BMC Gastroenterology

RESEARCH Open Access

The relationship between resilience, financial toxicity, and quality of life in patients with primary liver cancer: a cross-sectional study

Zhilin Mao[1], Huili Qian[2*], Rui Liu[3] and Ran Huo[1]

Abstract

Background Psychological stress and financial hardship are long-standing issues for patients with primary liver cancer. Financial toxicity levels are closely related to quality of life, and resilience is a key psychosocial resource for maintaining quality of life.

Objective The purpose of this study was to explore the relationship between resilience, financial toxicity, and quality of life.

Methods This cross-sectional study included 268 patients with primary liver cancer between July and December 2023. CD-RISC, COST-PROM, and QOL-LC were used to identify patients' resilience, financial toxicity, and quality of life. Univariate and multivariate analyses examined factors associated with quality of life, and Pearson's correlation analysis was used to analyze the relationship between the three scales. Subsequently, mediation analysis was used to analyze the effects of resilience on financial toxicity and quality of life.

Results The patients' average QOL-LC score was 125.41. Univariate analysis revealed that residence, monthly disposable household income, metastasis, China liver cancer staging (CNLC), and number of hospitalizations in the last year were statistically significant factors associated with quality of life. Higher resilience and lower financial toxicity (indicated by a higher COST-PROM score) were both moderately positively correlated with quality of life. Mediation analysis indicated that resilience partially mediated the relationship between financial toxicity and quality of life (mediation effect = 31.2%).

Conclusions The resilience exhibited by patients with primary liver cancer may help mitigate the impact of economic pressures on quality of life. Given its cross-sectional design, further validation of this causal pathway will undoubtedly constitute an important avenue for future research.

Keywords Primary liver cancer, Resilience, Financial toxicity, Quality of life, Intermediary analysis

*Correspondence:
Huili Qian
qianhuili0412@163.com
[1]International Medical Center, The University of Hong Kong-Shenzhen Hospital, Shenzhen, Guangdong 518053, China
[2]Department of Nursing, Shengzhou People's Hospital, Shengzhou, Zhejiang 312400, China
[3]School of Nursing, Guangxi University of Chinese Medicine, Nanning, Guangxi 530200, China

© The Author(s) 2025. **Open Access** This article is licensed under a Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License, which permits any non-commercial use, sharing, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if you modified the licensed material. You do not have permission under this licence to share adapted material derived from this article or parts of it. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit http://creativecommons.org/licenses/by-nc-nd/4.0/.

Introduction

Liver cancer is one of the most common cancers and ranked third among global cancer-related causes of death in 2022 [1]. Research projects a 53.8% increase in incidence over the next two decades [2]. The incidence of liver cancer varies by geographic location. In 2020, sub-Saharan Africa recorded an estimated 38,600 new liver cancer cases [3]. And in 2021, the incidence rate of HBV-related hepatocellular carcinoma (HCC) in Cambodia was 306 (95% UI: 148–607) [4]. Notably, developing countries in Asia accounted for 72.5% of globally reported liver cancer cases in 2020 [5]. Among these, China, as a high-risk region for chronic HBV infection and aflatoxin exposure [1], has the highest incidence rate [6], with a liver cancer mortality rate of 2.37% [7], posing a serious threat to public health.

HCC accounts for 75–85% of primary liver cancer cases [8], and it is the predominant form of liver cancer in China (93%) [7]. In China, routine liver cancer screening methods (abdominal ultrasound and alpha-fetoprotein) have low coverage rates, meaning most patients diagnosed with liver cancer are already at an advanced stage [7]. Furthermore, the disease necessitates prolonged and repeated hospital admissions, making the high cost of medical treatment an unavoidable issue. Multiple datasets indicate the substantial economic burden of HCC. For instance, in the United States, total financial liabilities within one year of HCC diagnosis can reach up to US$6,293 [9]. In Japan, expenses for HCC patients undergoing surgical resection alone amounted to approximately $5,555 [10]. In China, hospitalization costs for liver cancer reached 20.29 billion yuan in 2017 [11], with an average total expenditure per patient of 53,220 yuan (91.3% attributable to medical costs) [12]. This underscores the substantial burden of diagnosis and treatment for liver cancer.

The concept of financial toxicity was first proposed by Zafar et al. [13] in 2013, describing the direct or indirect economic pressures and burdens on individuals and families resulting from cancer diagnosis and treatment. It views both objective financial burdens and subjective financial distress as integral components of financial impact. Current research has found that financial toxicity in gynecological cancer patients is closely associated with role functioning, emotional functioning, and social functioning [14]. Additionally, studies in Turkey [15, 16] have shown that as the level of financial toxicity increases, psychological distress increases, treatment adherence decreases, and quality of life declines. Meanwhile, Murphy et al. [17] conducted a follow-up study of 500 cancer patients and found that 88% of cancer patients experienced financial toxicity within one year of diagnosis. Patients with financial toxicity had significantly increased risks of depression and post-traumatic stress disorder, as well as poorer quality of life. This indicates that financial stress has become an important factor exacerbating patients' psychological burdens and life pressures and reducing their overall quality of life [18–22].

The American Psychological Association defines resilience as an individual's capacity to adapt when confronted with tragedy, trauma, adversity, hardship, and sustained major life stressors [23]. Within cancer research, resilience is regarded as both a relatively stable psychological trait and a dynamic adaptive process, aiding cancer patients in maintaining or restoring psychosocial functioning across various stages [24]. As treatment cycles progress, psychological resources in liver cancer patients become progressively depleted. Resilience, as a protective factor for mental health, may mitigate the adverse effects of stressful events on the emotional and cognitive functioning of liver cancer patients [25]. Moreover, resilience is closely associated with positive psychological resources such as hope, post-traumatic growth, and social support strategies [26, 27]. Concurrently, a cross-sectional study on gynecological cancers [28] revealed a positive correlation between resilience and quality of life, with the strongest indirect effect being the cultivation of calmness and a sense of meaning. Fortunately, Zhang et al. [29] explored quality of life among permanent stoma patients using a hospital-home holistic care model based on 'timely intervention.' The resilience of intervention groups at 3 and 6 months post-discharge significantly exceeded that of the control group. This suggests that appropriate nursing interventions may enhance resilience and sustain quality of life for liver cancer patients.

Quality of life denotes an individual's lived experience of their life's goals, expectations, standards, and matters of concern within diverse cultural contexts and value systems [30]. Presently, both clinical practice and research focus intently on the quality of life of cancer patients [31]. Among liver cancer patients, the disease's characteristics, treatment outcomes, and associated costs impose a heavy disease burden and financial strain, severely compromising their psychological well-being and overall quality of life. Resilience, as a critical psychosocial resource, has been demonstrated to be a protective factor promoting positive adaptation and maintaining good quality of life in cancer patients [22, 25, 27, 32–34]. However, financial toxicity is widely recognized as a key risk factor significantly diminishing quality of life [14–17, 35, 36]. Its mechanism of action extends beyond material deprivation stemming from economic hardship, generating multidimensional distress through psychological strain and reduced treatment adherence [15, 21, 37]. Given its prevalence among liver cancer patients, heightened attention to their quality of life is imperative.

At present, no studies have examined the mediating role of resilience between financial toxicity and quality

of life among Chinese liver cancer patients. This research therefore investigates the relationships among resilience, financial toxicity, and quality of life, alongside resilience's mediating function between these two variables. The aim is to provide theoretical foundations for targeted psychological interventions for liver cancer patients. Kumpfer's [38] psychological resilience framework posits that when external stress disrupts an individual's equilibrium, it triggers dynamic interactions between psychological resilience traits and the environment. This process reshapes internal resilience factors, ultimately leading to resilient, adaptive, or maladaptive reconfiguration outcomes. According to this theory, financial toxicity—as a significant stressor—may deplete patients' psychological resilience resources, potentially affecting their quality of life. Consequently, this study proposes the following hypotheses:

Hypothesis 1: High financial toxicity will correlate with low resilience;

Hypothesis 2: High financial toxicity will correlate with low quality of life;

Hypothesis 3: High resilience will correlate with high quality of life;

Hypothesis 4: Resilience will mediate the relationship between financial toxicity and quality of life.

