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RESEARCH

Financial toxicity following surgical treatment for colorectal cancer: a cross-sectional study

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Abstract

Purpose Financial toxicity has become a global public health issue. The purpose of the study is to investigate and analyze the influencing factors of financial toxicity in patients with non-metastatic colorectal cancer.

Methods A convenient sample of 250 patients with stage I-III colorectal cancer was investigated in the study. They completed a set of questionnaires, including the Comprehensive Score for Financial Toxicity questionnaire, the Perceived Social Support Scale, and the Hospital Anxiety and Depression Scale. Univariate and multivariate linear regression were performed to investigate the influencing factors of financial toxicity.

Results Over half (52.8%, $n = 132$) of the colorectal cancer survivors experienced financial toxicity. Multivariate regression analysis showed that the factors associated with financial toxicity were young age, unemployment, low annual household income, chemotherapy, and the lack of sufficient social support ($p < 0.05$).

Conclusions Financial toxicity is common among non-metastatic colorectal cancer survivors. Young age, lower annual household income, unemployment, chemotherapy, and insufficient social support were associated with financial toxicity.

Keywords Financial toxicity · Cross-sectional survey · Determinants · Colorectal cancer · Social support

Introduction

Colorectal cancer is the third most common cause of cancer death worldwide, with more than 1.90 million cases and 935,000 deaths yearly [49]. It is estimated that there will be 592,232 new cases of colorectal cancer in China by 2022, accounting for 12.3% of cancer cases [54]. Over the past few decades, considerable advancements have been achieved in diagnosing and treating colorectal cancer [28]. Moreover, recent progress in next-generation sequencing and high-throughput technologies is beneficial to uncovering the underlying mechanisms of diversified therapeutic regimens in colorectal cancer [33]. All of these have significant improvements in overall survival and clinical effects for patients [2, 48].

Nevertheless, the cost of these technological advances also has caused a growing burden on patients and entire healthcare systems. In the USA, the financial burden caused by colorectal cancer was as high as $14.1 billion, accounting for 5.5% of the total cost of health care [34]. Compared with other cancers, the direct financial burden of colorectal cancer has the highest growth rate in China [7], and the direct medical expenses of colorectal cancer reached 61,829 CNY (approximately $8,698) per case [23]. Financial toxicity has become a globally severe economic problem [1], especially in middle-income countries, including China, because of low government spending on public health, insurance coverage gaps, and high care cost. Medical insurance in China consists of basic medical insurance for urban workers, basic medical insurance for urban residents, and new rural cooperative medical care. At the end of 2018, China's medical insurance participation rate reached 95%,

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covering 1.3 billion Chinese citizens [50]. Even though basic medical insurance has achieved universal coverage, uneven medical insurance coverage, unbalanced medical insurance reimbursement ratios, and expensive anticancer drugs still plague most cancer patients [8, 36].

The cost of cancer treatment can be divided into direct and indirect costs. Direct costs include drugs, adjuvant therapy, imaging tests, commuting, and lodging expenses, and indirect costs include time costs for patients and caregivers, and long-term production costs on account of diagnosis and treatment [8, 36]. The 1-year out-of-pocket costs of newly diagnosed colorectal cancer patients were 32,649 CNY (approximately $4,557) [23], the most expensive of the six major cancers in China, even though these were much lower than EUR 16,375–16,450 (approximately $16,777–16,854) for German male patients and $21,427 for Iranian patients [22, 38]. Due to the high cost of cancer care, many cancer survivors are more likely to face substantial self-payments and financial difficulties than those without cancer [56]. Financial hardship was prevalent in cancer survivors, with 25.3% of this group reporting material hardship (e.g., problems paying medical bills) and 34.3% reporting psychological hardship (e.g., worries about medical bills) [56]. In the past 10 years, the term "financial toxicity" has been popularized in cancer research. It is recognized that the financial toxicity related to the treatment and care can be just as significant as the physical toxicities traditionally associated with cancer therapeutics. Financial toxicity refers to cancer treatment's financial burden and suffering to patients and their families. This toxicity has been shown to affect 48–73% of cancer patients [19]. Some studies have shown that financial toxicity is associated with clinically relevant patient outcomes, including poorer health-related quality of life, decreased survival, increased symptom burden, and decreased treatment compliance [30, 43, 45].

