# RESEARCH

Investigating psychological difference between two genders in mental health after percutaneous coronary intervention for elderly patients with acute coronary syndrome

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# Abstract

**Objective** Psychological factors are closely correlated with coronary heart disease, and gender discrepancies occurs in mental health after percutaneous coronary intervention (PCI) for acute coronary syndrome patients (ACS) are worth studying.

**Methods** This study collected data from patients aged ≥ 60 diagnosed with ACS who underwent PCI treatment within one week of admission to the Cardiovascular Department of Ji'an Central People's Hospital between June 2021 and December 2022. The study group consisted of 113 female patients, whereas the control group consisted of 121 male patients. Baseline patient data, demography, and laboratory test results were collected. Anxiety and depression were assessed using the Self-rating anxiety scale (SAS) and Self-rating depression scale (SDS) before PCI and at 1, 4, and 12 weeks post-procedure. Descriptive data are presented as x±s. Group comparisons for continuous variables were conducted using t-tests, while categorical data were analyzed using chi-square tests. Multiple group comparisons were conducted using analysis of variance.

**Results** There were no statistically significant disparities observed in baseline characteristics between these two groups. The assessment of SAS and SDS scores exhibited no statistically significant difference between the two groups before PCI; however, after the procedure, elderly female ACS patients demonstrated notably elevated SAS and SDS scores when contrasted with their elderly male ACS counterparts. Both cohorts manifested their highest SAS and SDS scores before PCI, with a gradual reduction in these scores after the procedure. Elderly female ACS patients experienced a statistically significant reduction in SAS and SDS scores at both 4- and 12 weeks post-PCI compared to their pre-PCI scores.

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**Conclusions** Taken together, elderly female ACS patients undergoing PCI are more susceptible to the manifestation of anxiety and depression symptoms compared to their elderly male counterparts.

**Keywords** Acute coronary syndrome, Percutaneous coronary intervention, Anxiety, Depression, Self-rating anxiety scale, Self-rating depression scale

# Introduction

With the continuous advancement of medical knowledge and the emergence of the new biopsychosocial medical model, coronary heart disease is increasingly being understood as a psychosomatic disorder [1], and mucltiple risk factors including sex hormone-binding globulin, maternal and childhood factors, environmental factors contribute to the occurrence of coronary heart disease [2, 3]. Coronary artery calcium score and polygenic risk score have been used to predict and detect the occurrence of coronary heart disease [4]. Psychological factors, notably anxiety and depression, are gaining recognition for their significant impact on coronary heart disease [5, 6]. Acute coronary syndrome represents a severe subtype of coronary heart disease, specifically characterized by a set of clinical symptoms stemming from acute myocardial ischemia. It occurs when unstable atherosclerotic plaques in the coronary arteries rupture or erode, leading to thrombus formation and ischemia. This syndrome encompasses unstable angina (UA), non-ST-segment elevation myocardial infarction (NSTEMI), and ST-segment elevation myocardial infarction (STEMI). Percutaneous coronary intervention (PCI) is a widely used method for treating acute coronary syndrome (ACS) [7]. It offers several advantages such as high success rates, minimal trauma, and favorable patient acceptance. It has significantly reduced disability and mortality rates associated with ACS. However, PCI also comes with some negative impacts. A low prognostic nutritional index closely associated with an increased risk of long-term mortality in patients undergoing PCI for ACS [7].

Patients undergoing PCI often experience a complex array of adverse psychological emotions postoperatively, including fear, anxiety, and depression. These emotions arise from various factors, such as the nature of the disease itself, concerns about surgical risks, economic considerations related to stent placement, and the possibility of postoperative restenosis [8, 9]. These negative emotional states can trigger physiological and pathological changes in the patient's body, leading to events such as coronary artery spasm, thrombus formation within the stent, stent restenosis, and malignant arrhythmias [10]. The influence of complex adverse emotions, such as anxiety and depression on post-PCI outcomes in acute coronary syndrome primarily operates by stimulating platelet function, activating inflammatory responses, and overstimulating the sympathetic nervous system [11– 15]. These mechanisms underscore the importance of addressing the psychological well-being of ACS patients undergoing PCI as an integral part of their overall care.