Materials and methods

Study population

This cross-sectional study was conducted at the University of Hong Kong–Shenzhen Hospital in Shenzhen, Guangdong Province, China. Using convenience sampling, patients with primary liver cancer who were hospitalized in the Hepatobiliary Surgery Department, Oncology Department, and International Medical Center from July to December 2023 were selected. Inclusion criteria: ① Meets the diagnostic criteria outlined in the *Standard for Diagnosis and Treatment of Primary Liver Cancer (2022 Edition)* [39]; ② Age ≥ 18 years; ③ Disease duration > 1 month; ④ Informed consent and ability to complete the questionnaire assessment. Exclusion criteria: ① Patients with severe impairment of other vital organ functions and critical condition; ② Patients with a history of mental illness or cognitive impairment.

According to Kendall's sample estimation method, the sample size was taken as 5 to 10 times the number of variables analyzed in the study. A total of 27 predictor variables were considered in this study, including 17 variables of basic characteristics, resilience (3 dimensions), financial toxicity (3 dimensions), and quality of life (4 dimensions). The calculated sample size range is 135 to 270 cases. Considering a 20% non-response rate, the inclusion range is 152 to 324 cases. Ultimately, the sample size for this study was set at the average value of 238 cases.

Data collection

This study employed a combination of online (SoJump, https://www.wjx.cn/) and offline questionnaires (Supplementary Material S1) to collect data. To ensure data impartiality, medical staff underwent standardized neutral questioning training prior to data collection and were strictly required to safeguard patient privacy. First, we communicated with the patients' attending physicians to determine whether the patients met the inclusion and exclusion criteria for this study. Second, we spoke with the patients during their free time, explaining the purpose and significance of this study and the time required to complete the questionnaire (approximately 20 min). After obtaining informed consent from the patient, we asked them to complete the questionnaire either online or offline. Additionally, we clarified that the questionnaire should be completed by the patient themselves or by medical staff (with the patient dictating the responses and the medical staff filling in the form). To ensure the quality of the questionnaire, after medical staff completed the paper questionnaire, medical staff reviewed the questionnaire items and contents with the patient. Subsequently, the paper questionnaire was entered into SoJump (for convenient data organization and analysis). Finally, to ensure data accuracy, the four items of extra-hepatic metastasis, hepatitis, China liver cancer staging (CNLC), and treatment in the exported data were verified against the hospital medical record system, with the hospital medical record system serving as the standard. A total of 274 questionnaires were collected in this study (more than 70% were filled out by medical staff), and six invalid questionnaires were directly excluded using listwise deletion (three errors in demographic characteristics, two errors in the financial toxicity scale, and one error in the quality of life scale), resulting in a total of 268 valid questionnaires. Among the 268 questionnaires, the liver cancer classifications were as follows: 182 cases of HCC, 64 cases of intrahepatic cholangiocarcinoma (ICC), and 20 cases of combined hepatocellular-cholangiocarcinoma (cHCC-CCA).

Measurements

Descriptive information form

This section includes 2 aspects of information and 17 variables. ①Demographic characteristics: gender, age (years), marital status, number of children, residence, educational background, working state, monthly disposable household income (yuan), medical payment methods, transportation time to the hospital (h), chronic disease (hypertension, diabetes, coronary heart disease); ②Disease characteristics: extra-hepatic metastasis, hepatitis, CNLC [39] (Ⅰa/Ⅰb, Ⅱa/Ⅱb, Ⅲa/Ⅲb, Ⅳ), disease duration (months), number of hospitalizations in the last year, and treatment.

Connor-Davidson resilience scale (CD-RISC)

CD-RISC was a validated Chinese version of the Resilience Scale [40], with a Cronbach's α value of 0.95 in this study. The scale comprises three dimensions (optimism, strength, and tenacity) and a total of 25 items. A 5-point Likert scale was used, with "never" scored as 0 points, "rarely" as 1 point, "sometimes" as 2 points, "often" as 3 points, and "always" as 4 points. The score range is 0–100 points, with a total score of 0–35 points indicating a low level, 36–64 points indicating a moderate level, and 65–100 points indicating a high level. A higher total score indicates better resilience.

Comprehensive scores for financial toxicity based on the patient-reported outcome measures (COST-PROM)

The Chinese version of COST-PORM was used to assess the level of financial toxicity in liver cancer patients, and this tool has been validated [41]. The reliability of this scale was reverified, and Cronbach's α value was 0.85. The scale consists of three dimensions: economic expenditure, economic resources, and psychosocial responses. It uses a 5-point Likert scale, with 4 items (1, 6, 7, and 11) scored positively and the remaining 7 items scored negatively. The score ranges from 0 to 44 points, with a higher total score indicating lower financial toxicity. The severity of financial toxicity is divided into four levels: ≥26 is no financial toxicity, 14–25 is mild financial toxicity, 1–13 is moderate financial toxicity, and a total score of 0 is severe financial toxicity.

Quality of life scale for patients of liver cancer (QOL-LC)

Quality of life in liver cancer patients was assessed using the validated Chinese version of the QOL-LC scale [42], and the Cronbach's α value was 0.91. The scale contains 23 items and 4 domains (physical function, psychological function, social function, and symptom/side effects). The last item is not included in the total score; the score ranges from 0 to 220 points, and the higher the score, the better the quality of life.

Ethics statement

The study has received approval from the Ethics Committee of the University of Hong Kong–Shenzhen Hospital (Date: June 16, 2023; Reference Number: HKUSZH2023087). All participants provided informed consent and voluntarily completed the questionnaire. The data collected will be used solely for the purposes of this research, ensuring the protection of patients' personal privacy. This study was executed according to the code of ethics of the World Medical Association (Declaration of Helsinki) for studies on humans.

Data analysis

This study utilized IBM SPSS 26.0 and R 4.2.3 for data statistics and analysis. First, Cronbach's α value was used to assess the reliability of the three scales and their subscales ($\alpha \geq 0.70$ is acceptable; see Supplementary Material S2 for details). Secondly, in descriptive analyses, continuous variables were presented as mean ± standard deviation, while categorical variables were expressed as absolute and relative frequencies. For univariate analyses, Shapiro-Wilk normality tests were conducted; continuous variables meeting normality assumptions underwent t/F tests. Subsequently, we described the distribution of scale scores across different categories and plotted the characteristics of the three scales and their respective dimensions using the R packages ggplot2 (version 3.4.4) and ggbeeswarm (version 0.7.2). Scales passing normality tests underwent Pearson correlation analysis, with correlation heatmaps generated using the R package corrplot (version 0.92). Then, variables showing statistical significance in univariate analysis were then incorporated into a multiple linear regression model to validate factors influencing quality of life in liver cancer patients (considering the correlation between monthly disposable household income and the financial toxicity composite score scale, we did not include monthly disposable household income in the regression analysis). Prior to model construction, assumptions were validated: residual independence was assessed via the Durbin-Watson test; homogeneity of variance was confirmed using residual scatter plots; multicollinearity was ruled out with $VIF < 10$; and residual normality was verified through visual inspection of prediction probability plots. Finally, we employed the R package mediation (4.5.0) to test and calculate the mediating effect of resilience between financial toxicity and quality of life. This analysis utilized bootstrap resampling with 5000 iterations and estimated percentile confidence intervals. Mediating effect diagrams were generated using Microsoft Visio Professional 2021. Statistical significance was set at $P < 0.05$.

