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RESEARCH

Financial toxicity assessment and associated factors analysis of patients with cancer in China

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Abstract

Purpose Cancer-related expenditures present a lasting economic burden on patients and their families and may exert long-term adverse effects on the patients' life and quality of life. In this study, the comprehensive score for financial toxicity (COST) was used to investigate the financial toxicity (FT) levels and related risk factors in Chinese patients with cancer.

Methods Quantitative data were collected through a questionnaire covering three aspects: sociodemographic information, economic and behavioral cost-coping strategies, and the COST scale. Univariate and multivariate analyses were performed to identify factors associated with FT.

Results According to 594 completed questionnaires, the COST score ranged 0–41, with a median of 18 (mean±SD, 17.98±7.978). Over 80% of patients with cancer reported at least moderate FT (COST score <26). A multivariate model showed that urban residents, coverage by other health insurance policies, and higher household income and consumption expenditures were significantly associated with higher COST scores, indicative of lower FT. The middle-aged (45–59 years old), higher out-of-pocket (OOP) medication expenditures and hospitalizations, borrowed money, and forgone treatment were all significantly associated with lower COST scores, indicating higher FT.

Conclusion Severe FT was associated with sociodemographic factors among Chinese patients with cancer, family financial factors, and economic and behavioral cost-coping strategies. Government should identify and manage the patients with high-risk characteristics of FT and work out better health policies for them.

Keywords China · Patients with cancer · Financial toxicity · COST scale · Associated factors

Introduction

The economic burden of cancer is staggering across the globe, with cancer-related medication expenditures rising from $96 billion in 2016 to $164 billion in 2020 [1]. It not only brings heavy pressure on governments and society but also makes the families of patients with cancer face huge financial challenges. To describe the financial impact experienced by patients as a consequence of a disease and its related treatments, the concept of FT was introduced in 2009 [2, 3]. FT covers the objective financial hardship and subjective financial concerns related to cancer care [4]. The word "toxicity" is used to emphasize the financial cost of cancer treatment that can result in clinically relevant issues mimicking the physical and psychological toxicities of cancer treatment [3]. FT in patients with cancer has been studied extensively in both developed and developing countries [5, 6]. A consensus has been reached that the experience of cancer care-related FT is subject to multidimensional factors, including sociodemographic factors (e.g., age, gender), socioeconomic status (e.g., income, employment), and disease or treatment-related factors (e.g., other complications, cancer stage) [6, 7]. Several payer and policy-level factors, such as health insurance and medical assistance programs, also affect the FT experienced by patients with cancer [6, 8, 9].

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FT in patients with cancer is actually aggravating [10]. It was estimated that approximately 40–70% of patients with cancer would suffer from FT [11]. It exerts far-reaching impacts on the quality of life, adherence to treatment, and survival of patients with cancer, and the future prospects of the affected families [12]. China, the biggest developing country in the world, is also suffering from an immense cancer burden [13]. In 2020, a study involving 185 countries around the world found that China's age-standardized incidence rate (204.8 per 100,000) ranked 65th and the age-standardized mortality rate (129.4 per 100,000) was ranked 13th, and the two rates were above the global average [14]. While improving treatments can effectively prolong life and improve the quality of life of patients with cancer, they and their families in China are bearing a significant economic burden as cancer incidence is expected to increase, even in settings with universal health coverage (the Basic Medical Insurance for Urban and Rural Residents [BMIURR] and the Rural Residents and the Basic Medical Insurance for Urban Employees [BMIUE]) [15]. There were few studies specifically examining the FT experienced by patients with cancer in China [16]. Meanwhile, globally diverse medical insurance systems exert substantially different influences on FT, and, as a result, the research results of other countries cannot be fully applied to China. Therefore, our study aimed to further look into the FT of patients with cancer in China and to determine the association between sociodemographic factors, family financial status, and other diseases with FT. Moreover, we analyzed the financial and behavioral cost-coping strategies of patients with cancer in response to FT, including economic behavioral changes and medication non-compliance [11]. Understanding these factors can not only identify and screen patients with high-risk characteristics of FT, conduct risk management, and reduce the possibility of FT, but also understand their needs, and will shed light on policy suggestions for further optimizing medical insurance policies.

Materials and methods

Data sources

Z is a coastal city in southern China and ranked number 10 in terms of GDP per capita in Chinese cities in 2020. Since the restructuring of the medical insurance system in 1998, Z has been taking the lead by establishing a multi-level medical insurance system that covers the entire population. By November 2020, the number of people covered by basic medical insurance had reached 2.095 million.