Much attention has been paid to financial toxicity in breast, lung, prostate, bladder, kidney, and blood cancer patients [6, 16–18, 25, 40]. Studies on the financial toxicity of colorectal cancer were mainly conducted in countries with well-established social welfare systems, such as the USA, Ireland, and Germany [21, 35, 45]. Previously identified factors influencing financial toxicity generally included sociodemographic characteristics, clinical data, direct and indirect costs, expectations of possible financial burdens, individual's economic circumstances, and patient-specific values [25, 45, 47]. Additionally, oncologists were expected to investigate financial toxicity in advanced cancer patients who consistently report physical, mental, and emotional distress [15]. In a study of breast cancer, anxiety and depression were associated with financial toxicity [41]. All of these results provide further insights into the factors influencing financial toxicity. Because there are many differences between China and western countries in terms of medical systems, insurance systems, and patient attitudes, financial toxicity may vary in different influencing factors. With considerable advances in the treatment of non-metastatic colorectal cancer, the 5-year survival rate of stage I-III colorectal cancer patients reached 66.4% [37]. Prolonged postoperative survival of patients may lead to severe financial toxicity. However, few studies on financial toxicity among colorectal cancer patients in China have been conducted. The purpose of this study was to analyze the influencing factors of financial toxicity of non-metastatic colorectal cancer.

Methods

Design and sample

This was a single-institution, cross-sectional pilot study. We enrolled 287 patients with pathologically confirmed stage I-III colorectal cancer in a tertiary academic medical center in North China from January 2022 to June 2022. The patients were included if they (1) were at least 18 years old at the time of their cancer diagnosis, (2) underwent surgical care in this hospital, (3) received at least one type of adjuvant therapy (chemotherapy, radiotherapy) for at least 3 months, (4) had regular reading and writing skills, and (5) were able to complete surveys independently or with assistance. Patients were excluded if they had more than 1 type of cancer and had a history of mental illness or disorder.

Patients were recruited during their oncology hospital stay. We contacted the oncologists and nurses in charge in advance, and with their assistance, we evaluated the inpatients with colorectal cancer. We explained the purpose and significance of the investigation to patients who met the inclusion and exclusion criteria. Afterward, patients were given sufficient time to consider whether to participate in the study. After obtaining the patients' consent, we conducted our survey in a comfortable meeting room the hospital. We distributed questionnaires and informed consent forms to patients. They typically completed the questionnaires independently. For patients with difficulties in reading and writing, we read the questions item by item in neutral, non-suggestive language to aid patients in completing the questionnaires. After patients completed the questionnaires, we confirmed that the questionnaires had been completed. If there was any omission, patients were asked to immediately fill out the questionnaires. Among 287 patients we recruited, 29 refused to participate in the study because they were not feeling well, they were inconvenient, their families disagreed, and some did not disclose their reasons.

We estimated the sample size based on the formula $= \frac{\left(Z_{\frac{\alpha}{2}}\right)^2 p(1-p)}{d^2}$, where $N =$ initial estimated sample size, $Z =$ confidence level (α), $p =$ prevalence, and $d =$ marginal

error. The financial toxicity was evaluated in a previous study which was 16% [5]. With a 95% confidence level, a margin of error of 0.05, and an assumed 20% invalid completion rate. We estimated that at least 241 participants should be recruited. The Ethics Committee of the Affiliated Hospital of Qingdao University approved this study (NO. QYFYWZLL25862).

Data collection and measures

Our investigation consists of four questionnaires. Sociodemographic and clinicopathological data were collected using an 11-item questionnaire. Age, sex, residence, household income per year, employment status, marital status, primary insurance status, and education level were collected as sociodemographic factors. We extracted clinical data, including tumor stage at diagnosis, tumor location (colon/rectal), and treatment (chemotherapy, radiotherapy) from the electronic medical registry at the hospital.