Results

Univariate analysis of sample characteristics and quality of life

This study retrieved a total of 274 questionnaires, with 268 valid responses (response rate: 97.8%). The mean QOL-LC score was 125.41 ± 36.25 points. Table 1 presents the patients' basic demographic characteristics and statistically significant variables (full details are provided in Supplementary Material S3). Additionally, the results showed that there were statistically significant differences in quality of life based on residence, monthly disposable household income, extrahepatic metastasis, CNLC, and number of hospitalizations in the past year.

Table 1 Sample characteristics

Variable	Item	N (%)	Mean ± SD	t/F	P
Gender				−1.508	0.133
	Male	173(64.55)	122.94 ± 38.03		
	Female	95(35.45)	129.91 ± 32.48		
Age (years)				1.925	0.148
	18–44	28(10.45)	129.04 ± 25.96		
	45–59	126(47.01)	129.16 ± 36.43		
	≥ 60	114(42.54)	120.38 ± 37.84		
Marital status				2.263	0.082
	Married	226(84.33)	126.23 ± 35.83		
	Unmarried	22(8.21)	109.68 ± 41.31		
	Divorced	4(1.49)	153.00 ± 27.48		
	Widowed	16(5.97)	128.56 ± 31.87		
Number of children				1.465	0.225
	0	18(6.72)	114.56 ± 40.10		
	1	117(43.66)	127.72 ± 34.54		
	2	90(33.58)	121.59 ± 38.44		
	≥ 3	43(16.04)	131.67 ± 33.79		
Residence				2.118	0.035
	city	208(77.61)	127.91 ± 35.94		
	countryside	60(22.39)	116.73 ± 36.29		
Monthly disposable household income (yuan)				9.017	< 0.001
	< 5000	122(45.52)	113.97 ± 37.68		
	5000–10,000	70(26.12)	138.49 ± 36.06		
	10,001–15,000	42(15.67)	135.90 ± 26.73		
	> 15,000	34(12.69)	126.59 ± 28.88		
Extrahepatic metastasis				3.659	<0.001
	No	159(59.33)	131.97 ± 35.91		
	Yes	109(40.67)	115.84 ± 34.74		
CNLC				8.297	<0.001
	Ⅰa/Ⅰb	55(20.52)	140.16 ± 34.24		
	Ⅱa/Ⅱb	77(28.73)	132.3 ± 28.14		
	Ⅲa/Ⅲb	80(29.85)	118.2 ± 39.56		
	Ⅳ	56(20.90)	111.75 ± 36.57		
Number of hospitalizations in the last year				6.436	0.002
	< 5	160(59.70)	131.26 ± 34.81		
	5–9	59(22.01)	112.22 ± 39.02		
	≥ 10	49(18.28)	122.18 ± 33.45		

CNLC China liver cancer staging

Scale characteristics and correlations

Table 2 describes the characteristics of different resilience levels across the CD-RISC and COST-PROM scales (QOL-LC reports only total scores). Results indicate that 50% of patients exhibited moderate resilience, 41.42% experienced no financial toxicity, and 44.78% experienced mild financial toxicity. Furthermore, Fig. 1 illustrates the scores and distribution patterns across the three scales and their respective dimensions (detailed scores are provided in Supplementary Material S2).

Table 2 Scale characteristics

Scale	Degree	Score range	N(%)	Mean ± SD
CD-RISC		0–100	268(100)	46.79 ± 19.29
	Low	0–35	79(29.48)	24.96 ± 0.76
	Middle	36–64	134(50.00)	47.90 ± 0.71
	High	64–100	55(20.52)	75.44 ± 1.14
COST-PROM		0–44	268(100)	23.93 ± 8.38
	None	≥ 26	111(41.42)	31.92 ± 0.42
	Low	14–25	120(44.78)	20.65 ± 0.32
	Middle	1–13	37(13.81)	10.57 ± 0.38
	High	0	0(0.00)	/
QOL-LC		0–220	268(100)	125 ± 36.25

CD-RISC Connor-Davidson Resilience Scale, *COST-PROM* Comprehensive scores for financial toxicity based on the patient-reported outcome measures, *QOL-LC* Quality of life scale for patients of liver cancer

The correlation heatmap (Fig. 2) indicates that financial toxicity (higher total scores indicate lower financial toxicity) positively correlates with the resilience total score and its three subscales (optimism, strength, and tenacity) ($r = 0.45$, 0.41, 0.48, 0.40), while the quality of life total score and its four subscales (physical function, psychological function, social function, and symptom/side effects) ($r = 0.55$, 0.32, 0.40, 0.67, 0.42), respectively, validate Hypothesis 1 and Hypothesis 2. Resilience was positively correlated with quality of life ($r = 0.57$), confirming Hypothesis 3.

Regression analysis of quality of life

The independent variables were residence, extrahepatic metastasis, CNLC, number of hospitalizations in the past year, resilience, and financial toxicity, and the dependent variable was quality of life. There is no issue of multicollinearity between variables (VIF: 1.050–2.114). The results showed that CNLC, resilience, and financial toxicity were statistically significant, as shown in Table 3. Furthermore, $R^2 = 0.475$ (adjusted $R^2 = 0.462$), explaining 47.5% of the total variance in quality of life, $F = 39.286$, $P < 0.001$.

Mediation analysis

This section employs financial toxicity as the independent variable, resilience as the mediator variable, CNCL as the covariate, and quality of life as the dependent variable to conduct mediation analysis using the mediation package. When performing mediation analysis with the mediation package, both the mediator model and the outcome model must be constructed. Model.m represents the mediator fit model, while Model.y denotes the outcome fit model. Table 4 presents the fitting indices for both models. Figure 3 illustrates the mediating effect path and results.