While there have been reports on the impact of anxiety and depression on coronary heart disease, especially focusing on nursing studies [8], there is a noticeable dearth of research concerning the psychological wellbeing of patients undergoing PCI following acute coronary syndrome in China, as well as limited related studies in foreign literature. Furthermore, there is a significant gap in the research regarding the psychological health of elderly female patients undergoing PCI after acute coronary syndrome, both domestically and internationally. Our present study aims to investigate the psychological health characteristics, such as anxiety and depression, in elderly female patients undergoing PCI after acute coronary syndrome. Our goal is to provide a more robust clinical and scientific foundation for implementing psychological interventions tailored to this specific patient demographic.

# Methods

# Study population collection

The study population comprises patients diagnosed with ACS at the Department of Cardiovascular Medicine in our hospital between June 2021 and December 2022, all of whom underwent PCI within one week of admission and are aged 60 years or older. Based on specific inclusion and exclusion criteria, we categorized the subjects into two groups, the study group, and the control group, according to their gender. The study group consisted of 113 randomly selected female patients while the control group comprised 121 randomly selected male patients. The Medical Ethics Committee of Ji'an Hospital approved all the experiments described herein.

# Inclusion criteria

(1) Patients aged 60 years or older (2) Admitted to the Department of Cardiovascular Medicine at our hospital between June 2021 and December 2022 (3) Diagnosed with ACS (4) Underwent PCI within one week of admission (5) Met diagnostic criteria for acute coronary syndrome set by the World Health Organization and the International Society of Cardiology, including acute ST-segment elevation myocardial infarction, and unstable angina.

## **Exclusion criteria**

Patients were excluded if they met any of the following criteria: (1) Language communication difficulties, altered consciousness, or severe physical illness preventing questionnaire completion (2) Severe heart failure, liver or kidney diseases, malignancies, respiratory failure, or relevant medical history (3) Psychiatric or neurological disorders, a confirmed family history or personal history of psychiatric illness, or a history of psychological trauma (4) Severe valvular heart disease, cardiomyopathy, severe arrhythmias, or cerebrovascular organic diseases (5) Acute or chronic infectious diseases, hematologic diseases, autoimmune diseases, or connective tissue diseases (6) History of trauma or other surgeries within the past three months (7) History of alcohol abuse and/or drug use (8) Illiteracy.

# **Data collection**

General demographic data collection encompasses the acquisition of fundamental demographic information such as name, gender, age, marital status, educational attainment, occupation, family relationships, and economic status. The retrieval of laboratory and ancillary test findings for research subjects involves the assessment of various parameters, including blood pressure, heart rate, complete blood cell count, lipid profile, blood glucose, liver and kidney function assessments, cardiac enzyme concentrations, left ventricular ejection fraction measurements, chest X-ray interpretations, electrocardiogram results, and coronary angiography results. These results are classified based on coronary angiography as either indicative of single-vessel disease, doublevessel disease, or triple-vessel disease. Furthermore, they are classified based on PCI surgical outcomes, which are delineated as either surgical success or surgical failure.

# Psychological disorder questionnaire assessment

The assessment of psychological disorders is conducted through a questionnaire distributed by specially trained personnel. These questionnaires are designed in-house and provided to both patients and their family members, who are given instructions on how to complete them. Importantly, all survey forms lack headings, thus respondents won't be led by specific headings, allowing them to interpret the question more freely without preconceived notions and the questions focus on the subjective experiences and feelings of the respondents within the past week. The collected forms are then submitted within the designated time frame for statistical scoring and analysis.

Assessment with the SAS aims to gauge the test taker's subjective experience of anxiety. It comprised a total of 20 items, each rated on a 4-point scale. The raw score is obtained by summing responses to all questions, and the standard score is calculated using the formula: Final

Score = Raw Score  $\times$  1.25, rounded to the nearest whole number. Final scores falling within the range of 50–59 indicate mild anxiety, while scores between 60 and 69 indicate moderate anxiety. Scores exceeding 70 are indicative of severe anxiety. Assessment with the SDS offers an intuitive assessment of the subjective experiences with depressive symptoms. It comprised a total of 20 items, utilizing a scoring methodology and standard score calculation akin to that of the SAS calculation. The established cutoff value for SDS standard scores is 53 points, with scores ranging from 53 to 62 indicating mild depression, 63 to 72 indicating moderate depression, and scores surpassing 72 signifying severe depression.