From July to August 2021, with the assistance of local medical security institutions and public hospitals, we selected subjects from the database of patients with cancer in Z by completely random sampling. Given the probability of missing rate and the impact of COVID-19 on our study, we only targeted patients who were included in the database after December 2020, according to a ratio of 1:1.5, 600 patients who visited public hospitals were expected to enroll for a telephone follow-up survey.

To raise patient response rates, we used the fixed-line telephone of local medical security institutions and trained investigators in the data collection from patients with cancer via oral questionnaires. The questionnaires were eliminated if the subjects declined to be interviewed, failed to pass the logical check, and had incomplete answers. Two investigators inputted and checked the questionnaires. Our study was approved by the Ethics Committee of Tongji Medical College of Huazhong University of Science and Technology, Wuhan, China.

Measures

The questionnaire for data collection contained three components: sociodemographic data, economic and behavioral cost-coping strategies, and the COST scale.

The first part, i.e., the sociodemographic survey, mainly focused on sociodemographic factors, as specified in the research report, that affects the existence of FT [6]. The items involved demographic characteristics (e.g., household registration, age, gender), family financial status (e.g., total household income, OOP medication expenditures), other concomitant diseases, and hospitalizations (e.g., chronic diseases and times of hospital stays).

The second part, that is, the economic and behavioral cost-coping strategies involved the economic and behavioral coping measures taken by patients with cancer in response to FT [11]. Economic cost-coping strategies were measured by patients' responses to the question "Have you borrowed money for cancer treatment?". Behavioral cost-coping strategies, which were collectively referred to as medication non-compliance, were measured by patients' answers to the questions "Have you given up cancer treatment because of financial difficulties?" [11]. Patients indicated whether they had used any of these cost-coping strategies over the previous 1 year[2]. Different levels of economic and behavioral cost-coping strategies were found to be closely related to the severity of FT and also to exert an impact on patients' survival and quality of life [17–19].

The third part, namely, the COST scale, which was developed by de Souza et al., was designed to garner data on cancer survivors' experiences that could not be obtained by data collection or observations made by others [6]. The method is currently the most commonly used validated instrument to measure FT in patients with cancer and has been extensively used worldwide [20, 21]. The COST scale consists of 11 questions related to cost of services and medications,

resources and savings, and financial concerns [19]. The items are rated on a 5-point scale by using the Likert 5 of "Not at all (0) to"Very much (4)"[19]. Since each item scores from 0 to 4, the total COST score ranges from 0 to 44, with a lower score indicating a greater degree of FT [18]. The COST scale has been translated into Chinese, and relevant researchers tested the Chinese version and confirmed that the Chinese version possessed high reliability and validity, and exhibited good internal consistency [22, 23].

Statistical analysis

We first performed a descriptive statistics on different data types of demographic characteristics (mean, median, SD, percentage, 25th and 75th percentiles) to analyze the demographic characteristics. The association between FT and the collected factors was assessed by using univariate analysis (independent-sample *t* test, analysis of variance and Kruskal-Wallis test). Factors with a $p<0.05$ from the univariate analysis were included in a full model, and multivariate analysis was performed by employing a linear regression model to identify influencing factors associated with COST scores. We used EpiData 3.0 software package for questionnaire input and inspection, and IBM SPSS Statistics 25 for statistical analysis. *P* values less than 0.05 were considered to be statistically significant.

Results

This survey eventually collected 618 questionnaires, of which 594 were valid, with an effective rate of 96.12%. The COST scores of FT in this study ranged from 0 to 41, with a median of 18.00 and mean ± SD being 17.98±7.978. Table 1 shows the sociodemographic characteristics of all patients with cancer interviewed. Among the interviewees, 403 urban residents (67.8%) scored a higher median COST score (20.00) than their rural counterparts (15.00). The people on BMIURR were more (51.5%), and 453 patients (76.3%) were not covered by other health insurance policies, and their median COST score (17.00) was lower than that of patients who were on other health insurance policies (21.00). Univariate analysis revealed the differences in household registration type, age, employment status, and types of basic medical insurance and whether or not being on other health insurance policies was significant, with $\alpha=0.05$.

According to the Table 2, in the past year, the respondents' total household income was more concentrated between ¥50,000 and ¥100,000 (33.7%), and the consumption expenditures stood somewhere between ¥20,000 and ¥50,000 (33.7%). Two hundred ten (35.4%) and 298 (50.2%) patients reported the loss of job (working hours) due to cancer and OOP medication expenditures, respectively. The loss of job and OOP medication expenditures were more in the range of ¥10,000–¥50,000 (14.5%, 22.9%), and the median COST score decreased with the increase of the loss of job and OOP medication expenditures, indicating that the higher the job loss rate and OOP medication expenditures, the lower the COST score, and the more severe the FT in patients with cancer. Univariate analysis showed that household income, consumption expenditures, loss of job, and OOP medication expenditures were significantly different, with $\alpha=0.05$.