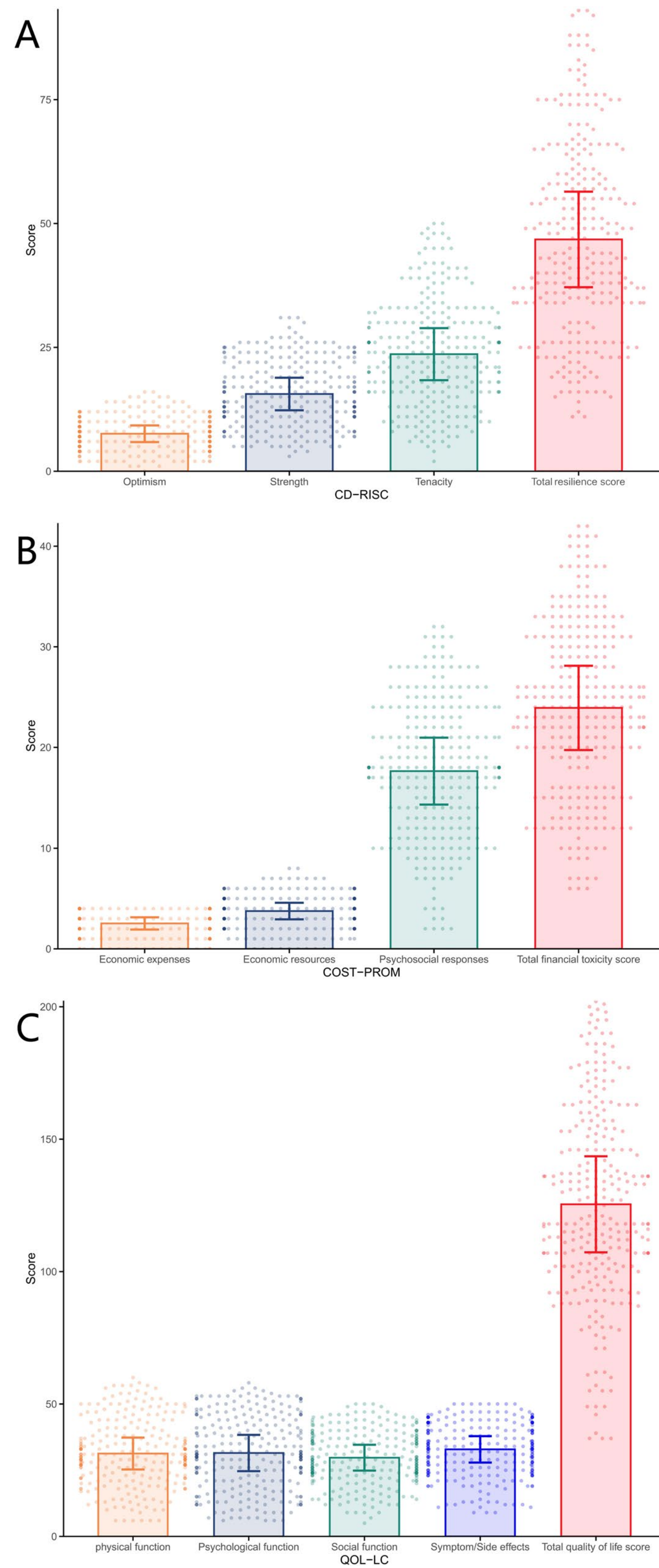

Fig. 1 Distribution of scale dimensions. CD-RISC, Connor-Davidson Resilience Scale; COST-PROM, Comprehensive scores for financial toxicity based on the patient-reported outcome measures; QOL-LC, Quality of life scale for patients of liver cancer. Furthermore, parts A, B, and C are the CD-RISC, COST-PROM, and QOL-LC scales, respectively, along with the scores and distribution of each dimension. In addition, each scatter point represents the corresponding score, showing the distribution of the scale dimension and total score

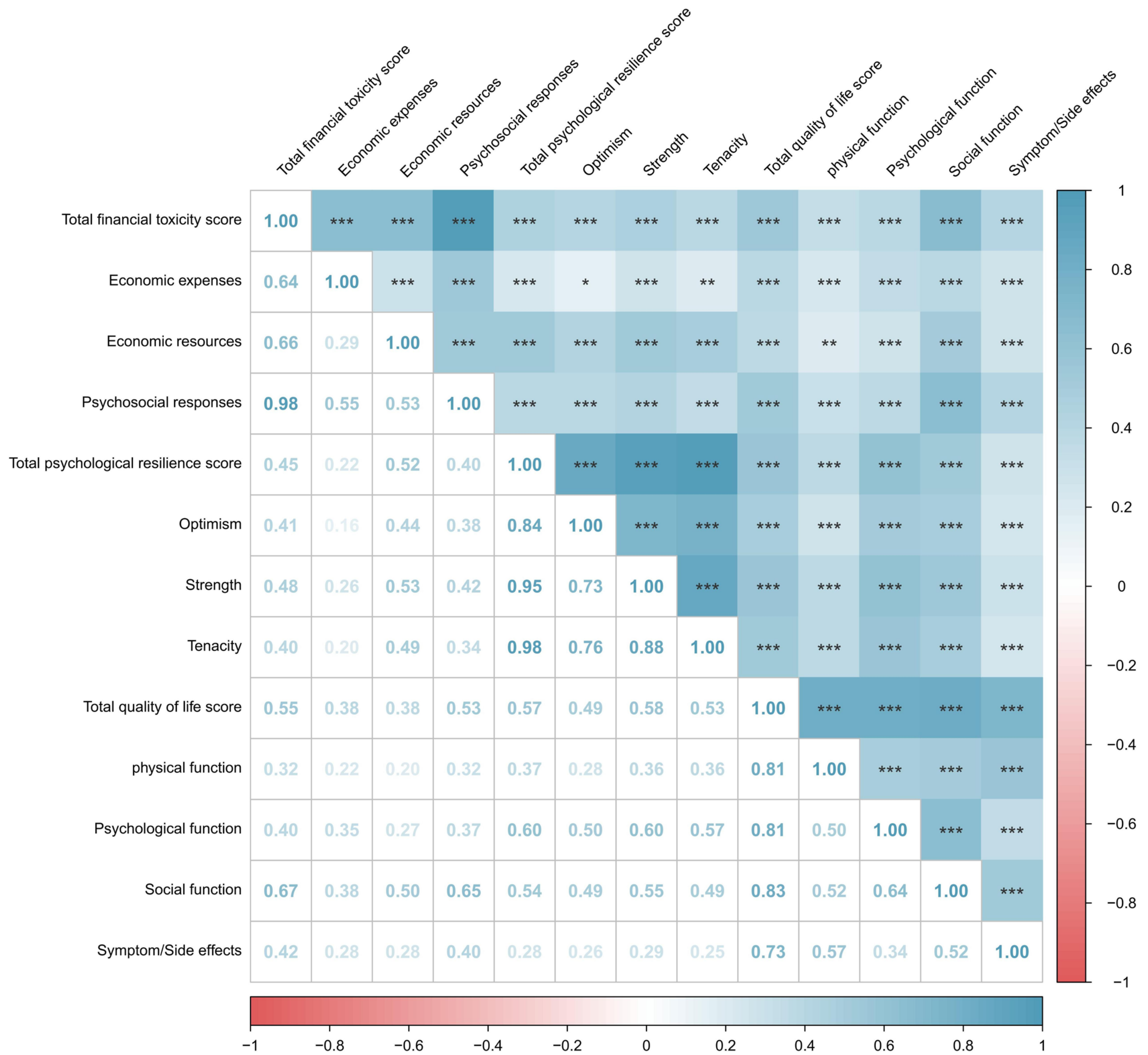

Fig. 2 The correlation heat map. Note: * P < 0.05; ** P < 0.01; *** P < 0.001

Table 3 Regression analysis of quality of life

Variable	B	SE	β	t	*P*	95% CI	
						Lower	Upper
(Constant)	75.812	10.375		7.307	< 0.001	55.383	96.24
Residence	−0.594	3.991	−0.007	−0.149	0.882	−8.452	7.264
Extrahepatic metastasis	1.245	4.806	0.017	0.259	0.796	−8.218	10.709
CNLC	−7.023	2.258	−0.202	−3.111	0.002	−11.469	−2.578
Number of hospitalizations in the last year	−2.374	2.142	−0.051	−1.108	0.269	−6.591	1.844
Resilience (CD-RISC)	0.712	0.096	0.379	7.417	< 0.001	0.523	0.901
Financial toxicity (COST-PROM)	1.533	0.222	0.354	6.904	< 0.001	1.096	1.970

CNLC China liver cancer staging, *CD-RISC* Connor-Davidson Resilience Scale, *COST-PROM* Comprehensive scores for financial toxicity based on the patient-reported outcome measures

Table 4 Model fit indices

Model	R^2	Adjusted R^2	F	*P*	AIC	BIC	RMSE
Model.m	0.229	0.218	19.56	<0.001	2288.15	2309.69	17.065
Model.y	0.473	0.463	46.96	<0.001	2526.60	2551.74	26.578

In Model.m, the mediator variable is resilience, the independent variable is financial toxicity, and the covariate is CNLC. In Model.y, the dependent variable is quality of life, the independent variable is financial toxicity, the mediator variable is resilience, and the covariate is CNLC