# Methodology

Anxiety and depression assessments using the SAS and SDS were administered to both the study group and the control group at four time points: before PCI, 1 week after PCI, 4 weeks after PCI, and 12 weeks after PCI. Raw scores were initially obtained from all question-naire responses and subsequently transformed into final scores using the formula: Final Score = Raw Score  $\times$  1.25, rounded to the nearest whole number. Comparative analyses were performed to evaluate the overall health status between the study and control groups. Additionally, pairwise comparisons were executed to assess differences in SAS and SDS final scores in between the following time points: before PCI, 1 week after PCI, 4 weeks after PCI, and 12 weeks after PCI.

# Statistical methods

Statistical analysis of the data acquired in this investigation was conducted using SPSS 23.0 software. Continuous data were expressed as mean±standard deviation (x±s). Group comparisons for continuous data were carried out using Student t-tests, while comparisons for categorical data were conducted using  $\chi^2$  tests. For multiple group comparisons, analysis of variance (ANOVA) was employed, with a significance threshold established at *P*<0.05 to indicate statistical significance.

# Results

# No significant difference occurrs on general demographic data, laboratory and ancillary test results between female and male patients

This study encompassed a total of 234 patients, with 113 of them being female and 121 male. The average age among female patients was  $72.51\pm9.48$  years, whereas the average age of male patients was  $70.23\pm7.89$  years. There were no significant differences in the mean ages between the two patient groups. Upon closer examination of various physiological parameters including blood pressure, heart rate, total cholesterol, low-density lipoprotein, blood glucose levels, serum creatinine levels, and

 Table 1
 Comparison of clinical features, demographics, and laboratory tests between the study group and the control group

General information	Study group	Control group	Р	
	(N=113)	(N=121)	value	
Age (years)	72.51±9.48	70.23±7.89	0.056	
Blood pressure (mmHg)	$142.56 \pm 30.76$	139.28±31.51	0.062	
Heart rate (beats/min)	$81.24 \pm 19.76$	$83.01 \pm 20.19$	0.068	
TC(mmol/l)	$4.83 \pm 1.21$	$4.68 \pm 1.60$	0.052	
LDL(mmol/l)	$3.34 \pm 0.97$	$3.41 \pm 1.04$	0.064	
GLU(mmol/l)	$6.31 \pm 2.97$	$6.51 \pm 2.47$	0.069	
CRE(umol/l)	$92.75 \pm 20.57$	95.21±21.64	0.061	
EF(%)	$54.32 \pm 10.71$	53.18±13.71	0.088	

TC=Total Cholesterol, LDL=Low-Density Lipoprotein, GLU=Glucose, CRE=Creatinine, EF=Ejection Fraction

left ventricular ejection fraction, there were no statistically significant differences in these markers (Table 1).

# Higher scores of SAS and SDS occur in female than in male patients after PCI treatment

As shown in Table 2, there were no significant differences in SAS and SDS scores before PCI procedure between the two patient groups. However, at one week, four weeks, and twelve weeks post-PCI procedure, the SAS and SDS scores for female patients were higher compared to those in the control group. It is worth mentioning that both patient groups experienced their highest SAS and SDS scores before PCI procedure, which gradually decreased following the surgical procedure.

# The scores of SAS and SDS decrease at 4 weeks and 12 weeks post-PCI procedure compared with preoperation

In females, both SAS and SDS scores exhibited significant decreases at 4 weeks and 12 weeks post-PCI procedure when compared to the scores recorded before PCI procedure ( $49.16\pm8.74$  vs.  $53.67\pm8.86$ , P=0.046;  $48.92\pm8.27$  vs.  $53.67\pm8.86$ , P=0.044;  $46.57\pm9.11$  vs.  $48.37\pm10.16$ , P=0.049;  $45.73\pm7.51$  vs.  $48.37\pm10.16$ , P=0.042, Table 3). However, there were no significant differences in SAS and SDS scores of patients between 1 week post-PCI procedure and patients before PCI procedure, and between patients at 4 weeks, 12 weeks post-PCI procedure and patients at 1 week post-PCI procedure.

