

# Health-Related Quality of Life and Influencing Factors in Coronary Heart Disease Based on the Scale QLICD-CHD (V2.0): A Cross-Sectional Study

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**Purpose:** Coronary heart disease (CHD) is difficult to cure, so more attention should be paid to improving patients' health-related quality of life (HRQoL). This paper focuses on identifying factors that affect HRQoL.

**Patients and Methods:** Overall, 189 in-patients with coronary heart disease were investigated at the Affiliated Hospital of Guangdong Medical University between 2015 and 2016. The scale Quality of Life Instruments for Chronic Diseases-Coronary heart disease (QLICD-CHD V2.0) was used to evaluate HRQoL and collect demographic information. Medical records were applied to collect patients' clinical indicators. A simple correlation analysis, Student's *t*-test, and a one-way analysis of variance were first performed to filter factors that might associate with HRQoL, and multiple linear regression was applied to finally identify related factors.

**Results:** Findings from multiple linear regression showed that the total score was related to family economy, treatment, indirect bilirubin, and albumin with regression coefficient  $B=5.209, -6.615, 0.378,$  and  $0.548,$  respectively. The physical functions were related to treatment, albumin, globular proteins, chloride, and red blood cell count with  $B=-9.031, 1.000, 0.612, 1.320,$  and  $5.161,$  respectively. The psychological function was in association with family economy, clinical course, serum phosphorus, and percentage of lymphocyte population with  $B=7.487, 6.411, -16.458,$  and  $0.090,$  respectively. The social function was associated with family economy, blood urea nitrogen, serum creatinine, and platelet distribution width with  $B=7.391, 1.331, -0.060,$  and  $-0.929,$  respectively. The special module was in association with treatment, indirect bilirubin, and serum calcium with  $B=-7.791, 0.414,$  and  $23.017,$  respectively.

**Conclusion:** Clinical indicators including albumin, globular proteins, chloride, red blood cell count, serum phosphorus, percentage of lymphocyte population, blood urea nitrogen, serum creatinine, platelet distribution width, indirect bilirubin, and serum calcium, as well as socio-demographic factors including the family economy, clinical course, and treatment, may affect coronary heart disease patients' HRQoL.

**Keywords:** quality of life, coronary heart disease, socio-demographic factors, clinical indicators, scale

## Introduction

Coronary heart disease (CHD) has high morbidity and mortality, leading to low health-related quality of life (HRQoL).<sup>1,2</sup> It can narrow blood vessel lumens, decrease blood circulations, and cause cardiac ischemia,<sup>3,4</sup> posing a great risk to human health. Unfortunately, considerable numbers of people suffered from CHD: 126.5 million patients globally in 2017<sup>5</sup> and 17.06 million in China in 2018,<sup>6</sup> among which more than 0.9 million needed interventional treatment.<sup>7</sup> Doctors are used to focus on determining patients' health conditions through electrocardiograms and coronary arteriography, while patients care more about eliminating discomfort and pain, because long-

lasting and incurable CHD requires lifetime regular medication and monitoring visits, probably resulting in work-ability loss, early retirement,<sup>8</sup> and even mental health issues. Therefore, both life expectancy and quality of life are essential for patients.

HRQoL refers to patients' subjective evaluation of their physical, psychological, and social health, and overall well-being level.<sup>9</sup> Due to the rise of the "biology-psychology-social medicine" model, people pay increasing attention to it.<sup>10</sup> Recently, researchers worldwide have veered from the treatment of CHD to enhancing patients' HRQoL. They utilized it as an indicator to assess the progress of treatment.<sup>11</sup> Most of the measurements of HRQoL are through scales. However, general scales may fail to precisely reflect CHD patients' subjective feelings. Typical general scales, such as the European Quality of Life Five Dimension Five level scale (EQ-5D-5L), include self-care, pain/discomfort, usual activities, mobility, and anxiety/depression. It reflects patients' HRQoL from different domains but does not consider the characteristics and clinical manifestations of CHD. Mei's (2021) study showed that less than 8% of patients had problems with self-care.<sup>12</sup> However, if more items about chest pain and chest distress that seriously bother CHD patients' normal life are added to the scale, patients can be especially evaluated and conclusions will be more accurate. Similarly, the 36-Item Short-Form Health Survey questionnaire (SF-36) focuses on overall health status without considering the effects of specific disorders.<sup>13</sup> In this study, we use the Quality of Life Instruments for Chronic Diseases (QLICD-CHD V2.0), a modular approach with a general module (QLICD-GM) and a specific one so common psychometric properties and distinctive disease features can be captured.<sup>14</sup>