One hundred fifty-four (25.9%) patients with cancer reported presence of other chronic diseases (Table 3). In the past year, most patients (52.9%) had been hospitalized for cancer less than three times. One hundred twenty-eight patients (21.5%) had borrowed money from friends or other sources, and their median COST score was lower than other counterparts (12.50 vs 20.00). Thirty-four patients (5.7%) gave up treatment due to financial difficulties, and their COST score was lower (11.00 vs 19.00) than other counterparts (Table 4). The univariate analysis demonstrated that the economic and behavioral cost-coping strategies were found to be related to the COST score.

In the multivariate model, we adjusted the potential confounding variables and found that patients' sociodemographic factors, family financial status, chronic diseases and hospitalization, and economic and behavioral cost-coping strategies were significantly correlated with COST scores (Table 5). Urban residents (β 1.833, *95% CI* 0.660–3.007, *P* 0.002), coverage by other health insurance policies (β 2.012, *95% CI* 0.718–3.306, *P* 0.002), higher household income (β 2.268, *95% CI* 0.866–3.671, *P* 0.002), and consumption expenditures (β 1.806, *95% CI* 0.061–3.551, *P* 0.043) were significantly associated with higher COST scores, indicating lower FT. The middle-aged (β −1.368, *95% CI* −2.465–0.270, *P* 0.015), higher OOP medication expenditures (β −5.137, *95% CI* −6.904–3.369, *P* <0.001) and hospitalizations (β −1.766, *95% CI* −3.161–0.371, *P* 0.013), borrowed money (β −4.068, *95% CI* −5.447–2.689, *P* <0.001), and forgone treatment (β −4.817, *95% CI* −7.176–2.458, *P* <0.001) were significantly associated with lower COST scores, representing higher FT.

Discussion

The purpose of this study was to assess the severity of FT in Chinese patients with cancer and to analyze the factors that influence FT and economic and behavioral cost-coping strategies that will help tailor treatment options and develop or work out appropriate policies to address this issue of FT [24]. Our study was unique because the subjects were patients with cancer not from a single center or patients with a single disease; it is possible to reduce the potential

Table 1 The sociodemographic characteristics of all patients with cancer and the results of univariate analysis of the COST score

Variables	$n = 594$ (%)	Mean COST score ± SD or median (P_{25}, P_{75})	*Statistics (t/F/H value)*	*P*
Household registration type			4.766	<0.001
Rural residents	191 (32.2%)	15.00 (11.00, 22.00)		
Urban residents	403 (67.8%)	20.00 (14.00, 24.00)		
Gender			0.299	0.765
Male	274 (46.1%)	19.00 (12.00, 23.00)		
Female	320 (53.9%)	18.00 (13.00, 23.00)		
Age			13.106	0.001
<45 years old	149 (25.1%)	19.00 (13.00, 26.00)		
45–59 years old	253 (42.6%)	17.00 (12.00, 22.00)		
≥60 years old	192 (32.3%)	20.00 (14.00, 23.00)		
Marriage status			0.014	0.989
Single and others	31 (5.2%)	17.00 (12.00, 25.00)		
Married	563 (94.8%)	18.00 (13.00, 23.00)		
Years of education			0.860	0.462
0–6 years	125 (21.0%)	17.25 ± 7.594		
7–9 years	179 (30.1%)	17.91 ± 8.073		
10–12 years	158 (26.6%)	17.94 ± 7.666		
More than 12 years	132 (22.2%)	18.83 ± 8.562		
Employment status			21.723	<0.001
Unemployed and others	183 (30.8%)	15.00 (11.00, 21.00)		
Retired	226 (38.0%)	20.00 (14.00, 23.00)		
Employed	185 (31.1%)	20.00 (14.00, 24.00)		
*Types of basic medical insurance**			2.254	0.025
BMIURR	306 (51.5%)	17.27 ± 7.586		
BMIUE	288 (48.5%)	18.74 ± 8.320		
*Whether or not covered by other health insurances^*			5.417	<0.001
No	453 (76.3%)	17.00 (12.00, 22.00)		
Yes	141 (23.7%)	21.00 (16.00, 27.50)		

**BMIUE*, the Basic Medical Insurance for Urban Employees; *BMIURR*, the Basic Medical Insurance for Urban and Rural Residents.