 Table 3
 Comparison of SAS and SDS scores between before

 PCI procedure and 1 week, 4 weeks, and 12 weeks post-PCI procedure

Groups	Before PCI procedure	1 week post- PCI procedure	4 weeks post-PCI procedure	12weeks post-PCI procedure
SAS	$53.67 \pm 8.86$	$50.89 \pm 9.15$	$49.16 \pm 8.74$	$48.92 \pm 8.27$
SDS	48.37±10.16	47.64±10.53	46.57±9.11	45.73±7.51

Similarly, comparisons between the scores at 4 weeks and 12 weeks post-PCI procedure also revealed no significant differences.

Additionally, the study group conducted comparisons of SAS scores between pre-PCI and 1 week post-PCI procedure (P=0.058), pre-PCI and 4 weeks post-PCI procedure (P=0.046), pre-PCI and 12 weeks post-PCI procedure (P = 0.044), 1 week post-PCI procedure and 4 weeks post-PCI procedure (P = 0.055), 1 week post-PCI procedure and 12 weeks post-PCI procedure (P = 0.053), and 4 weeks post-PCI procedure and 12 weeks post-PCI procedure (P = 0.089). For the SDS scores, comparisons were made between the pre-PCI and 1 week post-PCI procedure (P=0.073), pre-PCI and 4 weeks post-PCI procedure (P=0.049), pre-PCI and 12 weeks post-PCI procedure (P = 0.042), 1 week post-PCI procedure and 4 weeks post-PCI procedure (P = 0.066), 1 week post-PCI procedure and 12 weeks post-PCI procedure (P = 0.056), and 4 weeks post-PCI procedure and 12 weeks post-PCI procedure (P = 0.085).

# Discussion

This clinical study focused on elderly patients with ACS, specifically on the differences between the genders, and investigated their anxiety and depression levels following PCI procedures. Our finding revealed that there were no significant differences in baseline characteristics between these two groups. Preoperative scores on the SAS and SDS also exhibited no significant differences. However, a few weeks following the procedure, both SAS and SDS scores were higher in female patients than in their male counterparts. In both groups, the highest SAS and SDS scores were recorded before the operation, and these

**Table 2** Comparison of SAS and SDS scores between the study group and the control group before PCI procedure, one week after PCI procedure, four weeks after PCI procedure, and twelve weeks after PCI procedure

	SAS			SDS		
Groups	Study group	Control group	P value	Study group	Control group	P value
Before PCI procedure	$53.67 \pm 8.86$	51.41±9.31	0.066	48.37±10.16	46.57±9.34	0.073
1 week post- PCI procedure	50.89±9.15	47.21±8.53	0.047	47.64±10.53	43.37±9.82	0.048
4 weeks post- PCI procedure	49.16±8.74	45.37±8.61	0.043	46.57±9.11	41.19±7.36	0.036
12 weeks post- PCI procedure	48.92±8.27	44.89±7.35	0.041	45.73±7.51	40.81±6.82	0.031

scores gradually decreased post-PCI. Nevertheless, female patients exhibited a significant reduction in their SAS and SDS scores at 4 weeks and 12 weeks post-PCI when compared to their pre-PCI levels.

The aim of our study was to explore the psychological well-being of elderly female patients who have experienced ACS and required PCI. We employed questionnaire surveys and clinical assessments to investigate a specific group of elderly female ACS patients, with a primary focus on assessing anxiety and depression levels post-PCI. Our results indicated that elderly female ACS patients showed higher levels of anxiety and depression following PCI. It may be caused by elderly female is more sensitive than elderly male when they are confronted with difficulties, elderly female themselves are also lack of knowledge and confidence about the disease, and they often appear different degrees of fear, tension, anxiety, depression and other adverse psychological emotions after PCI for ACS, which may also be related to postmenopausal endocrine disorders in elderly female. These adverse psychological states, including anxiety and depression, had a significant impact on the patients' quality of life and disease outcomes, thereby creating a vicious cycle [16, 17]. Due to their heightened sensitivity, preexisting anxiety, lack of disease awareness, and diminished self-confidence, elderly women often experienced varying degrees of fear, apprehension, tension, anxiety, and depression after PCI. This heightened psychological distress increases the risk of future adverse cardiovascular events and could potentially trigger another myocardial infarction or stroke if left it untreated. Consequently, analyzing the psychological well-being of elderly female ACS patients and offering early psychological intervention is of paramount importance [18].