In addition, prior work has documented that CHD patients from different European countries reported different major problems on the EQ-5D-5L scale.<sup>15</sup> As a result, we assume that cultural variations have a significant impact on HRQoL. However, in China, specific measurement tools are demanded for the HRQoL of patients with CHD. Researchers in the United States have developed the Seattle Angina Questionnaire (SAQ), which includes physiological constraints, treatment satisfaction, disease perception, angina stability, and angina frequency, among which the stability and frequency of pain are important indicators of patients' physical condition.<sup>16</sup> Similarly, the Kansas City Cardiomyopathy Questionnaire (KCCQ) is a disease-specific health status measure for patients with heart disease that can discover minor clinical changes.<sup>17</sup> However, in the process of developing and evaluating the scales above, all the patients selected were Americans. So, due to the lack of a specific Chinese social and cultural environment, these scales may be unsuitable to be used in China. Chinese people, in particular, value family. In traditional Chinese culture, a family is a social group with a clear division of labor and performing its duties. Therefore, family ties and the ability to fulfill family responsibilities will significantly impact HRQoL.<sup>18</sup> Based on the review of the above-mentioned scales, we realized that EQ-5D-5L and SAQ lack items about family relationships. Although SF-36 and KCCQ measure the intimacy between family members, they fail to test whether patients can continue to take on corresponding family roles such as parents. In this regard, we used QLICD-CHD V2.0, which satisfies the criteria for accurate measurement of the HRQoL of CHD patients in China with important items such as family responsibility.

Some scholars have found socio-demographic characteristics that affect HRQoL but the relationships between clinical indicators and HRQoL are not well understood. Jiang<sup>19</sup> (2017) used QLICD-CHD V2.0 to conclude that age, gender, and medical treatment can affect patients' HRQoL, which is agreed upon by different scholars.<sup>20,21</sup> Slepecky (2017) found that patients with depression symptoms reported lower QOL,<sup>22</sup> and Matsuda (2017) suggested that sleep quality played an important role in HRQOL.<sup>23</sup> Apart from socio-demographic factors, we assumed that certain clinical indicators can reflect patients' HRQoL. Fu's (2022)<sup>24</sup> study showed that patients with a lower level of D-dimer felt lower HRQoL. Erdem (2016)<sup>25</sup> observed the correlation between the severity of coronary artery disease and high red cell distribution width values. These studies indicated that biomarkers may predict CHD patients' HRQoL, but there are few studies on its mechanism at home and abroad. We believe that through the detection of objective clinical indicators in blood routine, blood biochemistry, urine routine, and blood gas analysis, we can make up for the shortcomings of the current HRQoL research. Therefore, we intend to use QLICD-CHD (V2.0) to further explore the related socio-demographic factors and possible objective clinical indicators that affect HRQoL and provide a basis for the formulation of intervention strategies.

## Methods

### Study Design and Setting

A cross-sectional method is used for in-patients with CHD at the Affiliated Hospital of Guangdong Medical University from January 2015 to December 2016. It is a tertiary first-class hospital located in Zhanjiang, China.

### Participants

We selected patients with CHD from the Affiliated Hospital of Guangdong Medical University as subjects.

Inclusion criteria: (1) patients diagnosed with CHD; (2) patients with necessary comprehension, writing, and reading skills.

Exclusion criteria: (1) patients who were illiterate; (2) patients with other serious diseases; (3) patients who refused to cooperate.

All patients signed an informed agreement before taking part in the trial.

### Instruments and Variables

QLICD-CHD (V2.0) is about CHD in Quality of Life Instruments for Chronic Diseases (QLICD). The internal consistency  $\alpha$  of the whole scale is higher than 0.70. The test-retest reliability coefficient in all fields is higher than 0.80, and its standardized response mean (SRM) is higher than 0.32. The scale is small, and the patient can finish it in less than 15 min. Therefore, it is a reliable indicator that can correctly reflect the actual feelings of patients and is feasible in clinical settings.<sup>26</sup> The specific module involves 14 items and QLICD-GM contains three domains, including 9 items in physiological function, 11 items in psychological function, and 8 items in social function, with a total of 28 items. All 42 indexes are evaluated by a 5-point Likert scale. Positive items are scored in the order of 1 to 5, while negative items are reversely rated. The raw score (RS) is generated by the sum of the scores for each field. RS is transformed into Standard Score (SS) using the formula:  $SS = (RS - \text{Min}) \times 100 / R$ , so that scores in each dimension can be compared (MIN, R represents the minimum score, and the score range). The scores range from 0 to 100. A greater HRQoL is indicated by a higher score.