^Other health insurance policies refer to the medical insurance policies complementary to the basic medical insurance, including commercial medical insurance and community medical insurance and other policies.

sampling bias to a certain extent. And our sample size was larger than other comparable prior studies conducted in China, which could be helpful to have more power for extrapolation of the conclusion.

The patients in this study registered a median COST score of 18, more than 80% of patients with cancer reported at least moderate FT (COST score <26 [11]), and nearly one-third of them suffered from severe FT (COST score <14 [11]), lower than the 25.5 and 22.5 reported by other Chinese scholars [19, 25]. Although previous studies focused on patients in a single center and with a single disease type, they also demonstrated very serious FT experienced by patients with cancer in China, and the incidence of FT was found to be higher than that of other developing countries [10, 26, 27]. Other related studies have found that characteristics such as rural residents [28], female [29], younger age [7, 19], unemployment [4, 11], marriage [27, 30], lower educational level [11, 31], and lower income [4, 10, 19, 30] were associated with higher FT, but our results revealed that FT was independent of gender [31], marital status [26], and education [17]. Sociodemographic differences in FT were reflected in household residence type [27], medical insurance policies [4, 7, 32], and OOP medication expenditures which are consistent with existing studies, confirming that demographic risk factors are extensive.

A prior study has found that rural patients preferred tertiary hospitals in cities for a better quality of care, so compared with urban patients, rural patients tend to bear a heavier financial burden due to increased indirect non-medical

Table 2 The family financial situation of all patients with cancer and univariate analysis of the COST score

Variables	*n*=594 (%)	Mean COST score ± SD or median (P_{25}, P_{75})	*Statistics (t/F/H value)*	*P*
Total household income in the past year (CNY)			20.168	<0.001
[¥0, ¥20,000]	93 (15.7%)	17.69 ± 8.197		
(¥20,000, ¥50,000]	135 (22.7%)	14.70 ± 7.820		
(¥50,000, ¥100,000]	200 (33.7%)	17.47 ± 7.672		
More than ¥100,000	166 (27.9%)	21.45 ± 7.025		
*Household consumption expenditures in the past year (CNY)^*			9.915	<0.001
[¥0, ¥20,000]	155 (26.1%)	17.28 ± 8.297		
(¥20,000, ¥50,000]	200 (33.7%)	16.74 ± 7.504		
(¥50,000, ¥100,000]	159 (26.8%)	18.11 ± 7.803		
More than ¥100,000	80 (13.5%)	22.20±7.553		
Loss of job due to cancer in the past year (CNY)§			19.182	<0.001
Not available	384 (64.6%)	19.00 (13.00, 23.00)		
[¥0, ¥10,000]	64 (10.8%)	21.00 (15.00, 23.75)		
(¥10,000, ¥50,000]	86 (14.5%)	16.00 (12.75, 20.25)		
More than ¥50,000	60 (10.1%)	13.00 (11.00, 20.50)		
OOP medication expenditures in the past year (CNY)¶			48.855	<0.001
Not available	296 (49.8%)	20.00 (14.25, 24.00)		
[¥0, ¥10,000]	93 (15.7%)	20.00 (14.50, 25.50)		
(¥10,000, ¥50,000]	136 (22.9%)	16.00 (11.25, 22.00)		
More than ¥50,000	69 (11.6%)	12.00 (7.50, 16.50)		

^The household consumption expenditure refers to the total expenditure of the household for daily life in the past year, including the purchase of goods and cultural life, services, and other non-commodity expenditures

§Loss of job due to cancer we consider in this study as the product of normal working hours lost due to the impact of cancer and average salary in the past year

¶OOP medication expenditures refer to medication-related expenditures not covered by basic medical insurance

expenses, such as commuting and accommodation [25, 33]. This is especially true of rural patients who are unemployed, retired, or had lower incomes and are more likely to show higher FT [12]. In addition, we have found that middle-aged people have higher FT than younger people. It may be the middle-aged face raising children and the double pressure of supporting the elderly, so the subjective reflection of FT is more serious.

Table 3 Hospitalization and chronic diseases of all patients with cancer and univariate analysis of the COST score

Variables	*n*=594 (%)	Mean COST score ± SD or median (P_{25}, P_{75})	*Statistics (t/F/H value)*	*P*
*Do you have any chronic diseases ?^*			0.926	0.355
No	440 (74.1%)	17.81 ± 8.049		
Yes	154 (25.9%)	18.49 ± 7.776		
How many times have you been hospitalized for cancer in the past year?			24.541	<0.001
0–3	314 (52.9%)	20.06 ± 7.930		
4–7	141 (23.7%)	15.34 ± 7.147		
8 and more	139 (23.4%)	15.98 ± 7.622		

^If the same disease was diagnosed more than once by the doctor, it was counted as one time.