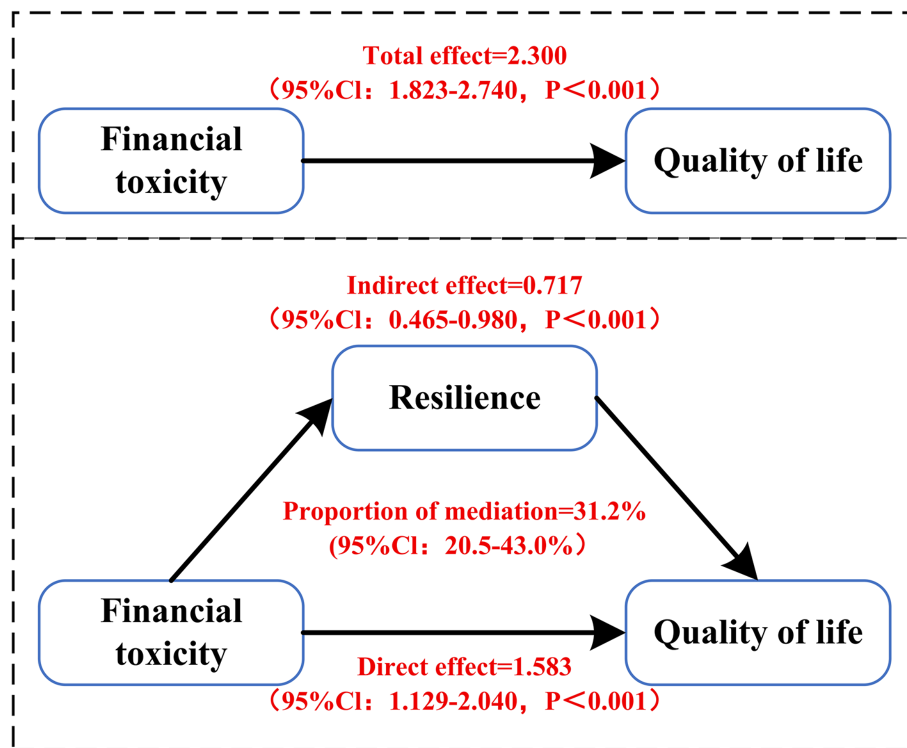

Fig. 3 Results of the intermediary model

This analysis revealed a statistically significant association between financial toxicity and quality of life: total effect = 2.300 (standardized total effect = 0.532), direct effect = 1.583 (standardized direct effect = 0.366), and indirect effect = 0.717 (standardized indirect effect = 0.166). Furthermore, the findings supported Hypothesis 4: Resilience partially mediated the relationship between financial toxicity and quality of life (mediation effect size: 31.2%, 95% confidence interval: 20.5–43.0%).

Discussion

Our study employed the QOL-LC scale, yielding a quality of life score of 125.41 ± 36.25 for patients with primary liver cancer, consistent with findings reported by Zhang et al. [43]. Studies conducted within distinct sociocultural contexts, such as those by American and Japanese researchers [44, 45] utilizing the FACT-Hep, the European Organization for Research and Treatment of Cancer (EORTC) QLQ-C30, and EORTC QLQ-HCC18 scales, respectively. Although their scores cannot be directly compared with our findings, these studies indicate that psychosocial factors influence the quality of life of primary liver cancer patients—the Japanese study [45] explicitly demonstrated that depressive symptoms are closely associated with poorer quality of life in liver cancer patients. Based on this, and considering the cultural context of this study, we propose that beyond disease characteristics and economic burdens, China's unique Confucianism and collectivism may also exert an influence on patients' quality of life. Confucianism emphasizes family cohesion and relationship maintenance, manifesting in patient care through family members (either rotating or designated individuals) bearing primary caregiving responsibilities. While this model demonstrates the mutual aid advantages of collectivism, it also imposes psychological and nursing burdens on caregivers, disrupts normal life rhythms, and implicitly shifts a greater share of social caregiving responsibilities within the family [46]. This provides a crucial cultural perspective for understanding the unique mechanisms underlying the quality of life of primary liver cancer patients.

The relationship between demographic characteristics, disease characteristics, and quality of life

Research indicates statistically significant disparities in quality of life between city and countryside areas. These differences are primarily evident in transportation, medical facilities and equipment, and recreational infrastructure [47]. This may contribute to lower disease detection rates among rural residents (22.39% of patients in this study were from rural areas) [48, 49]. However, Rivera et al. [50] observed no difference in social functioning between rural and non-rural cancer survivors, potentially linked to their return to familiar social networks after completing treatment phases [51]. Secondly, monthly disposable household income correlates closely with quality of life, possibly due to treatment non-adherence arising from financial burdens [15]. Furthermore, a Saudi Arabian study demonstrated a moderate negative correlation between financial instability and quality of life [18]. Moreover, extrahepatic metastasis correlates with quality of life. This is because extrahepatic metastasis not only signifies a poorer prognosis and significantly impaired liver function [52], but may also induce depressive symptoms that adversely affect quality of life [45, 53]. Systemic treatment modalities also exert negative impacts on patients' quality of life [52, 54]. Subsequently, CNLC correlates with quality of life. A Spanish cross-sectional study [55] observed a gradient decline in quality of life with increasing tumor stage, though this research was limited by not restricting cancer types and including 77.7% of patients with advanced disease. Our study, however, included a more balanced distribution of CNLC stages. Compared to studies employing the Barcelona Clinic Liver Cancer (BCLC) staging system [44] (where advanced stages correlate with emotional well-being), findings from localized CNLC [39] are more compelling. Finally, the number of hospitalizations in the last year correlates with quality of life, reflecting the linear decline in quality of life observed in cancer patients from pre-treatment through treatment [56]. Research indicates that longer hospital stays or increased prior treatment episodes correlate with lower levels of hope and quality of life [57, 58]. A possible explanation is that frequent changes in environment (hospitalization) may weaken patients' community support networks [51].

Resilience and financial toxicity in relation to quality of life

Our research found that high resilience correlates with high quality of life, a finding consistent with current research results [25, 59]. Resilience is an adaptive trajectory or mechanism in response to adversities such as cancer [60]. Manne et al. [28] found that women newly diagnosed with gynecological cancer had relatively high average resilience, but resilience began to dynamically change as the disease progressed, treatment side effects emerged, and physical and mental fatigue increased [24]. Additionally, the correlation between resilience and quality of life varies among patients with different types of cancer. Lung cancer patients exhibit a higher correlation than gastric cancer and colorectal cancer patients [61]. In our study, primary liver cancer patients demonstrated an even higher correlation ($r = 0.57$). A possible reason is that most primary liver cancer patients are diagnosed at an advanced stage, having already suffered significant physical and mental trauma, leading them to adopt more resilient behaviors to cope with this distress [27].

Our data found that low levels of financial toxicity correlate with high quality of life. This finding is consistent with the results of several studies [15, 20, 62]. Belcher et al. [21] found that financial hardship is positively correlated with emotional well-being, pain, role limitations due to physical health, and role limitations due to emotional problems in quality of life, suggesting that economic stress may have a significant impact on patients' overall well-being. In addition, Ürek and colleagues [15] found that financial toxicity is closely related to treatment compliance. Although insurance can reimburse part of the medical expenses, the ancillary expenses of cancer treatment (such as personal work sacrifice, food, transportation, accommodation, and fees) still need to be paid out of pocket, which is a considerable expense. As a result, cancer patients may alter their treatment regimen, fail to adhere to medical advice, or even discontinue cancer treatment [37] due to financial burdens, which severely compromises their physical and mental health.