Also, a self-made general information questionnaire about the basic characteristics of patients (eg, age and nation) and socio-economic characteristics (eg, occupation and medical insurance) data, and clinical status (eg, clinical course and treatment) is used.

### Survey Methods

We invited the patients to finish the QLICD-CHD independently on the day of hospitalization and checked the questionnaires immediately to guarantee the integrality. Then, we compared the personal information on the scale with the medical record system to ensure it was correct and then input the data. Sixty-one biochemical indexes, such as serum calcium, total bilirubin, albumin, and so on, were collected from the hospital medical record information systems, including biochemical blood tests, liver function tests, routine urine tests, blood routine, and so on.

### Statistical Analysis

The data were statistically analyzed using SPSS software. First, the statistical description was used to analyse demographic elements. Second, univariate analysis of the relations between the QLICD-CHD (V2.0) domains and socio-demographic elements was tested by one-way analysis of variance (ANOVA), followed by a two-way comparison using the LSD-*t* test. *T*-test was carried out for dichotomous variables. The correlations between QLICD-CHD (V2.0) scores and clinical parameters were assessed by the Pearson correlation test. Finally, the initial screening results of the above two stages were taken as independent variables, and multiple-regression analysis (Stepwise selection) was carried out. Physical, psychological, and social functions, the specific module, and the total score of the scale were considered as dependent variables. The selection criterion (*p*-in) was 0.05, and the elimination criterion (*p*-out) was 0.10. Before multiple linear regressions, the categorical variables were

recoded. Marriage was quantified as married 1, single 2; the family economy was quantified as poor 1, moderate 2, good 3; the type was quantified as angina 1, myocardial infarction 2.

## Results

### Sample Characteristics

The demographic features of the selected patients are listed in Table 1. The age of patients ranged from 22 to 88. The average age was  $66.90 \pm 11.40$ . Most patients were from Han ethnic group. Most of them were men (62.4%) and married (84.7%), with moderate economic conditions (61.9%). Less than half (45.0%) have attended secondary school.

### HRQoL Scores of Patients with CHD

Table 2 shows the average scores of the patients' HRQoL using QLICD-CHD (V2.0). Social function (SOD) with  $73.67 \pm 15.57$  (95% CI 71.44–75.90) was the highest, followed by physical function (PHD) ( $63.84 \pm 16.23$ ) (95% CI 61.59–66.03) and psychological function (PSD) ( $63.07 \pm 17.22$ ) (95% CI 60.51–65.31); the figure was smallest in specific module (SPD) ( $57.63 \pm 14.73$ ) (95% CI 55.56–59.10), and the total score averaged  $63.44 \pm 12.27$  (95% CI 61.71–65.08).

**Table 1** Socio-Demographic Characteristics of the Sample (n=189)

Characteristics	N	%	Characteristics	N	%
Gender			Family economy		
Male	118	62.4	Poor	51	27.0
Female	71	37.6	Moderate	117	61.9
Nation			Good	21	11.1
Han	187	98.9	Medical insurance		
Others	2	1.1	Urban employee Medical format	146	77.2
Marriage			Cooperative medical care	32	16.9
Married	160	84.7	Self-paid	8	4.2
Single	29	15.3	Missing	3	1.7
Type			Treatment		
Angina	112	59.3	Thrombolytic therapy	158	83.6
Myocardial infarction	71	37.6	Interventional therapy	25	13.2
Occupation			Missing	6	3.2
Worker	35	18.5	Education		
Farmer	62	32.8	Primary school	65	34.4
Teacher	13	6.9	Junior high school	39	20.6
Cadre	43	22.8	Senior high School and above	85	45
Self-employed	10	5.3	Clinical course		
Others	26	13.8	Acute attacks	133	70.4
			Paracmasia	49	25.9