Financial toxicity was assessed using the 11-item Comprehensive Score for Financial Toxicity (COST) questionnaire. It scored from 0 to 44, and each item was rated on a 4-point. Low values represented financial toxicity from more significant treatment modalities [12]. The psychometric properties of the scale were tested in insured patients with multiple myeloma, and the COST measure showed reliable internal consistency [24]. The test–retest intraclass correlation coefficient (ICC) was 0.80 [13]. The Cronbach's α coefficient of the scale in this study was 0.930.

Another scale was the Perceived Social Support Scale (PSSS), with 12 self-reported items measuring three domains of subjective social support level, including family support, friends support, and other support [24]. Each item was rated on a 7-point, and scores of respective domains were standardized into a range of 12 to 84. There was a positive correlation between scores and social support. The Cronbach's α coefficient of 0.814 indicated that the scale's internal consistency was good among the Chinese colorectal cancer patients.

The patient's anxiety and depression were measured by the Hospital Anxiety and Depression Scale (HADS). The scale consists of 14 items, seven for the anxiety subscale and seven for the depression subscale [42]. Each item was scored on a 4-point response scale from 0 to 3. The total score range for the subscales is 0 to 21. The recommended score for suspected cases is 8 to 10, and the recommended score for confirmed cases is ≥ 11. In the study, the Cronbach's α for the HADS total score was 0.709, and the Cronbach's α for the anxiety and depression subscales was 0.908 and 0.814, indicating good to excellent internal consistency of the scale.

Statistical analysis

Continuous data were expressed as means with the standard deviation, and categorical data were expressed as percentages and frequencies. The normal distribution of COST scores was assessed with the Shapiro–Wilk normality test. As appropriate, we compared sociodemographic and clinical characteristics using the student's *t*-test, chi-square test, and ANOVA, as appropriate. Patients were initially divided into two groups based on the media COST score (score 21) to determine the relationship between COST score and sociodemographic, psychosocial, and treatment factors of objects.

We then constructed a multiple regression model to determine the correlation between each element of the original continuous data scale and the COST score. When choosing a model, we first analyzed one variable from the univariate linear regression analysis and then selected variables with $P < 0.05$ to construct a multivariate regression model. The expansion factor for each variance is used to check the collinearity of the selected variables. Hosmer-Ramesh's test determined the excellent fit of the final model. All statistical tests were two-tailed, and *P* values less than 0.05 were considered statistically significant. Statistical analyses were performed in SPSS 26.0.

Results

Distribution of demographic and clinical variables

We recruited 287 patients in oncology wards; 258 patients returned the questionnaires, with a response rate of 89.9%. We excluded eight patients whose electronic medical record was incomplete. Then there were 250 subjects in our final analysis sample.

The baseline patient characteristics of the total cohort and COST scores are presented in Table 1. The median age of the sample was 62.0 years. 62.4% of the participants were male. Approximately 43.6% of respondents were retired, and most (92.8%) patients were married. In addition, 66.0% of the patients participated in Urban Employees Basic Medical Insurance (UEBMI). Patients' average annual household income ranged from 20,000 to 49,999 (CNY). More than half (54.8%) of the patients were in stage III colorectal cancer, and most received chemotherapy (82.8%) and radiotherapy (69.6%). 35 (14.0%) patients reported advanced social support. The median COST score was 21. Compared with the patients who scored above 21, the patients who scored below the median were younger, female, less likely to be retired, had a higher household income, possessed UEBMI, and was more likely to have higher education. The patients who scored below the median also had a lower pathological

Table 1 Patients characteristics by COST score ($N=250$)