Table 4 The economic and behavioral cost-coping strategies for all patients with cancer and univariate analysis of the COST score

Variables	*n*=594 (%)	Mean COST score ± SD or median (P_{25}, P_{75})	*Statistics (t/F/H value)*	*P*
Have you borrowed money for cancer treatment in the past year?			8.765	<0.001
No	466 (78.5%)	20.00 (14.75, 24.00)		
Yes	128 (21.5%)	12.50 (8.00, 17.00)		
Do you have given up cancer treatment because of financial difficulties in the past year?			5.076	<0.001
No	560 (94.3%)	19.00 (13.00, 23.00)		
Yes	34 (5.7%)	11.00 (6.00, 16.25)		

Catastrophic health expenditure (CHE) occurs more frequently in low-income households, with patients from low-income households being up to six times more likely to incur CHE than patients from high-income households, which was consistent with some previous findings [34]. The Chinese government has now achieved universal medical insurance coverage, and the expanded insurance coverage has made health services more accessible to most people. But the breadth of coverage and the level of reimbursement remain comparably insufficient, and the gain provided by universal health insurance coverage has been offset by the higher expenditure resulting from higher-quality healthcare services [35]. The average reimbursement rate of basic medical insurance is about 50–70% [36]. This finding further indicates that the basic medical insurance system is insufficient for patients with cancer, and the government-sponsored social insurance systems alone cannot serve to provide more inclusive and higher-level health protection for low-income groups or rural families [37]. China has established a multilevel medical insurance system, in which supplementary medical insurance policies, such as serious diseases insurance and commercial health insurance, are important supplements and extensions of basic medical insurance [38], which will help increase the family's ability to afford the cost of cancer treatment [39]. However, the coverage rate of the supplementary medical insurance in China remains relatively low, especially in rural regions. Their awareness of health risk prevention is poor, and they do not understand how the supplementary medical insurance works and its importance. At the same time, facing a great many commercial health insurance policies and mind-boggling protection clauses, less-educated rural residents have difficulties choosing the policies right for them.

High OOP expenditures may cause poor adherence to treatments with potentially adverse clinical outcomes and catastrophic financial effects and may cause treatment withdrawal in up to 32 % of patients [40, 41]. Our study also confirmed that OOP medical expenditures of patients with cancer were incident drivers of FT, multiple hospitalizations increase OOP medical expenses, and higher OOP resulted in more severe FT. Medication expenditures account for a large portion of OOP expenditures. Previous studies have shown that health insurance has no mitigating effect on the OOP expenditures on outpatient medications, and there are differences between BMIUE and BMIURR in OOP expenditures for inpatient treatment [42]. Under the current scheme, patients have to rely on inpatient services for reimbursable medications, so increased hospitalizations and OOP expenditures on medications are significant contributors to severe FT in patients with cancer and also lead to already-overcrowded hospitals being overwhelmed [42].

It is noteworthy that some patients with cancer with high FT employed a wide array of cost-coping strategies in response to the higher financial stress, ranging from financially taking a loan to behaviorally quitting treatment [21, 23, 31]. Our data (Table 5) showed that borrowing and treatment abandonment were negatively correlated with FT. However, our study did not address more common strategies, such as cutting spending on food, clothing, or leisure to cope with FT [18]. Multiple studies have shown that FT is associated with treatment interruption, poor medication compliance, and denial of needed care [18, 43], and respondents with high FT were seven times more likely to delay or abandon treatment due to financial constraints [10], ultimately resulting in unfavorable survival and quality of life [2, 36].

Based on our analysis, we recommend that medical health insurance coverage should be extended to outpatient services, especially medications. And the Chinese government should strengthen the publicity of supplementary medical insurance and further regulate the growth of commercial health insurance in the country, including tax credits that should be encouraged to increase supplemental supplementary medical insurance coverage. Meanwhile, relevant departments should identify and prevent patients with high-risk FT characteristics, conduct risk management and dynamic monitoring for them, and reduce the possibility of FT among poor families.