**Table 2** The Standardized Scores of Quality of Life in CHD Patients by QLICD-CHD (V2.0)

Domains	(Mean±SD)	Minimum	Maximum
Physical function (PHD)	$63.84 \pm 16.23$	11.11	100.00
Psychological function (PSD)	$63.07 \pm 17.22$	20.45	100.00
Social function(SOD)	$73.67 \pm 15.57$	21.88	100.00
Special module (SPD)	$57.63 \pm 14.73$	19.64	89.29
Total scale score (TOT)	$63.44 \pm 12.27$	29.17	95.24

## HRQoL Scores Comparisons by Univariate Analysis

The results of the comparative analysis of the different variables and dimensions are listed in Table 3. There were significant differences in PHD, SPD, and TOT among treatment groups and clinical types ( $P < 0.05$ ). Patients with

**Table 3** Univariate Analysis of Quality of Life in Patients with Coronary Artery Disease

	Variables	Worker & Farmer	Others		t	P
Occupation	Number	97	92			
	PHD	64.00±16.06	63.67±16.49		0.138	0.891
	PSD	63.33±16.19	62.79±18.32		0.213	0.832
	SOD	72.10±15.74	75.33±15.29		-1.433	0.154
	SPD	57.62±14.38	57.64±15.16		-0.012	0.990
	TOT	63.24±11.84	63.65±12.77		-0.232	0.817
Gender	Variables	Male	Female		t	P
	Number	118	71			
	PHD	62.97±16.94	65.29±14.97		-0.954	0.341
	PSD	63.62±16.23	62.16±18.55		0.561	0.576
	SOD	72.77±16.34	75.17±14.18		-1.026	0.306
	SPD	58.36±13.98	56.41±15.92		0.883	0.378
Marriage	Variables	Single	Married		t	P
	Number	29	160			
	PHD	63.12±17.18	63.97±16.10		-0.260	0.795
	PSD	67.31±17.96	62.30±17.02		1.448	0.149
	SOD	78.34±13.25	72.83±15.84		1.762	0.080
	SPD	58.12±15.19	57.54±14.69		0.845	0.845
Education	Variables	Primary school	High school	>High school	F	P
	Number	65	39	85		
	PHD	63.63±16.38	62.53±16.18	64.60±16.28	0.224	0.799
	PSD	59.40±15.87	67.13±17.29	64.01±17.81	2.733	0.068
	SOD	70.62±17.51	72.19±14.06	76.69±14.22 <sup>b</sup>	3.083	0.048
	SPD	56.45±13.92	57.28±14.37	58.69±15.56	0.438	0.646
Family economy	Variables	Poor	Moderate	Good	F	P
	Number	51	117	21		
	PHD	62.25±16.68	63.86±16.13	67.59±15.79	0.803	0.450
	PSD	56.41±14.16	64.82±17.57 <sup>b</sup>	69.48±17.91 <sup>b</sup>	6.190	0.002
	SOD	67.83±13.83	74.30±15.54 <sup>b</sup>	84.37±13.76 <sup>bc</sup>	9.415	<0.001
	SPD	54.65±14.18	58.92±15.30	57.65±12.11	1.501	0.226
Type	Variables	Angina	Myocardial infarction		t	P
	Number	112	71			
	PHD	66.66±15.01 <sup>a</sup>	59.15±17.26 <sup>a</sup>		3.111	0.002
	PSD	63.77±18.25	61.20±15.39		1.025	0.307
	SOD	73.32±16.01	73.98±15.42		-0.278	0.783
	SPD	59.51±14.60 <sup>a</sup>	54.67±4.73 <sup>a</sup>		2.177	0.031
Clinical course	Variables	Acute attacks	Paroxysmia		t	P
	Number	133	49			
	PHD	61.29±16.42 <sup>a</sup>	70.29±14.25 <sup>a</sup>		-3.390	0.001
	PSD	60.78±16.49 <sup>a</sup>	68.36±18.17 <sup>a</sup>		-2.677	0.008
	SOD	72.81±15.96	75.82±15.21		-1.144	0.254
	SPD	56.09±14.79	62.09±14.09		-2.459	0.015
TOT	61.62±11.98 <sup>a</sup>	68.11±12.17 <sup>a</sup>		-3.226	0.043	

(Continued)

**Table 3** (Continued).

	Variables	Worker & Farmer	Others		t	P
Treatment	Variables	Thrombolytic therapy	Interventional therapy		t	P
	Number	158	25			
	PHD	65.01±15.51 <sup>a</sup>	55.77±18.99 <sup>a</sup>		2.678	0.008
	PSD	63.55±17.37	57.90±15.54		1.529	0.128
	SOD	74.34±15.72	68.75±15.30		1.659	0.099
	SPD	58.90±14.72 <sup>a</sup>	49.64±12.88 <sup>a</sup>		2.969	0.003
	TOT	64.37±12.16 <sup>a</sup>	56.76±11.50 <sup>a</sup>		2.928	0.004

**Notes:** <sup>a</sup> $P < 0.05$ ; Multiple comparison by LSD-t test after ANOVA; <sup>b</sup> $P < 0.05$ , compared with the first level; <sup>c</sup> $P < 0.05$ , compared with the second level.