The finding of this study indicates that there is a certain degree of variability in anxiety and depression levels among elderly female patients who have undergone PCI for ACS. One week after the PCI procedure, anxiety and depression may still present, possibly due to the time required for physical recovery and psychological adaptation following the procedure. However, as time passes, particularly at four and twelve weeks post-PCI procedure, there is a noticeable decline in anxiety and depression levels, likely attributed to the gradual physical recuperation and stabilization of psychological adaptation. The findings of this study have several significant clinical implications. Healthcare professionals, including doctors and nurses, should pay closer attention to the psychological well-being of elderly female ACS patients who have undergone PCI procedure and provide necessary psychological support and interventions post-PCI procedure. Furthermore, these results underscore the importance of considering gender differences when developing intervention strategies and treatment plans to improve therapeutic efficacy. In clinical practice, healthcare providers should be vigilant for symptoms of anxiety and depression at the one-week post-PCI procedure mark and offer appropriate psychological support and interventions. Additionally, the substantial decrease at four and twelve weeks post-PCI procedure suggests that patients are slowly adjusting to life after PCI procedure and their physical circumstances. However, this also underscores the continued need for sustained attention and support. More importantly, our study highlights the medical workers, patients and their family members should pay more attention to the mental health status of elderly female ACS patients after PCI, they should also timely detect the anxiety and depression of these patients, and then timely provide health education, psychological intervention and drug treatment for them, thereby reducing the incidence of cardiovascular events in elderly female ACS patients after PCI, and improving the quality of life after PCI.

Several limitations also occur in our study, such as the following aspects. On the one hand, the design of an observational study limits the ability to infer causal relationships. Observational studies can only observe correlations between phenomena and cannot establish causality. On the other hand, as the study focused exclusively on elderly patients, and our results may not be readily generalizable to other age groups. In addition, the study may be susceptible to memory and information bias. Data collection relied on questionnaire surveys, which could introduce subjective biases in patients' self-assessments of their anxiety and depression. Finally, due to the limited sample size, the reliability and representativeness of the study results may be compromised. A smaller sample size can lead to instability and errors in interpretation. Hopefully that future research can expand the sample size to enhance the reliability and representativeness of the study results. Furthermore, further exploration of factors that may influence the anxiety and depression levels in elderly female patients with acute coronary syndrome, such as family support and socioeconomic factors, could help in formulating more effective interventions and ultimately achieve disease prevention.

# Conclusion

This clinical study found gender disparities among ACS patients, with evidence indicating that elderly female patients may experience higher levels of anxiety and depression following PCI. However, according to the current international guidelines on the prevention and treatment of anxiety and depression, not all elderly female patients need to regularly take anti-anxiety drugs, even not all elderly female patients with anxiety need anti-anxiety drugs. Generally, elderly female patients with mild or moderate anxiety disorders can alleviated anxiety

symptoms without anti-anxiety drugs but only take nondrug treatment measures such as health education and psychological intervention. For elderly female patients with severe anxiety or moderate anxiety whose anxiety symptom can't be significantly relieved after non-drug treatment such as psychological intervention, anti-anxiety drugs are recommended to use in addition to psychological intervention. Therefore, these findings have important implications for clinical practice, emphasizing the importance of actively monitoring and early intervening to support the psychological well-being of elderly female ACS patients.

# Abbreviations

ACS	acute coronary syndrome
CRE	Creatinine
EF	Ejection fraction
GLU	Glucose
LDL	Low-density lipoprotein
NSTEMI	Non-ST-segment elevation myocardial infarction
PCI	Percutaneous coronary intervention
SAS	Self-rating anxiety scale
SDS	Self-rating depression scale
STEMI	ST-segment elevation myocardial infarction
TC	Total cholesterol
UA	Unstable angina

#### Author contributions

M. P. and J.L. designed the study and wrote the paper. L.K. and J.G. acquired data and analyzed the data. S.L. and C.Y. interpreted the results. The final version to be submitted was approved by all the authors.

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#### Data availability

No datasets were generated or analysed during the current study.

# Declarations

#### Human ethics and consent to participate

Ethical approval was obtained for all experimental procedures by The Medical Ethics Committee of Ji'an Hospital (No. 2021101120).

#### **Consent for publication**

All participating authors agree to publication of the article.

#### **Competing interests**

The authors declare no competing interests.

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