This study was subject to some limitations. First, there was a large gap in the treatment costs among malignancies of different stages, and late-stage patients may have higher

Table 5 Factors associated with COST scores on multivariate analysis

Variables	*β*	*P*	*95% CI*
Household registration type			
Rural residents			
Urban residents	1.833	0.002	0.660–3.007
Age			
<45 years old			
45–60 years old	−1.368	0.015	−2.465–0.270
≥60 years old	−0.306	0.742	−2.136–1.523
Employment status			
Unemployed and others			
Retired	−0.059	0.943	−1.658–1.541
Employed	0.241	0.760	−1.304–1.786
Types of basic medical insurance			
BMIURR			
BMIUE	1.113	0.059	−0.043–2.269
Whether or not covered by other health insurance			
No			
Yes	2.012	0.002	0.718–3.306
Total household income in the past year (CNY)			
[¥0, ¥20,000]			
(¥20,000, ¥50,000]	−1.925	0.007	−3.319–0.532
(¥50,000, ¥100,000]	0.008	0.994	−1.920–1.936
More than ¥100,000	2.268	0.002	0.866–3.671
Household consumption expenditures in the past year (CNY)			
[¥0, ¥20,000]			
(¥20,000, ¥50,000]	1.404	0.080	−0.171–2.979
(¥50,000, ¥100,000]	2.021	0.023	0.275–3.767
More than ¥100,000	1.806	0.043	0.061–3.551
Loss of job due to cancer in the past year (CNY)			
Not available			
[¥0, ¥10,000]	0.131	0.898	−1.870–2.131
(¥10,000, ¥50,000]	−0.044	0.962	−1.842–1.755
More than ¥50,000	−1.741	0.095	−3.788–0.306
OOP medication expenditures in the past year(CNY)			
Not available			
[¥0, ¥10,000]	−0.112	0.888	−1.679–1.455
(¥10,000, ¥50,000]	−1.761	0.010	−3.105–0.417
More than ¥50,000	−5.137	<0.001	−6.904–3.369
How many times have you been hospitalized for cancer in the past year?			
0–3			
4–7	−2.525	<0.001	−3.895–1.154
8 and more	−1.766	0.013	−3.161–0.371
Have you borrowed money for cancer treatment in the past year?			
No			
Yes	−4.068	<0.001	−5.447–2.689
Do you have given up treatment because of financial difficulties?			
No			
Yes	−4.817	<0.001	−7.176–2.458

FT due to longer treatment time [19, 26, 44]. Since we did not select patients in terms of the duration of their systemic therapy, we may have underestimated the impact of FT in our cohort. Second, while we chose the representative cities in China, and the data are all from the whole municipal level, it is still a single-center study, and further consideration is needed to extend our findings to other countries or regions. And the last, given patients were recruited if they were added to the database after December 2020, this is worth further research to explore as the financial impact of the COVID-19 pandemic may influence or confound results.

Conclusion

Our study found that severe FT was associated with sociodemographic factors among Chinese patients with cancer, family financial factors, and economic and behavioral cost-coping strategies. These findings should prompt the government to identify and manage the patients with high-risk characteristics of FT and further strengthen the improvement and optimization of relevant health policies for patients with cancer.

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Data Availability Restrictions apply to the availability of these data.

Declarations

Ethics approval This study was approved by the Ethics Committee of Tongji Medical College of Huazhong University of Science and Technology, Wuhan, China (No. S050).

Competing interests The authors declare no competing interests.