Characteristic	Entire cohort ($N=250$)	COST ≤ 21($n=132$)	COST > 21 ($n=118$)	P value
Median age (range), years	62.0 (52.75~68)	57.0 (48.0~65.8)	65.0 (58.8~70.0)	< 0.001
Age group				< 0.001
< 50	40 (16.0%)	36 (27.3%)	4 (3.4%)	
50–64	107 (42.8%)	58 (43.9%)	49 (41.5%)	
65–74	87 (34.8%)	35 (26.5%)	52 (44.1%)	
≥ 75	16 (6.4%)	3 (2.3%)	13 (11.0%)	
Sex				0.003
Male	156 (62.4%)	71 (45.5%)	85 (54.5%)	
Female	94 (37.6%)	61 (64.9%)	33 (35.1%)	
Residence				< 0.001
Rural	108 (43.2)	80 (74.1%)	52 (36.6%)	
Urban	142 (56.8)	28 (25.9%)	90 (63.4%)	
Marital status				0.374
Married	232 (92.8%)	120 (57.1%)	112 (48.3%)	
Unmarried/divorced/widowed	18 (7.2%)	12 (67.4%)	6 (35.3%)	
Employment status				< 0.001
Employed (full-time, part-time)	57 (22.8%)	36 (63.2%)	21 (36.8%)	
Retired	109 (43.6%)	24 (22.0%)	85 (78.0%)	
Unemployed	84 (33.6%)	72 (85.7%)	12 (14.3%)	
Education level				0.003
Illiteracy	11 (4.4%)	8 (72.7%)	3 (27.3%)	
Primary school	36 (14.4%)	27 (75.0%)	9 (25.0%)	
Junior or Senior high school	136 (54.4%)	71 (52.2%)	65 (47.8%)	
University and above	67 (26.8%)	26 (38.8%)	41 (61.2%)	
Household income per year (CNY)				< 0.001
< 20,000	68 (27.2%)	58 (85.3%)	10 (14.7%)	
20,000–49,999	75 (30.0%)	40 (53.3%)	35 (46.7%)	
50,000–99,999	72 (28.8%)	24 (33.3%)	48 (66.7%)	
≥ 100,000	35 (14.0%)	10 (28.6%)	25 (71.4%)	
Primary insurance status				< 0.001
UEBMI	165 (66.0%)	64 (38.8%)	101 (61.2%)	
URBMI	9 (3.6%)	7 (77.8%)	2 (22.2%)	
NRCMS	72 (28.8%)	58 (80.6%)	14 (19.4%)	
None	4 (1.6%)	3 (76.0%)	1 (25.0%)	
Site				0.542
Rectum	139 (55.6%)	71 (51.1%)	68 (48.9%)	
Colon	111 (44.4%)	61 (55.0%)	50 (45.0%)	
Stage				< 0.001
I	15 (6.0%)	1 (6.7%)	14 (93.3%)	
II	98 (39.2%)	51 (52.0%)	47 (48.0%)	
III	137 (54.8%)	80 (58.4%)	57 (41.6%)	
Chemotherapy				< 0.001
Yes	207 (82.8%)	119 (57.5%)	88 (42.5%)	
No	43 (17.2%)	13 (30.2%)	30 (69.8%)	
Radiotherapy				0.025
Yes	174 (69.6%)	100 (57.5%)	74 (42.5%)	
No	76 (30.4%)	32 (42.1%)	44 (57.9%)	
Anxiety				< 0.001
None	124 (49.6%)	47 (35.6%)	77 (65.3%)	
Might exist	72 (28.8%)	50 (37.9%)	22 (18.6%)	

Table 1 (continued)

Characteristic	Entire cohort ($N=250$)	COST ≤ 21($n=132$)	COST > 21 ($n=118$)	P value
Certainly exist	54 (21.6%)	35 (26.5%)	19 (16.1%)	
Depression				< 0.001
None	166 (66.4%)	72 (54.5%)	94 (79.7%)	
Might exist	55 (22.0%)	40 (30.3%)	15 (12.7%)	
Certainly exist	29 (11.6%)	20 (15.2%)	9 (7.6%)	
Social support level				< 0.001
Low level of social support	27 (10.8%)	22 (16.7%)	5 (4.2%)	
Moderate level of social support	188 (75.2%)	105 (79.5%)	83 (70.3%)	
High level of social support	35 (14.0%)	5 (3.8%)	30 (25.4%)	

Abbreviations: *CNY*, Chinese yuan; *NRCMS*, New Rural Cooperative Medical Scheme; *UEBMI*, Urban Employees Basic Medical Insurance; *URBMI*, Urban Residents Basic Medical Insurance

stage, received radiation and chemotherapy, and were more reasonable to be free of depression and anxiety. Finally, having a moderate level of social support was more common among groups with lower COST scores. In this study, over half (52.8%) of colorectal cancer survivors experienced financial toxicity.