This study found that high resilience is correlated with low financial toxicity. Currently, many studies [22, 63, 64] have shown that resilience is one of the important factors associated with financial toxicity in patients with lung cancer, breast cancer, and colorectal cancer. The possible reason is that resilience is related to family income [33] and can predict financial stress [32]. At the same time, high resilience may be related to more support from family members, reflecting higher family cohesion and a stronger sense of identity [65], which may enable resilience to mitigate financial stress and reduce financial toxicity. In addition, the relationship between resilience and financial toxicity is bidirectional. A qualitative study in Ghana [66] found that parents caring for children with sickle cell disease often face reduced employment opportunities, leading to a cycle of economic insecurity, and balancing work with caring for the child can result in stress and depression that impact resilience.

The mediating role of resilience in financial toxicity and quality of life

This study found that resilience mediates the relationship between financial toxicity and quality of life, suggesting the following possible associations between financial

toxicity and quality of life: On one hand, financial toxicity may be directly linked to material deprivation. Against the backdrop of high treatment costs for liver cancer and impaired liver function, patients may face agonizing choices between disease treatment and sustaining basic living standards for family members [16]. Such stressors may further impact treatment adherence and patient role withdrawal [15, 37], potentially correlating with lower quality of life. On the other hand, financial toxicity may relate to quality of life through psychosocial mechanisms. Prolonged financial stress, as a chronic stressor, may be associated with depletion of psychological resources and reduced resilience levels [22, 33], thereby impairing emotional health [15, 21], social interaction abilities [14, 67], role functioning [14], and coping strategies [36]. These factors may collectively exacerbate patients' feelings of helplessness, despair, and coping failure when facing cancer [27, 28], thereby further linking financial toxicity to its impact on quality of life.

The mediating findings of this study suggest that resilience may serve as a potential target for future intervention research. Resilience is a malleable psychological trait [24], and research indicates that patients with high resilience are more likely to employ coping strategies such as positive emotional expression, positive reevaluation, and cultivating calmness and meaning to maintain quality of life [28]. This suggests that beyond mitigating financial toxicity at the macro level, enhancing resilience through financial counseling and psychosocial support may indirectly influence patients' financial toxicity and quality of life.

China's healthcare system boasts extensive coverage [62], yet reimbursement rates for liver cancer treatment remain low. This underscores the urgent need for national interventions, particularly expanding the scope and intensity of medical insurance coverage. Additionally, scholars have proposed integrating "financial health" as a routine component of clinical assessments [68]. During hospital treatment, healthcare providers should offer specialized financial counseling to cancer patients, enabling early identification of those at high risk of economic burden and collaborative development of personalized treatment plans. This approach helps alleviate patients' financial uncertainty and reduce psychological resource depletion, potentially enhancing their psychological resilience in confronting disease challenges. Crucially, parallel psychosocial support cultivates patient resilience. Strengths-Based cognitive-behavioral Therapy (CBT), developed by Padesky et al. [69], starts from the patient's perspective to identify strengths and formulate logically personalized strategies. This approach stimulates patients' inner strength and enhances their sense of self-efficacy, potentially mitigating the potential impact of financial circumstances [70, 71]. While healthcare systems vary globally, the negative effects of financial toxicity on patients' psychological and social functioning are consistent. This study's identification of resilience as a mediating factor provides a crucial theoretical foundation for future intervention research.

Limitations

Despite a sound theoretical and methodological foundation, this study has certain limitations. First, as a cross-sectional study, it restricts our ability to explore causal relationships and determine directionality among the three variables; thus, the observed relationships are merely correlations. Second, questionnaire data collection relies on self-reporting, which, while valid, introduces reporting bias. Additionally, while having medical staff complete questionnaires on behalf of patients facilitated participation from those unable to self-report, this introduced significant interviewer bias. We implemented measures such as pre-study training for medical staff and repeated confirmation of questionnaire items and responses during data collection; however, complete avoidance of interviewer bias remains unattainable. Fourth, for feasibility reasons, we employed convenience sampling to select a single-center sample. This resulted in selection bias and limits the generalizability of findings to other populations, necessitating caution when interpreting or extrapolating these results. Fifth, this study was conducted at a single, high-level university hospital (The University of Hong Kong–Shenzhen Hospital) in a major metropolitan area (Shenzhen, China). The study population, its socioeconomic status, and healthcare accessibility may differ structurally from liver cancer patients in rural China, other regions with lower economic development, or other countries. Our findings also indicate that place of residence is a factor influencing quality of life, confirming this point. Therefore, this may limit the generalizability of the findings to other regions and countries with different environments and cultures. Furthermore, the inclusion of patients without restrictions on cancer stage—where patients at different stages face varying economic pressures and psychological distress (though Lei et al. [12] found no expenditure differences among stage I-IV HCC patients)—may introduce confounding bias into our results. Finally, the absence of certain sociodemographic variables—such as informal financial assistance from relatives and friends or out-of-pocket expenses for cancer treatment—as potential confounders may have prevented our assessment of patients' financial toxicity from fully capturing the true situation.

Conclusion

The high cost of liver cancer treatment significantly impacts treatment outcomes and quality of life for patients. This study found that the quality of life among

patients with primary liver cancer was at a moderate level, and resilience, financial toxicity, and quality of life were mutually correlated. Moreover, mediation analysis revealed that resilience plays a partial mediating role between economic toxicity and quality of life. These findings indicate that addressing patients' financial burdens and prioritizing resilience cultivation may significantly improve their quality of life. Future studies could adopt a multicenter, prospective longitudinal design to further validate the causal role of resilience in mediating pathways.

Abbreviations

HCC	Hepatocellular carcinoma
CNLC	China liver cancer staging
ICC	Intrahepatic cholangiocarcinoma
cHCC-CCA	Combined hepatocellular-cholangiocarcinoma
CD-RISC	Connor-davidson resilience scale
COST-PROM	Comprehensive scores for financial toxicity based on the patient-reported outcome measures
QOL-LC	Quality of life scale for patients of liver cancer
EORTC	The European Organization for Research and Treatment of Cancer
BCLC	The Barcelona clinic liver cancer
CBT	Cognitive-behavioural therapy

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12876-025-04458-x.

Supplementary Material 1.

Acknowledgements
Not applicable.

Authors' contributions
Mao designed the study and wrote the paper. Qian completed the data analysis and wrote the paper. Liu interpreted the data, Huo provided suggestions for the draft.

Funding
This study did not receive funding.

Data availability
All data generated or analyzed during this study are included in this paper [and its supplementary information file].

Declarations

Ethics approval and consent to participate
This study is a cross-sectional study and has been approved by the Ethics Committee of The University of Hong Kong–Shenzhen Hospital (Date: June 16, 2023; Reference Number: HKUSZH2023087). All participants provided informed consent and voluntarily completed the questionnaire. The data collected will be used solely for the purposes of this research, ensuring the protection of patients' personal privacy. This study was executed according to the code of ethics of the World Medical Association (Declaration of Helsinki) for studies on humans.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

Received: 31 August 2025 / Accepted: 6 November 2025
Published online: 12 December 2025