References

1. Global Oncology Trends (2021) Outlook to 2025. IQVIA Institute for Human Data Science pp 2, 48
2. de Souza JA, Yap BJ, Hlubocky FJ et al (2014) The development of a financial toxicity patient-reported outcome in cancer: The COST measure. Cancer 120:3245–3253. https://doi.org/10.1002/cncr.28814
3. O'Connor JM, Kircher SM, de Souza JA (2016) Financial toxicity in cancer care. J Community Support Oncol 14:101–106. 10.12788/jcso.0239
4. Bouberhan S, Shea M, Kennedy A et al (2019) Financial toxicity in gynecologic oncology. Gynecol Oncol 154:8–12. https://doi.org/10.1016/j.ygyno.2019.04.003
5. Longo CJ, Fitch MI, Banfield L et al (2020) Financial toxicity associated with a cancer diagnosis in publicly funded healthcare countries: a systematic review. Support Care Cancer 28:4645–4665. https://doi.org/10.1007/s00520-020-05620-9
6. Xu B, Hu L, Cheng Q et al (2022) A systematic review of financial toxicity among cancer patients in China. Asia Pac J Oncol Nurs 9:100071. https://doi.org/10.1016/j.apjon.2022.04.010
7. Smith GL, Lopez-Olivo MA, Advani PG et al (2019) Financial burdens of cancer treatment: a systematic review of risk factors and outcomes. J Natl Compr Canc Netw 17:1184–1192. https://doi.org/10.6004/jnccn.2019.7305
8. Yabroff KR, Bradley C, CT SY (2020) Understanding financial hardship among cancer survivors in the United States: strategies for prevention and mitigation. J Clin Oncol 38:292–301. https://doi.org/10.1200/JCO.19.01564
9. Hong YR, Salloum RG, Yadav S et al (2020) Patient-provider discussion about cancer treatment costs and out-of-pocket spending: implications for shared decision making in cancer care. Value Health 23:1592–1598. https://doi.org/10.1016/j.jval.2020.08.002
10. Susilowati M, Afiyanti Y (2021) The socio-demographic factors correlated with financial toxicity among patients with breast cancer in Indonesia. J Public Health Res 10:jphr.2021.2403. https://doi.org/10.4081/jphr.2021.2403
11. Esselen KM, Gompers A, Hacker MR et al (2021) Evaluating meaningful levels of financial toxicity in gynecologic cancers. Int J Gynecol Cancer 31:801–806. https://doi.org/10.1136/ijgc-2021-002475
12. Bhoo-Pathy N, Ng CW, Lim GC et al (2019) Financial toxicity after cancer in a setting with universal health coverage: a call for urgent action. J Oncol Pract 15:e537–e546. https://doi.org/10.1200/JOP.18.00619
13. Qiu H, Cao S, Xu R (2021) Cancer incidence, mortality, and burden in China: a time-trend analysis and comparison with the United States and United Kingdom based on the global epidemiological data released in 2020. Cancer Commun (Lond) 41:1037–1048. https://doi.org/10.1002/cac2.12197
14. Cao W, Chen HD, Yu YW et al (2021) Changing profiles of cancer burden worldwide and in China: a secondary analysis of the global cancer statistics 2020. Chin Med J (Engl) 134:783–791. https://doi.org/10.1097/CM9.0000000000001474
15. Su M, Lao J, Zhang N et al (2020) Financial hardship in Chinese cancer survivors. Cancer 126:3312–3321. https://doi.org/10.1002/cncr.32943
16. Yu H, Li H, Zuo T et al (2022) Financial toxicity and psychological distress in adults with cancer: a treatment-based analysis. Asia Pac J Oncol Nurs. 9(9):100069. https://doi.org/10.1016/j.apjon.2022.04.008
17. Aviki EM, Thom B, Braxton K et al (2022) Patient-reported benefit from proposed interventions to reduce financial toxicity during cancer treatment. Support Care Cancer 30:2713–2721. https://doi.org/10.1007/s00520-021-06697-6
18. Honda K, Gyawali B, Ando M et al (2019) Prospective survey of financial toxicity measured by the comprehensive score for financial toxicity in Japanese patients with cancer. J Glob Oncol 5:1–8. https://doi.org/10.1200/JGO.19.00003
19. Jing J, Feng R, Zhang X et al (2020) Financial toxicity and its associated patient and cancer factors among women with breast cancer: a single-center analysis of low-middle income region in China. Breast Cancer Res Treat 181:435–443. https://doi.org/10.1007/s10549-020-05632-3