Results of ANOVA

Table 2 shows associations between financial toxicity and the demographic variables. The variables with significant differences in financial toxicity were age, employment status, education level, household income, cancer staging, chemotherapy, radiotherapy, anxiety, depression, and social support level ($P<0.05$).

Results of univariate and multivariate linear regression

The relationship between patient characteristics and COST outcomes was further elucidated by linear regression. Simple linear regression and multiple regression models were constructed, as shown in Table 3. In the univariate analysis, old age, female, higher income, living in the urban, education level of university and above, retirement at home, not receiving chemotherapy, and a high level of social support were all protective against financial toxicity ($P<0.05$). However, unemployed, primary school education, participation in New Rural Cooperative Medical Scheme (NRCMS), and mild anxiety and depression were associated with increased levels of financial toxicity ($P<0.05$). Marital status, cancer disease site, cancer stage, and radiation therapy were not significantly related to financial toxicity ($P>0.05$). In the multivariate analysis (Table 3), young age, unemployed, low annual household income, chemotherapy, and the lack of sufficient social support remained determinants for financial toxicity ($P<0.05$). However, sex, type of medical insurance, place of residence, education level, anxiety, and depression status were no longer significantly associated with financial toxicity ($P>0.05$).

Discussion

In the cross-sectional study, we investigated the financial toxicity of postoperative non-metastatic colorectal cancer patients in a tertiary hospital in eastern China and analyzed the associated influencing factors. The Comprehensive Score for Financial Toxicity (COST) was used to measure the financial toxicity of colorectal cancer patients. We found that 52.8% of colorectal cancer survivors suffered from financial toxicity. Our findings suggested that the patients most likely to have financial toxicity were young, had low annual household income, were unemployed, received chemotherapy, and lacked sufficient social support.

Our study demonstrated that elderly patients (> 65 years old) were protected against financial toxicity compared with patients aged 18–65. This result was consistent with prior research on cancer survivors [4, 55]. In the USA, cancer-related financial hardship was more common among survivors aged 18–65 than among older survivors (53.6% vs. 42.0%) [20]. A study found that because younger survivors were more likely to have fewer comorbidities, they may be able to tolerate aggressive therapeutic schemes. Therefore, treatment costs may be higher in younger survivors than in the elderly [31]. For instance, the 1-year net cost for stage III colorectal patients aged 18–64 was $61,600, while the 1-year net cost for patients 65 and older was$56,600 [4]. Previous studies suggested that younger patients had lower savings and the absence of a stable welfare guarantee. Furthermore, cancer treatment and disability caused lower working hours [27]. As the economic backbone of the entire family, young cancer patients in China may bear the most extraordinary economic pressure in society. They