**Abbreviations:** PHD, Physical function; PSD, Psychological function; SOD, Social function; SPD, Special module; TOT, Total scale score.

interventional therapy and myocardial infarction had more severe signs and symptoms and worse cardiac function than those who have undergone thrombolytic therapy and angina pectoris. The SOD scores were inconsistent between education levels ( $P < 0.05$ ). Highly educated patients have a higher social function related to their mastery of health knowledge. The SOD, PSD, and TOT were statistically different between economic status ( $P < 0.05$ ) with better-off patients scoring higher in a two-way comparison, probably because high income and better economic conditions can guarantee lifelong treatment and improve patients' emotional states. The PHD, PSD, and TOT exhibited differences between groups of clinical course ( $P < 0.05$ ). Compared to the patients during paracmasia, the patients experiencing acute attacks report higher HRQoL scores. Other socio-demographic factors were not statistically different and did not affect the scores on the dimensions of HRQoL ( $P > 0.05$ ). In conclusion, patients with angina type, thrombolytic therapy, acute attacks, high education, and high income had a relatively better HRQoL.

## Simple Correlation Analysis

A simple correlation analysis was performed between clinical objective indicators and HRQoL scores (see Table 4). We found that there was a certain relationship between these 18 clinical indexes and HRQoL scores. Patients' scores in physical function rise ( $r = 0.146 - 0.334$ ,  $P < 0.05$ ) with the increase in the total protein, albumin, globular proteins, prealbumin, chloride, serum calcium, percentage of lymphocyte population, red blood cell count, haemoglobin, and hematocrit, while dropped ( $r = -0.223 - -0.184$ ,  $P < 0.05$ ) with the increase in alanine aminotransferase, aspartate transaminase, blood urea nitrogen, and

**Table 4** Simple Correlation Analysis Between Scores of Quality of Life and Clinical Indicators ( $r$ )

Clinical Indicators	Physical Function	Psychological Function	Social Function	Special Module	Total Scale Score
Total protein	0.300**	0.036	0.100	0.050	0.142
Albumin	0.334**	0.070	0.093	0.065	0.169*
Globular proteins	0.188*	0.004	0.113	-0.015	0.076
Alanine aminotransferase	-0.223**	-0.078	-0.034	-0.057	-0.123
Aspartate transaminase	-0.184*	-0.043	0.003	-0.043	-0.084
Total bilirubin	-0.035	0.093	-0.004	0.171*	0.091
Indirect bilirubin	0.023	0.102	0.010	0.193*	0.123
Prealbumin	0.231**	0.052	0.075	0.030	0.114
Blood urea nitrogen	-0.199**	-0.057	0.056	-0.028	-0.075
Serum creatinine	-0.217**	-0.105	-0.067	-0.034	-0.130
Chloride	0.182*	0.112	0.128	-0.030	0.112
Serum calcium	0.202**	0.010	0.094	0.124	0.133
Serum phosphorus	-0.052	-0.188*	-0.009	-0.134	-0.139
Percentage of lymphocyte population	0.146*	0.112	0.068	0.082	0.132
Red blood cell count	0.241**	0.081	0.030	0.015	0.112
Haemoglobin	0.200**	0.032	-0.047	0.085	0.092
Hematocrit	0.222**	0.038	-0.033	0.082	0.102
Platelet distribution width	-0.076	-0.087	-0.159*	0.083	-0.059

**Notes:** The  $r$  in the table represents the correlation coefficient. \* $P < 0.05$ . \*\* $P < 0.01$ .

serum creatinine. A significant negative relationship exists between serum phosphorus and psychological function ( $r=-0.188$ ,  $P<0.05$ ). Platelet distribution width was negatively associated with the social function ( $r=-0.159$ ,  $P<0.05$ ). Both higher total bilirubin and indirect bilirubin contributed to higher special module scores ( $r=0.171$ ,  $0.193$ ,  $P<0.05$ ). The total scores showed a statistically significant positive correlation with albumin ( $r=0.169$ ,  $P<0.05$ ).