References

1. Bray F, Laversanne M, Sung H, Ferlay J, Siegel RL, Soerjomataram I, et al. Global cancer statistics 2022: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. CA Cancer J Clin. 2024;74:229–63.
2. Guo Q, Zhu X, Beeraka NM, Zhao R, Li S, Li F, et al. Projected epidemiological trends and burden of liver cancer by 2040 based on GBD, CI5plus, and WHO data. Sci Rep. 2024;14:28131.
3. Bray F, Parkin DM. Cancer in sub-Saharan Africa in 2020: a review of current estimates of the national burden, data gaps, and future needs. Lancet Oncol. 2022;23:719–28.
4. Wang D, Sou S, Rith S, Touch S, Tan M, Virak V, et al. Primary liver cancer disease burden in Cambodia during 1990–2021: a systematic analysis of datasets from the global burden of disease study 2021. BMC Gastroenterol. 2025;25:474.
5. Zhang CH, Cheng Y, Zhang S, Fan J, Gao Q. Changing epidemiology of hepatocellular carcinoma in Asia. Liver Int. 2022;42(9):2029–41.
6. Bray F, Ferlay J, Soerjomataram I, Siegel RL, Torre LA, Jemal A. Global cancer statistics 2018: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. CA Cancer J Clin. 2018;68:394–424.
7. He J, Chen WQ, Shen HB. China guideline for liver cancer screening (2022, Beijing). Journal of Clinical Hepatology. 2022: 1739–1758. https://doi.org/10.3969/j.issn.1001-5256.2022.08.007.
8. Dasgupta P, Henshaw C, Youlden DR, Clark PJ, Aitken JF, Baade PD. Global trends in incidence rates of primary adult liver cancers: a systematic review and meta-analysis. Front Oncol. 2020;10:171.
9. Desai R, Jiang Y, VanWagner LB, Singal AG, Lieber SR. Financial burden in a US cohort of patients with HCC. Hepatol Commun. 2024;8:e0453.
10. Fukuda H, Sato D, Moriwaki K, Ishida H. Differences in healthcare expenditure estimates according to statistical approach: a nationwide claims database study on patients with hepatocellular carcinoma. PLoS One. 2020;15:e0237316.
11. Cai Y, Chen W, Wang X, Xia X, Cui X, Wu S, et al. Contemporary trends on expenditure of hospital care on total cancer and its subtypes in China during 2008–2017. Chin J Cancer Res. 2021;33:627–36.
12. Lei H, Lei L, Shi J, Wu Y, Liang L, Huang H, et al. No expenditure difference among patients with liver cancer at stage I-IV: findings from a multicenter cross-sectional study in China. Chin J Cancer Res. 2020;32:516–29.
13. Zafar SY, Abernethy AP. Financial toxicity, Part I: a new name for a growing problem. Oncology (Williston Park). 2013; 27:80–81, 149.
14. Kajimoto Y, Honda K, Suzuki S, Mori M, Tsubouchi H, Nakao K, et al. Association between financial toxicity and health-related quality of life of patients with gynecologic cancer. Int J Clin Oncol. 2023;28:454–67.
15. Ürek D, Uğurluoğlu Ö. Predictors of financial toxicity and its associations with health-related quality of life and treatment non-adherence in Turkish cancer patients. Support Care Cancer. 2022;30:865–74.
16. Yücel KB, Özay ZI, Sütcüoğlu O, Yazıcı O, Üner A, Günel N, et al. Greater financial toxicity correlates with increased psychological distress and lower quality of life among Turkish cancer patients. Support Care Cancer. 2023;31:137.
17. Murphy PB, Severance S, Savage S, Obeng-Gyasi S, Timsina LR, Zarzaur BL. Financial toxicity is associated with worse physical and emotional long-term outcomes after traumatic injury. J Trauma Acute Care Surg. 2019;87:1189–96.
18. Almutairi M, Almutairi AA, Alodhialah AM. Impact of social determinants on quality of life in socioeconomically disadvantaged cancer survivors: a mixed-methods study. Cancer Manag Res. 2025;17:1271–92.
19. McDougall JA, Blair CK, Wiggins CL, Goodwin MB, Chiu VK, Rajput A, et al. Socioeconomic disparities in health-related quality of life among colorectal cancer survivors. J Cancer Surviv. 2019;13:459–67.
20. Mehlis K, Witte J, Surmann B, Kudlich M, Apostolidis L, Walther J, et al. The patient-level effect of the cost of cancer care - financial burden in German cancer patients. BMC Cancer. 2020;20:529.
21. Belcher SM, Lee H, Nguyen J, Curseen K, Lal A, Zarrabi AJ, et al. Financial hardship and quality of life among patients with advanced cancer receiving outpatient palliative care: a pilot study. Cancer Nurs. 2023;46:3–13.
22. Chen X, Yan Q, Tang Y, Zhu J, Zhang W, Zhang J. Financial toxicity, family resilience and negative emotions among young and middle-aged breast cancer patients: a multicentre cross-sectional study. Breast. 2024;75:103735.
23. Newman R. APA's resilience initiative. Prof Psychol Res Pract. 2005;36:227–9.