Table 2 Distribution of COST score by patient characteristics

Patient characteristic	n	COST score, mean ± SD (median)	*P* value
Age group			< 0.001
< 50	40	14.3 ± 6.9 (13.0)	
50–64	107	19.5 ± 9.5 (19.0)	
65–74	87	22.2 ± 10.1 (25.0)	
≥ 75	16	26.9 ± 6.3 (26.0)	
Sex			0.052
Male	156	21.8 ± 9.4 (24.0)	
Female	94	17.2 ± 9.4 (16.0)	
Residence			0.404
Rural	108	15.0 ± 8.2 (14.0)	
Urban	142	24.0 ± 8.9 (26.0)	
Marital status			0.772
Married	232	20.4 ± 9.8 (21.0)	
Unmarried/divorced/widowed	18	17.1 ± 7.4 (16.0)	
Employment status			< 0.001
Employed (full-time, part-time)	57	19.5 ± 7.9 (19.0)	
Retired	109	27.2 ± 6.4 (19.0)	
Unemployed	84	11.3 ± 6.3 (28.0)	
Education level			0.859
None	11	12.6 ± 8.2 (10.0)	
Primary school	36	13.2 ± 8.5 (9.0)	
Junior or Senior high school	136	20.7 ± 9.3 (21.0)	
University and above	67	23.8 ± 8.9 (26.0)	
Household income per year (CNY)			< 0.001
< 20,000	68	12.3 ± 8.7 (10.0)	
20,000–49,999	75	19.6 ± 8.8 (21.0)	
50,000–99,999	72	24.8 ± 8.7 (26.0)	
≥ 100,000	35	26.7 ± 7.4 (28.0)	
Primary insurance status			0.471
UEBMI	165	23.8 ± 8.6 (25.0)	
URBMI	9	13.3 ± 7.8 (11.0)	
NRCMS	72	12.9 ± 7.4 (10.0)	
None	4	13.3 ± 7.8 (11.0)	
Site			0.561
Rectum	139	19.6 ± 9.8 (21.0)	
Colon	111	20.7 ± 9.6(19.0)	
Stage			0.032
I	15	25.1 ± 5.5 (25.0)	
II	98	20.1 ± 9.3 (21.0)	
III	137	19.6 ± 10.1 (19.0)	
Chemotherapy			0.089
Yes	206	19.6 ± 9.9 (19.0)	
No	44	22.6 ± 8.3 (24.0)	
Radiotherapy			0.563
Yes	172	19.5 ± 9.9 (19.0)	
No	78	21.5 ± 9.1 (23.0)	
Anxiety			0.533
None	124	22.5 ± 9.5 (25.0)	
Might exist	72	17.2 ± 9.1 (16.0)	
Certainly exist	54	18.6 ± 9.1 (19.0)	
Depression			0.406
None	166	21.7 ± 9.6 (24.0)	
Might exist	55	15.7 ± 8.7 (13.0)	
Certainly exist	29	19.5 ± 9.8 (19.0)	
Social support level			0.056
Low level of social support	27	13.9 ± 7.9 (10.0)	
Moderate level of social support	188	19.7 ± 9.7 (19.0)	
High level of social support	35	26.9 ± 6.0 (27.0)	

For all categorical variables, chi-square test was performed

P value = level of statistical significance; Significant ($p < 0.05$)

usually take the responsibilities of caring for their aging parents, raising children, and paying for daily living expenses. After the cancer diagnosis, there is less time to accumulate assets, resulting in lower income. One study showed that most unemployed and disabled colorectal cancer patients were young (mean age, 51.3 years) and could not undertake work after being diagnosed with colorectal cancer [45]. Due to the global COVID-19 pandemic, the financial toxicity of young cancer patients was further compounded by the fact that 21% of cancer patients reported a change in employment status. More than half of the patients expressed concerns about their future financial situation, so the above reasons aggravated the financial toxicity of young patients (Y. S. [9, 10]. Additionally, people over 65 generally have fulfilled the responsibilities and obligations of supporting their parents and raising their children in China. They are entitled to retirement pensions and are more likely to have considerable retirement savings. Savings and superannuation are unique financial cushions to ease cash flow during periods of low income and high spending due to cancer treatment. Hence, the financial toxicity in this study appeared to be milder in the elderly.

This study showed that unemployment and lower household income were significantly associated with the financial toxicity of patients. A study found that 45% of colorectal cancer patients with stage III lost their jobs because of the treatment; simultaneously, they worked to lessen the financial burden [51]. Young adults with advanced disease had a 56% higher risk of losing paid work within 4 years of diagnosis than the general population, and the decline in household income because of unemployment was closely relevant to a decrease in quality of life and economic stress [58]. One study on the employment of cancer survivors