### Multiple Linear Regression Analysis

We took the scores of the physiological function, psychological function, specific module, and the total scale as dependent variables, 23 indexes selected by univariate analysis and simple correlation analysis as independent variables, and used the multiple linear regression method to evaluate each index comprehensively. Classification factors were re-encoded before the multiple linear regression (see Table 5). Table 6 lists the outcomes of the multiple linear regression. The variables of the physical function included in the model were treatment ( $B=-9.031$ ,  $t=-2.784$ ,  $P=0.006$ ), albumin ( $B=1.000$ ,  $t=2.948$ ,  $P=0.004$ ), globular proteins ( $B=0.612$ ,  $t=2.088$ ,  $P=0.038$ ), chloride ( $B=1.320$ ,  $t=3.990$ ,  $P<0.001$ ), and red blood cell count ( $B=5.161$ ,  $t=2.506$ ,  $P=0.013$ ). The determination coefficient  $R^2$  was  $0.239$  ( $F=10.197$ ,  $P<0.001$ ); The psychological function included the following contents: family economy ( $B=7.487$ ,  $t=3.433$ ,  $P=0.001$ ), clinical course ( $B=6.411$ ,  $t=2.198$ ,  $P=0.029$ ), serum phosphorus ( $B=-16.458$ ,  $t=-2.614$ ,  $P=0.010$ ), and percentage of the lymphocyte

**Table 5** The Variable Assignment of Multiple Linear Regression

Variables	Description/Recoding	Variables	Description/Recoding
Type(X1)	Angina = 1, myocardial infarction= 2	Alanine aminotransferase(X13)	Measured value
Clinical course (X2)	Acute attacks= 1, paracmasia = 2	Aspartate transaminase(X14)	Measured value
Family economy(X3)	Poor = 1, moderate = 2, good = 3	Globular proteins(X15)	Measured value
Education(X4)	Primary school=1 Junior high school=2 Senior high school and above=3	Serum creatinine(X16)	Measured value
Treatment(X5)	Thrombolytic therapy=1 Interventional therapy =2	Serum calcium(X17)	Measured value
Total protein(X6)	Measured value	SERUM phosphorus (X18)	Measured value
Albumin(X7)	Measured value	Percentage of lymphocyte population(X19)	Measured value
Total bilirubin(X8)	Measured value	Red blood cell count(X20)	Measured value
Indirect bilirubin(X9)	Measured value	Haemoglobin(X21)	Measured value
Prealbumin(X10)	Measured value	Hematocrit(X22)	Measured value
Blood urea nitrogen (X11)	Measured value	Platelet distribution width(X23)	Measured value
Chloride(X12)	Measured value		

**Table 6** Factors Influencing Quality of Life Scores in CHD Screened by Multiple Linear Regression Analysis

Domains	Factors	B	Std. Error	Standardized B	t	P
PHD	Constants	-141.644	39.359		-3.599	<0.001
	Treatment	-9.031	3.243	-0.193	-2.784	0.006
	Albumin	1.000	0.339	0.231	2.948	0.004
	Globular proteins	0.612	0.293	0.155	2.088	0.038
	Chloride	1.320	0.331	0.282	3.990	<0.001
	Red blood cell count	5.161	2.059	0.190	2.506	0.013
PSD	Constants	57.151	9.218		6.200	<0.001
	Family economy	7.487	2.181	0.252	3.433	0.001
	Clinical course	6.411	2.917	0.160	2.198	0.029
	Serum phosphorus	-16.458	6.295	-0.190	-2.614	0.010
	Percentage of lymphocyte population	0.090	0.044	0.151	2.063	0.041

(Continued)

Table 6 (Continued).