24. Eicher M, Matzka M, Dubey C, White K. Resilience in adult cancer care: an integrative literature review. Oncol Nurs Forum. 2015;42:E3-16.
25. Duran S, Varol U, Tekir Ö, Soytürk AH. Resilience's impact on quality of life and post-traumatic growth in breast cancer patients during treatment. Breast Cancer. 2024;31:807–14.
26. Sihvola S, Kuosmanen L, Kvist T. Resilience and related factors in colorectal cancer patients: a systematic review. Eur J Oncol Nurs. 2022;56:102079.
27. Macía P, Barranco M, Gorbeña S, Iraurgi I. Expression of resilience, coping and quality of life in people with cancer. PLoS One. 2020;15:e236572.
28. Manne SL, Myers-Virtue S, Kashy D, Ozga M, Kissane D, Heckman C, et al. Resilience, positive coping, and quality of life among women newly diagnosed with gynecological cancers. Cancer Nurs. 2015;38:375–82.
29. Zhang X, Gao R, Lin JL, Chen N, Lin Q, Huang GF, et al. Effects of hospital-family holistic care model on the health outcome of patients with permanent enterostomy based on the theory of 'Timing It Right.' J Clin Nurs. 2020;29:2196–208.
30. The WHOQOL Group. The World Health Organization quality of life assessment (WHOQOL): position paper from the World Health Organization. Soc Sci Med. 1995;41:1403–9.
31. Cai R, Lin H, Mao Q, Zhang C, Tan Y, Cheng Q. Research hotspots and trends in cancer rehabilitation: a bibliometric analysis (2013–2023). Support Care Cancer. 2025;33:296.
32. Hassan-Abbas NM. Resilience and risk factors predict family stress among married palestinians in Israel during the COVID-19 pandemic. Front Psychol. 2022;13:913330. https://doi.org/10.3389/fpsyg.2022.913330.
33. Shao M, Yang H, Du R, Zhang M, Zhu J, Zhang H, et al. Family resilience in cancer treatment and key influencing factors: a systematic review. Eur J Oncol Nurs. 2023;66:102403.
34. Solano JP, Da SA, Soares IA, Ashmawi HA, Vieira JE. Resilience and hope during advanced disease: a pilot study with metastatic colorectal cancer patients. BMC Palliat Care. 2016;15:70.
35. Lara-Morales A, Soto-Ruiz N, Agudelo-Suárez AA, García-Vivar C. Social determinants of health in post-treatment cancer survivors: scoping review. Eur J Oncol Nurs. 2024;70:102614.
36. Wang Y, Luo B, Wang X, Ji Q, Cao X. Financial toxicity, coping strategies, and quality of life among Chinese patients with hematologic malignancies: a cross-sectional study. Support Care Cancer. 2024;32:475.
37. Sasaki T, Aoyama M, Igarashi N, Morita T, Shima Y, Miyashita M. Influence of financial burden on withdrawal or change of cancer treatment in Japan: results of a bereavement survey. Support Care Cancer. 2022;30:5115–23.
38. Kumpfer KL. Factors and processes contributing to resilience. In: Glantz MD, Johnson JL, editors. Boston: MA: Springer; 2002. p. 179–224. https://doi.org/10.1007/0-306-47167-1_9.
39. General Office of National Health Commission. Standard for diagnosis and treatment of primary liver cancer (2022 edition). Journal of Clinical Hepatology. 2022; 38: 288–303. https://doi.org/10.3969/j.issn.1001-5256.2022.02.009.
40. Wu L, Tan Y, Liu Y. Factor structure and psychometric evaluation of the Connor-Davidson resilience scale in a new employee population of China. BMC Psychiatry. 2017;17:49.
41. Su XQ, Wu TT, Zhang HY, Shi Q, Xu Y, Kuai BX, et al. Mediating and moderating factors between stigma and adaptability to return to work for cancer survivors. Sci Rep. 2024;14:30944.
42. Zou Y, Yang Q, Guan B, Fu X, Wang J, Li Y. Survey on mental health status and quality of life and correlation among patients with permanent stoma of colorectal tumor. Comput Math Methods Med. 2022;2022:5792312.
43. Zhang YL, Yin Y, Bai L, Wei HH, Liu YY. Mediation effect of psychological resilience between post-traumatic growth and quality of life in patients with primary liver cancer. China Medical Herald. 2024; 21: 162–167. https://doi.org/10.20047/j.issn1673-7210.2024.36.30.
44. Gupta A, Zorzi J, Ho WJ, Baretti M, Azad NS, Griffith P, et al. Relationship of hepatocellular carcinoma stage and hepatic function to health-related quality of life: a single center analysis. Healthcare. 2023;11:2571.
45. Mikoshiba N, Miyashita M, Sakai T, Tateishi R, Koike K. Depressive symptoms after treatment in hepatocellular carcinoma survivors: prevalence, determinants, and impact on health-related quality of life. Psychooncology. 2013;22:2347–53.
46. Yang X, Hao Y, George SM, Wang L. Factors associated with health-related quality of life among Chinese caregivers of the older adults living in the community: a cross-sectional study. Health Qual Life Outcomes. 2012;10:143.
47. Pekçetin E, Pekçetin S, Sağlamoğlu E, Ekici G. Urban versus rural older adults: occupational balance and quality of life comparison. BMC Geriatr. 2025;25:49.
48 Boah M, Cyuzuzo C, Uwinkindi F, Kalinda C, Yohannes T, Isano S, et al. Health and well-being of older adults in rural and urban Rwanda: epidemiological findings from a population based cross-sectional study. J Glob Health. 2025;15:4108.
49. Wilson NW, Couper ID, De Vries E, Reid S, Fish T, Marais BJ. A critical review of interventions to redress the inequitable distribution of healthcare professionals to rural and remote areas. Rural Remote Health. 2009;9:1060.
50. Rivera RJ, Borger T, Sizemore Y, Burris JL. Similarities and differences across the underlying dimensions of social functioning in rural and nonrural cancer survivors: a mixed-methods study. J Rural Health. 2023;39:434–43.
51. Carnahan LR, Rauscher GH, Watson KS, Altfeld S, Zimmermann K, Ferrans CE, et al. Comparing the roles of social context, networks, and perceived social functioning with health-related quality of life among self-reported rural female cancer survivors. Support Care Cancer. 2021;29:331–40.
52. Long HY, Huang TY, Xie XY, Long JT, Liu BX. Treatment strategies for hepatocellular carcinoma with extrahepatic metastasis. World J Clin Cases. 2021;9:5754–68.
53. You XM, Lu FC, Li FR, Zhao FJ, Huo RR. Dynamics trajectory of patient-reported quality of life and its associated risk factors among hepatocellular carcinoma patients receiving immune checkpoint inhibitors: a prospective cohort study. Front Immunol. 2024;15:1463655.
54. Cheng AL, Kang YK, Chen Z, Tsao CJ, Qin S, Kim JS, et al. Efficacy and safety of sorafenib in patients in the Asia-Pacific region with advanced hepatocellular carcinoma: a phase III randomised, double-blind, placebo-controlled trial. Lancet Oncol. 2009;10:25–34.
55 Oh HS, Menéndez ÁF, Santos VS, Martínez ÁR, Ribeiro FF, Vilanova-Trillo L, et al. Evaluating health related quality of life in outpatients receiving anti-cancer treatment: results from an observational, cross-sectional study. Health Qual Life Outcomes. 2021;19:245.
56. Fang P, Tan KS, Grover S, McFadien MK, Troxel AB, Lin L. Psychosocial encounters correlates with higher patient-reported functional quality of life in gynecological cancer patients receiving radiotherapy. Radiat Oncol. 2015;10:34.
57. Chen NY, Chen KH, Wang YW, Tsai HH, Lee WC, Weng LC. The impact of symptom distress on health-related quality of life in liver cancer patients receiving arterial chemoembolization: the mediating role of hope. BMC Gastroenterol. 2022;22:456.
58. Shinn EH, Taylor CL, Kilgore K, Valentine A, Bodurka DC, Kavanagh J, et al. Associations with worry about dying and hopelessness in ambulatory ovarian cancer patients. Palliat Support Care. 2009;7:299–306.
59. Costa A, Heitkemper MM, Alencar GP, Damiani LP, Silva R, Jarrett ME. Social support is a predictor of lower stress and higher quality of life and resilience in Brazilian patients with colorectal cancer. Cancer Nurs. 2017;40:352–60.
60. Mancini AD, Bonanno GA. Predictors and parameters of resilience to loss: toward an individual differences model. J Pers. 2009;77:1805–32.
61 Ye ZJ, Qiu HZ, Li PF, Liang MZ, Zhu YF, Zeng Z, et al. Predicting changes in quality of life and emotional distress in Chinese patients with lung, gastric, and colon-rectal cancer diagnoses: the role of psychological resilience. Psychooncology. 2017;26:829–35.
62 Xu T, Xu L, Xi H, Zhang Y, Zhou Y, Chang N, et al. Assessment of financial toxicity among patients with advanced lung cancer in Western China. Front Public Health. 2021;9: 754199.
63. Zhang X, Zhang L, Geng Z, Shang M, Wang A, Zheng X, et al. Potential profile analysis of financial toxicity and its related factors among lung cancer patients. BMC Cancer. 2025;25:740.
64. Shao M, Yao L, Zhang M, Zhou H, Ding Y, Bai L, et al. Post-surgery financial toxicity and its influencing factors in colorectal cancer care: a cross-sectional study. Eur J Oncol Nurs. 2024;68:102518.
65. Stevenson C, Wakefield J, Bowe M, Kellezi B, Jones B, McNamara N. Weathering the economic storm together: family identification predicts future well-being during COVID-19 via enhanced financial resilience. J Fam Psychol. 2022;36:337–45.
66. Ampomah MO, Atkin K, Ohene LA, Achempim-Ansong G, Korsah KA, Laari L. Financial strain and resilience: a qualitative exploration of parental perspectives on caring for children with sickle cell disease in Ghana. BMC Health Serv Res. 2024;24:1380.
67. Moss JL, Bernacchi V, Kitt-Lewis E. Active social engagement and health among older adults: assessing differences by cancer survivorship status. Health Qual Life Outcomes. 2024;22:67.
68. Shankaran V, Ramsey S. Addressing the financial burden of cancer treatment: from copay to can't pay. JAMA Oncol. 2015;1:273–4.
69. Padesky CA, Mooney KA. Strengths-based cognitive-behavioural therapy: a four-step model to build resilience. Clin Psychol Psychother. 2012;19:283–90.

70. Mongelli MN, Giri S, Peipert BJ, Helenowski IB, Yount SE, Sturgeon C. Financial burden and quality of life among thyroid cancer survivors. Surgery. 2020;167:631–7.
71. Liao RW, Hu WC, Kuo CY, Hsu WL, Tzeng IS. Adult individual resilience interventions: a PRISMA-compliant meta-analysis. J Psychiatr Res. 2025;189:352–64.

Publisher's note

Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.