Table 3 Univariate and multivariate linear regression

Patient characteristic	Univariate analysis		Multivariable analysis	
	Coefficient (95% CI)	*P* value	Coefficient (95% CI)	*P* value
Age group				
< 50(reference)				
50–64	− 1.0 (− 3.4 to 1.5)	0.431	2.9 (0.3 to 5.5)	0.023
65–74	3.2 (0.7 to 5.7)	0.012	6.4 (3.4 to 9.4)	< 0.001
≥ 75	7.2 (2.4 to 12.1)	0.004	8.8 (4.5 to 13.0)	< 0.001
Sex				
Male(reference)				
Female	− 4.6 (− 7.1 to − 2.2)	< 0.001	− 1.6 (− 3.3 to 0.2)	0.053
Residence				
Rural(reference)				
Urban	9.0 (6.8 to 11.1)	< 0.001	− 1.1 (− 3.3 to 1.2)	0.353
Employment status				
Employed (full − time, part − time) (reference)				
Retired	12.6 (1.2 to 14.5)	0.001	5.5 (− 1.8 to 8.1)	0.075
Unemployed	− 13.3 (− 15.2 to − 11.3)	0.001	− 2.4 (− 5.3 to − 1.1)	< 0.001
Education level				
Illiteracy(reference)				
Primary school	− 8.0 (− 11.3 to − 4.8)	< 0.001	− 1.5 (− 5.1 to 3.2)	0.659
Junior and Senior high school	1.3 (− 1.1 to 3.8)	0.274	− 0.9 (− 4.9 to 3.2)	0.667
University and above	5.0 (2.3 to 7.7)	< 0.001	− 0.1 (4.6 to 4.5)	0.974
Household income per year (CNY)				
< 20,000(reference)				
20,000–49,999	− 0.7 (− 3.3 to 2.0)	0.623	3.7 (1.0 to 6.4)	0.007
50,000–99,999	6.6 (4.0 to 9.1)	< 0.001	7.0 (3.7 to 10.3)	< 0.001
≥ 100,000	7.7 (4.3 to 11.0)	< 0.001	11.5 (7.4 to 15.5)	< 0.001
Primary insurance status				
UEBMI (reference)				
URBMI	− 7.0 (− 13.4 to − 0.6)	0.032	− 0.2 (− 4.6 to 4.2)	0.927
NRCMS	− 10.2 (− 12.5 to − 7.8)	< 0.001	− 1.4 (− 4.1 to 1.3)	0.320
None	− 7.0 (− 16.5 to 2.6)	0.154	− 3.8 (− 10.0 to 2.6)	2.554
Chemotherapy				
Yes(reference)				
No	3.1 (− 1.0 to 6.2)	0.057	3.6 (1.5 to 5.6)	0.001
Anxiety				
None(reference)				
Might exist	− 4.1 (− 6.7 to − 1.5)	0.002	− 1.1 (− 3.0 to 0.8)	0.265
Certainly exist	− 2.0 (− 4.9 to 1.0)	0.186	− 0.1 (− 2.9 to 2.7)	0.940
Depression				
None(reference)				
Might exist	− 5.6 (− 8.4 to − 2.8)	< 0.001	− 1.4 (− 3.6 to 0.8)	0.198
Certainly exist	− 0.7 (− 4.5 to 3.1)	0.715	− 0.4 (− 3.6 to 2.8)	0.821
Social support level				
Low level of social support (reference)				
Moderate level of social support	− 1.5 (− 4.3 to 1.3)	0.285	1.1 (− 1.4 to 3.6)	0.379
High level of social support	7.9 (4.6 to 11.3)	< 0.001	3.8 (0.5 to 7.1)	0.024

Abbreviations: *CI*, confidence interval

P value = level of statistical significance; Significant ($p < 0.05$)

showed that the average time cost of traveling to and from treatment for working-age patients was $4,809 per month. Moreover, those who lost their jobs or had to retire early because of cancer may experience a drop in their incomes [32]. The physical stress and potential psychological burden of long-term medication and treatment may also prevent them from jobs, compromising work capacity and productivity to some extent in the long run [3]. In the same way, the family caregiver had to spend considerable time and energy, resulting in reduced personal income [53]. All the above causes brought lower household income and more severe financial burdens.