Domains	Factors	B	Std. Error	Standardized B	t	P
SOD	Constants	4.869	34.642		0.141	0.888
	Family economy	7.391	1.946	0.275	3.798	<0.001
	Blood urea nitrogen	1.331	0.513	0.281	2.595	0.010
	Serum creatinine	-0.060	0.026	-0.247	-2.284	0.024
	Platelet distribution width	-0.929	0.406	-0.166	-2.288	0.023
SPD	Constants	13.770	25.576		0.538	0.591
	Treatment	-7.791	3.164	-0.184	-2.462	0.015
	Indirect bilirubin	0.414	0.205	0.152	2.019	0.045
	Serum calcium	23.017	10.436	0.172	2.205	0.029
TOT	Constant	-0.598	37.946		-1.574	0.117
	Family economy	5.209	1.546	0.245	3.369	0.001
	Treatment	-6.615	2.561	-0.186	-2.583	0.011
	Indirect bilirubin	0.378	0.168	0.165	2.253	0.026
	Albumin	0.548	0.239	0.166	2.292	0.023

Note: B: Regression coefficients.

Abbreviations: PHD, Physical function; PSD, Psychological function; SOD, Social function; SPD, Special module; TOT, Total scale score.

population ( $B=0.090$ ,  $t=2.063$ ,  $P=0.041$ ) ( $F=6.678$ ,  $R^2=0.141$ ,  $P<0.001$ ). The variables in the social function model were as follows: family economy ( $B=7.391$ ,  $t=3.798$ ,  $P<0.001$ ), blood urea nitrogen ( $B=1.331$ ,  $t=2.595$ ,  $P=0.010$ ), serum creatinine ( $B=-0.060$ ,  $t=-2.284$ ,  $P=0.024$ ), and platelet distribution width ( $B=-0.929$ ,  $t=-2.288$ ,  $P=0.023$ ) ( $F=6.163$ ,  $R^2=0.187$ ,  $P<0.001$ ). The variables included in the model of special modules were treatment ( $B=-7.791$ ,  $t=-2.462$ ,  $P=0.015$ ), indirect bilirubin ( $B=0.414$ ,  $t=2.019$ ,  $P=0.045$ ), and serum calcium ( $B=23.017$ ,  $t=2.205$ ,  $P=0.029$ ) ( $F=4.236$ ,  $R^2=0.116$ ,  $P=0.001$ ). The variables included in the total scale score model were family economy ( $B=5.209$ ,  $t=2.253$ ,  $P=0.001$ ), treatment ( $B=-6.615$ ,  $t=-2.583$ ,  $P=0.011$ ), indirect bilirubin ( $B=0.378$ ,  $t=2.292$ ,  $P=0.026$ ) and albumin ( $B=0.548$ ,  $t=2.292$ ,  $P=0.023$ ) ( $F=5.504$ ,  $R^2=0.170$ ,  $P<0.001$ ). Although  $R^2$  in these models were slightly low, these results suggest that dynamically monitoring clinical indicators such as albumin, globular proteins, chloride, and red blood cell count levels may provide more sensitive information for further observations of CHD patients' clinical states.

## Discussion

The World Health Organization reported that 7.4 million people died of CHD in 2015.<sup>27</sup> CHD is incurable and patients' HRQoL is lower than healthy people<sup>28</sup>, so it is necessary to target improving it, which is an important indicator to reflect patients' subjective well-being in the treatment progress.<sup>29</sup> Previous studies have illustrated some factors like occupation reported that compared with retired patients those who are employed shon and marriage may affect CHD patients' HRQoL, Dou (2022),<sup>21</sup> for example highele, rwer HRQoL. However, these studies have either not used disease-specific instruments or have not focused on clinical indicators. In this study, we optimised the scale QLICD-CHD (V2.0) whose general module can compare HRQoL for different chronic illnesses and the specific module reflects specific symptoms. Among all the scores of modules, SOD ranked the highest which was aligned with Tang's study.<sup>30</sup> Possibly because 84.7% of patients were married, they were greatly cared for in life and gained sufficient social support. PHD ranked second followed by PSD and SPD. Compared with hypertension patients measured by QLICD-HY,<sup>31</sup> CHD patients' PSD averaged lower possibly because of the weak heart's inability to provide adequate blood to the brain, which leads to neurological symptoms and mental illnesses.<sup>32</sup> So CHD patients suffer from emotional disturbance even depression with a higher likelihood.<sup>33,34</sup> The specific module scored the lowest. Probably because patients have characteristic symptoms including shortness of breath and chest discomfort, and they are always worried about chest pain attacks leading to increased insecurity and stress. Unfortunately, chronic stress raises the risk of CHD, which also weakens psychological function.<sup>35</sup>