20. Witte J, Mehlis K, Surmann B et al (2019) Methods for measuring financial toxicity after cancer diagnosis and treatment: a systematic review and its implications. Ann Oncol 30:1061–1070. https://doi.org/10.1093/annonc/mdz140
21. Zhu Z, Xing W, Lizarondo L et al (2020) Psychometric properties of selfreported financial toxicity measures in cancer survivors: a systematic review protocol using COSMIN methodology. BMJ Open 10:e036365. https://doi.org/10.1136/bmjopen-2019-036365
22. Yu HH, Bi X, Liu YY (2017) Reliability and validity of the Chinese version on comprehensive scores for financial toxicity based on the patient-reported outcome measures. Zhonghua Liu Xing Bing Xue Za Zhi 38:1118–1120. https://doi.org/10.3760/cma.j.issn.0254-6450.2017.08.024
23. Yu HH, Yu ZF, Li H et al (2021) The comprehensive score for financial toxicity in China: validation and responsiveness. J Pain Symptom Manage 61:1297–1304.e1. https://doi.org/10.1016/j.jpainsymman.2020.12.021
24. Aranda S, Currow D (2016) Financial toxicity in clinical care today: a "menu without prices". Med J Aust 205:529–530. https://doi.org/10.5694/mja16.00960
25. Xu T, Xu L, Xi H et al (2022) Assessment of financial toxicity among patients with advanced lung cancer in Western China. Front Public Health 9:754199. https://doi.org/10.3389/fpubh.2021.754199
26. Ngan TT, Van Minh H, Donnelly M et al (2021) Financial toxicity due to breast cancer treatment in low- and middle-income countries: evidence from Vietnam. Support Care Cancer 29:6325–6333. https://doi.org/10.1007/s00520-021-06210-z
27. Mejri N, Berrazega Y, Boujnah R et al (2021) Assessing the financial toxicity in Tunisian cancer patients using the comprehensive score for financial toxicity (COST). Support Care Cancer 29:4105–4111. https://doi.org/10.1007/s00520-020-05944-6
28. Skrabal Ross X, Gunn KM, Olver I (2021) Understanding the strategies rural cancer patients and survivors use to manage financial toxicity and the broader implications on their lives. Support Care Cancer 29:5487–5496. https://doi.org/10.1007/s00520-021-06086-z
29. Gordon LG, Merollini KMD, Lowe A et al (2017) A systematic review of financial toxicity among cancer survivors: we can't pay the co-pay. Patient 10:295–309. https://doi.org/10.1007/s40271-016-0204-x
30. Huntington SF, Weiss BM, Vogl DT et al (2015) Financial toxicity in insured patients with multiple myeloma: a cross-sectional pilot study. Lancet Haematol 2:e408–e416. https://doi.org/10.1016/S2352-3026(15)00151-9
31. McLean L, Hong W, McLachlan SA (2021) Financial toxicity in patients with cancer attending a public Australian tertiary hospital: a pilot study. Asia Pac J Clin Oncol 17:245–252. https://doi.org/10.1111/ajco.13448
32. Carrera PM, Kantarjian HM, Blinder VS (2018) The financial burden and distress of patients with cancer: understanding and stepping-up action on the financial toxicity of cancer treatment. CA Cancer J Clin 68:153–165. https://doi.org/10.3322/caac.21443
33. Newton JC, Johnson CE, Hohnen H et al (2018) Out-of-pocket expenses experienced by rural Western Australians diagnosed with cancer. Support Care Cancer 26:3543–3552. https://doi.org/10.1007/s00520-018-4205-2
34. Kim S, Kwon S (2015) Impact of the policy of expanding benefit coverage for cancer patients on catastrophic health expenditure across different income groups in South Korea. Soc Sci Med 138:241–247. https://doi.org/10.1016/j.socscimed.2015.06.012
35. Wang N, Gao W, Ma M et al (2021) The medical insurance system's weakness to provide economic protection for vulnerable citizens in China: a five-year longitudinal study. Arch Gerontol Geriatr 92:104227. https://doi.org/10.1016/j.archger.2020.104227
36. Yuan B, Li J, Wu L et al (2019) Multi-level social health insurance system in the age of frequent employment change: the urban unemployment-induced insurance transition and healthcare utilization in China. Healthcare (Basel) 7:77. https://doi.org/10.3390/healthcare7020077
37. Su CW, Sun TZ (2021) Does institutional quality and remittances inflow crowd-in private investment to avoid Dutch disease? A case for emerging seven (E7) economies. Shabbir Ahmad Nawazish Mirza Resour Policy 22:24–32
38. Ma Y, Liu Z, Shen S (2020) Public-private or master-servant? Examining the implementation of the serious disease insurance scheme in China. Int J Environ Res Public Health 17:1490. https://doi.org/10.3390/ijerph17051490
39. Zhou Y, Cai S, Jin M et al (2020) Economic burden for retinoblastoma patients in China. J Med Econ 23:1553–1557. https://doi.org/10.1080/13696998.2020.1831518
40. Doshi JA, Li P, Huo H et al (2018) Association of patient out-of-pocket costs with prescription abandonment and delay in fills of novel oral anticancer agents. J Clin Oncol 36:476–482. https://doi.org/10.1200/JCO.2017.74.5091
41. Bordonaro R, Piazza D, Sergi C et al (2021) Out-of-pocket costs in gastrointestinal cancer patients: lack of a perfectly framed problem contributing to financial toxicity. Crit Rev Oncol Hematol 167:103501. https://doi.org/10.1016/j.critrevonc.2021.103501
42. Zhang A, Nikoloski Z, Mossialos E (2017) Does health insurance reduce out-of-pocket expenditure? Heterogeneity among China's middle-aged and elderly. Soc Sci Med 190:11–19. https://doi.org/10.1016/j.socscimed.2017.08.005
43. Zheng Z, Han X, Guy GP Jr et al (2017) Do cancer survivors change their prescription drug use for financial reasons? Findings from a nationally representative sample in the United States. Cancer 123:1453–1463. https://doi.org/10.1002/cncr.30560
44. Sun L, Legood R, Dos-Santos-Silva I et al (2018) Global treatment costs of breast cancer by stage: a systematic review. PLoS One 13:e0207993. https://doi.org/10.1371/journal.pone.0207993