidepressant medications; these modalities are endorsed by both national guidelines and international psycho-cardiological consensus statements⁵⁰. Lu et al. previously reported a depression treatment rate of only 9.5% in Chinese CVCs between 2012 and 2015⁵¹. In the present nationwide cohort, treatment rates for depression and anxiety have risen to approximately 50%, substantially exceeding earlier figures. This improvement may be attributed to the publication of the Chinese Expert Consensus on Psychological Prescriptions for patients with CVD, as well as the implementation of training courses in fundamental psychological skills for cardiologists in China⁵⁰. Marked geographic heterogeneity persists. South Central China, characterised by more rapid socioeconomic development, demonstrated the highest treatment rates, whereas economically disadvantaged regions lagged behind. These disparities underscore the necessity of region-specific, culturally adapted mental-health strategies for CVD patients. Notably, 40.7% of participants with depression symptoms and 40.1% with anxiety symptoms exhibited mild severity that did not fulfil formal diagnostic criteria¹⁴. Among these mild cases, treatment rates were 39.8% and 40.4%, respectively. Given that two-thirds of these patients also reported concurrent cardiovascular symptoms (e.g., chest distress, dyspnea, palpitations), misattribution and suboptimal management remain concerns. Both the “*Recommendations from the Chinese Consensus of Standard Psycho-Cardiology Clinics*” and the “*Psychological Health, Well-Being, and the Mind-Heart-Body Connection: A Scientific Statement from the American Heart Association*” emphasize that mild depression and anxiety in CVD can be effectively managed with psycho-education or behavioral interventions, leading to improved cardiovascular outcomes, mental health, and quality of life^{29,30}. Consequently, cardiologists should maintain heightened vigilance for even sub-threshold psychological symptoms in this population.

This study further demonstrates that Chinese cardiologists exhibit a pronounced preference for traditional Chinese medicine in the management of depression and anxiety among patients with CVDs whereas psycho-education is comparatively underutilised. In accordance with current guidelines, psycho-education constitutes the recommended first-line intervention for mild affective disorders in this population; given the high proportion of mild depression and anxiety observed in Chinese CVCs, greater emphasis on structured psycho-education is warranted. Although prior studies have provided preliminary evidence supporting the efficacy of specific traditional Chinese medicine formulations in mild-to-moderate depression and anxiety^{52,53}, rigorous, large-scale clinical trials are required to validate their safety and effectiveness specifically in CVD patients. Conversely, the prescription of Western pharmacotherapy rose incrementally with symptom severity but remained below 10% even in severe cases. This limited utilisation, coupled with infrequent referral to mental-health specialists, underscores a critical gap in cardiologists’ training and highlights the pressing need for enhanced educational initiatives and integrated care pathways.

Limitation

The mentioned results should be considered under the light of several limitations. First, the assessment was done at 121 subcenters across 20 provinces. Therefore, the possibility of variation between subcenters exists. However, all participating subcenters completed a standardized assessment process before the study, and stringent quality control procedures were used during the study. Second, we only used self-report questionnaires for depression and anxiety assessment. However, the inventories are highly reliable and have strong construct validity from prior research, as described in the introduction and methods. Additionally, this study was designed to simulate the process of rapid screening for anxiety and depressive symptoms in the CVC to provide cardiologists with premise for initial treatment and referrals to the psychological department. Therefore, self-report measures were used to facilitate the assessment of a sample of CVCs. Third, behavioral risk profiles, especially smoking and drinking habits, were not included in the regression analysis. However, some comorbidities (e.g., dyslipidemia and diabetes) were included in the regression analysis, which to some extent reflected the impact of lifestyle habits. Finally, the cross-sectional design of the study makes any inference of a causal relationship between mental health and predictors weak.

Conclusion

This study highlights the substantial mental-health burden among Chinese CVCs and underscores the urgent need for systematic integration of psycho-cardiology into routine clinical practice. Implementation of level-specific training curricula—emphasizing advanced diagnostic algorithms in tertiary hospitals—should be prioritized. Concurrently, eliminating regional inequities, enhancing cardiologists’ competencies, and proactively managing mild cases are likely to improve patient-centred outcomes and attenuate long-term healthcare expenditures.

Future investigations should adopt longitudinal designs to delineate the bidirectional relationship between CVD progression and mental-health trajectories. Priority research agendas include (i) comparative effectiveness analyses of clinical outcomes in recognized versus unrecognized cases, and (ii) rigorous evaluation of the relative efficacy of structured psycho-education versus traditional Chinese medicine in patients with mild depression or anxiety.

Data availability

Data is provided within the manuscript.

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Author contributions

D.R.J. designed the study protocol. L.Y.Y., Y.S.C., L.P.Z., Y.G.L., W.W.X., W.D.D., L.W., W.H.Y., Z.M.T., Z.P.Q., Z.Y.L., Z.F.H. conducted data collection. C.R. conducted data management, cleaning. C.R. wrote the first draft of the paper. D.R.J. and C.R. substantially revised the manuscript. All authors read and approved the final manuscript.

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Declarations

Ethics approval and consent to participate

Informed consent was obtained from all participants. The procedures were carried out in accordance with the Declaration of Helsinki. Ethical approval for this study was also obtained from the ethics committee of the Peking University Research Ethics Service (2021-PHB181-001).

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

Additional information

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Correspondence and requests for materials should be addressed to R.D.

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