Chemotherapy was associated with increased financial toxicity in our study. In a survey of 409 participants, 57% of cancer patients received chemotherapy, and 67% of patients in this population experienced financial toxicity [57]. Adjuvant chemotherapy is currently the most common and effective treatment modality for colorectal cancer individuals after surgery. Approximately half of the American patients received chemotherapy regimens [52], and respondents receiving chemotherapy reported significant financial burdens [26, 44]. In China, 72.5% of stage II–III colorectal cancer patients received adjuvant therapy (G. [9, 10]. Unfortunately, patients receiving chemotherapy also had advanced staging or severe comorbidities, which resulted in higher reported financial toxicity [16, 17]. At present, adjuvant chemotherapy for colorectal cancer usually lasts 3–6 months with various chemotherapy regimens. Although China government continues to expand the proportion of medical insurance reimbursement for anticancer drugs, patients are still in financial difficulties due to high treatment costs.

In our study, lack of high levels of social support was another factor associated with financial toxicity in the colorectal cancer population. The finding of our study is consistent with the previous result [29]. Nearly one-third of patients with colorectal cancer had decreased levels of social support after diagnosis and treatment [39], and only 14% of participants in this study had high levels of social support. Because of the fear of burdening others, patients avoid communication and contact with informal caregivers, exacerbating their loneliness [11]. A sound social support system could relieve negative emotions such as anxiety and depression. Non-professional caregivers can provide practical material support to patients reducing the overall economic burden. At the same time, it is recommended to increase the communication between oncologists and patients and nurses and patients. Discussion of medical costs is an integral part of high-quality life. Through cost communication, individuals can understand their economic status to seek extensive support from all walks of life.

It is indisputable that the Chinese government has been committed to providing support for patients. China has established a comprehensive medical insurance system through the deepening reform of the health system since 2009 and the Healthy China 2030 Plan [14]. To narrow the diversities in per capita premiums and capital sources, the government set up the outpatient serious disease system to increase the reimbursement rate and reimbursement ceiling for medical expenses. In addition, an urban and rural critical illness insurance system was also established to break the cycle of poverty by preventing the low-income group from being pushed into poverty due to high medical costs [36, 50]. To reduce the economic burden of cancer patients, China continues to expand the coverage of targeted drugs included in medical insurance. Four new colorectal cancer targeted drugs, including cetuximab and bevacizumab, were approved in 2021. However, patients still face enormous financial pressure because of the uneven distribution of health resources and increasing medical costs. In the future, multiple and multifaceted supportive measures should be implemented for colorectal cancer patients.

Limitations

There are several limitations regarding the generalizability of our study. Firstly, it was a single-centered study design, and we recruited a relatively small number of study subjects. Our research was conducted in a large tertiary hospital in a coastal city. The socio-economic level of the region is significantly higher than the average level. Further studies with multi-center, larger-sample, and universal coverage of areas with economic representation are needed to validate our findings. Secondly, the cross-sectional study design restricts any causal inference. Long-term financial toxicity is not assessed in patients with colorectal cancer after the end of treatment. Future prospective longitudinal studies are needed to investigate the financial toxicity profile of cancer survivors during their cancer experiences. However, we believe this finding contributes to the ongoing debate on factors associated with financial toxicity in cancer patients. This study's results supply insights for further exploration of determinants for financial toxicity in colorectal cancer patients.

Conclusions

In our study, financial toxicity affects at least half of survivors with stage I–III colorectal cancer. Young age, lower annual household income, unemployment, chemotherapy, and insufficient social support were associated with financial toxicity. We will conduct large-scale prospective surveys to assess the financial toxicity of colorectal cancer patients and design targeted interventions to solve the patients' financial toxicity. It is essential to strengthen the clinical discussion of costs by popularizing cost-related health literacy among cancer survivors and oncologists.

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Data availability The datasets generated during and analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval This study was performed in line with the principles of the Declaration of Helsinki. The Ethics Committee of the Affiliated Hospital of Qingdao University approved this study (NO. QYFYWZLL25862).

Consent to participate Informed consent was obtained from all individual participants included in the study.

Consent for publication The authors affirm that human research participants provided informed consent for the publication of the images in Table(s) 1, 2, and 3.

Competing interests The authors declare no competing interests.

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