Results from the multiple linear regression analysis further confirmed that among the socio-demographic factors family economy correlated significantly with scores in PSD and SOD, which was in line with Zhang's research.<sup>36</sup> Patients with higher economic status tend to have better HRQoL because they are more accessible to emotional and material support from the surrounding environment, which can release physical stress and benefit their health physically and mentally.<sup>37</sup> Social support exerted a promoting effect on HRQoL in patients with coronary heart disease,<sup>38</sup> but those who stayed on breadline received a low level of social support.<sup>39</sup>

In terms of clinical indicators, chlorine is one of the vital influencers of PHD. Chlorine is the most prevalent anion in the extracellular fluid.<sup>40</sup> It has various vital physiological functions, such as acid-base homeostasis, regulation of glomerular filtration rate, gastrointestinal function, and so on.<sup>41</sup> Meanwhile, low chlorine level gives rise to hypochloremia, which can cause nausea and vomiting. These affect patients' appetite and sleep, thus affecting the PHD score. Therefore, changes in chlorine should also be monitored throughout therapeutic therapy.

The percentage of the lymphocyte population was one of the vital influencers in PSD. A study suggested that when coronary artery lesions patients' lymphocyte counts are lower, their immunity reduces, and they are susceptible to viral or bacterial infections.<sup>42,43</sup> So patients subjectively consider that the symptoms are aggravated and feel anxiety.

Also, current study discovered that CHD patients with higher albumin levels achieve higher scores in TOT, which is consistent with previous studies.<sup>44,45</sup> Albumin has been proven to be a nutritional marker,<sup>46</sup> and good nutrition provides a fundamental building block for the prevention and treatment of CHD.<sup>47</sup> However, low albumin will lead to hypoalbuminemia, which may be a risk factor accelerating CHD<sup>48</sup> so albumin affects patients' life quality scores.

These findings extend those of Fu's (2022)<sup>24</sup> and Erdem (2016),<sup>25</sup> confirming more biomarkers related to HRQoL. Our results provide compelling evidence for the associations between objective clinical indicators and CHD patients' subjective well-being. Measurements of blood routine, blood biochemistry, urine routine, and blood gas analysis are economical and easy to reach. As treatment progresses, doctors can closely monitor objective clinical indicators such as chloride and albumin discovered in this study and adjust treatment strategies.

We admit that this paper has some limitations. First, it should, however, be noted that in a cross-sectional method, it is difficult to prove that one variable causes another. To corroborate the causal correlations suggested by the findings, longitudinal or interventional studies would be required. Second, because the participants were selected in the same hospital, the results might not apply to all patients and more hospitals in China should be implemented in the future study. Third, only 61 clinical objective indicators were included in this study and the coefficient of determination  $R^2$  for each model was not high enough, suggesting that our selection of clinical indicators for measurement has certain limitations, so more clinical variables should be taken into account. Despite these inadequacies, this study addresses the gap that the impact of clinical indicators on HRQoL received little attention in research before and finds that clinical data such as albumin, globular proteins, and chloride are independent factors of HRQoL. They can be detected by a routine blood examination, which is inexpensive and easy. This paper explores new ideas for the improvement of HRQoL that consider clinical indicators, but the specific impact mechanism still needs to be further studied.

## Conclusion

We used the disease-specific scale QLICD-CHD (V2.0) to evaluate patients' HRQoL and utilized multiple linear regression analysis to finally confirm effective elements. From the results obtained, we conclude that demographic data like the family economy and clinical indicators such as chloride and percentage of lymphocyte population are significant factors in HRQoL for CHD patients. Clinicians can enhance their understanding of patients' mental and physical states by closely monitoring related biomarkers. Clinicians can enhance their understanding of patients' mental and physical states by closely monitoring related biomarkers.

## Abbreviations

QLICD-CHD, Chronic Diseases-Coronary heart disease (V2.0); CHD, coronary heart disease; HRQoL, health-related quality of life; SOD, Social function; PHD, physical function; PSD, psychological function; SPD, specific module; TOT, Total scale score; EQ-5D-5L, European Quality of Life Five Dimension Five level scale; SF-36, 36-Item Short-Form Health Survey questionnaire; SAQ, Seattle Angina Questionnaire; KCCQ, Kansas City Cardiomyopathy Questionnaire.

## Ethics Approval and Consent to Participate

The institutional review board of the affiliated hospital of Guangdong Medical University agreed with the study protocol and informed consent form (PJ2012052, YJYS2019010). All methods were carried out in accordance with relevant guidelines and regulations. All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

## Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising, or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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## Disclosure

The authors report no conflicts of interest in this work.

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