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Original Article

Financial toxicity and its risk factors among patients with cancer in China: A nationwide multisite study

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ABSTRACT

Objective: We assessed financial toxicity (FT) among Chinese patients with cancer and investigated associated risk factors guided by a multilevel conceptual framework.

Methods: Applying multistage stratified sampling, we selected six tertiary and six secondary hospitals across three economically diverse provinces in China. From February to October 2022, 1208 patients with cancer participated. FT was measured using the COmprehensive Score for financial Toxicity (COST), with 28 potential risk factors identified at multilevel. Multiple regression analysis was used for risk factor identification.

Results: FT prevalence was 82.6% (95% confidence interval [CI]: 80.5%, 84.8%), with high FT (COST score ≤ 18.5) observed in 40.9% of participants (95% CI: 38.1%, 43.7%). Significant risk factors included younger age at cancer diagnosis, unmarried status, low annual household income, negative impact of cancer on participants' or family caregiver's work, advanced cancer stage, longer hospital stay for cancer treatment or treatment-related side effects, high perceived stress, poor emotional/informational support, lack of social medical insurance or having urban and rural resident basic medical insurance, lack of commercial medical insurance, tertiary hospital treatment, and inadequate cost discussions with healthcare providers (all $P < 0.05$).

Conclusions: Cancer-related FT is prevalent in China, contributing to disparities in cancer care access and health-related outcomes. The risk factors associated with cancer-related FT encompasses multilevel, including patient/family, provider/practice, and payer/policy levels. There is an urgent need for collective efforts by patients, healthcare providers, policymakers, and insurers to safeguard the financial security and well-being of individuals affected by cancer, promoting health equities in the realm of cancer care.

Introduction

While advances in cancer screening and treatment have improved survival times,[1] the rising costs of anti-cancer therapies have raised concerns about access to care, the quality of care, and the overall well-being in diverse healthcare systems such as those in China.[2] In China, despite a publicly funded healthcare system with almost universal access to medical insurance, residents with cancer face significant health-related financial challenges. Although more than 95% of Chinese residents are covered by Urban Employee Basic Medical Insurance (UEBMI) or Urban and Rural Resident Basic Medical Insurance (URRBMI) plans,[3] a significant out-of-pocket (OOP) health expenditure burden remains. In 2020, the total health expenditure reached 7217.5 billion Chinese yuan (CNY), of which individual OOP health expenditure comprised 27.7%.[4] This financial burden is attributed to the limits of basic insurance, which only covers government-stipulated expenses for

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medicines, diagnoses, and treatments.[5,6] In 2019, hospitalization reimbursement rates under UEBMI and URRBMI were 75.6% and 59.7%, respectively.[3] Many expensive targeted anti-cancer drugs are excluded from the National Reimbursement Drug List,[7] resulting in lower reimbursement rates for cancer treatment costs (58%) than for other chronic-disease treatment costs (64%–70%).[8]

Financial toxicity (FT), the adverse impact of cancer care costs on patients and their families,[9–11] has become a critical consideration in comprehensive cancer care. Previous studies have demonstrated that FTs pose challenges to patients' financial security, hinder access to treatment, and impact the overall well-being and survival, resulting in health inequity among populations affected by cancer.[9,12,13]

Several recent studies have investigated the prevalence of cancer-related FT in China and analyzed associated factors to facilitate the development of relevant interventions and policies. The prevalence of FT among Chinese patients with cancer is 61%–84%.[9] Studies conducted in one or a few tertiary hospitals within a province have identified factors associated with FT,[14–21] including income, age, health insurance status, employment status, post-cancer employment changes, educational level, place of residence, cancer stage, treatment plan, and social support. Another study conducted in two tertiary hospitals across two provinces identified urban–rural differences in FT,[22] and an association between enhanced eHealth literacy and a low risk of FT was reported.[23] Nationwide, two studies covering 843 and 664 patients with cancer from 33 tertiary hospitals in 31 provinces of China identified some factors influencing FT,[24,25] such as income, cancer stage, health status, sex, educational level, age, employment status, targeted therapy, household size, and geographical location.

Although these studies offer valuable insights into the factors influencing cancer-related FT in China, most of these investigations were conducted in one or a few tertiary hospitals within a province. Although two studies included 33 hospitals across 31 provinces, the exclusive use of tertiary hospitals introduced biases and hampered the generalizability of the findings to the broader cancer population. Moreover, none of the studies applied conceptual frameworks to guide the selection of potential risk factors, which may have hindered a complete understanding of the risk factors.

To address these gaps, our study assessed the prevalence of FT among Chinese patients with cancer, using multistage stratified sampling to enhance sample representativeness. Moreover, we systematically investigated potential risk factors associated with FT among patients with cancer, guided by a conceptual framework summarizing the multilevel risk factors.[26,27] This framework identified factors at various levels, namely patients and families, providers and care teams, organization and practice settings, insurers and payers, state and national policies, and employers (Fig. 1). Patient- and family-level factors comprised demographics, socioeconomic status, and clinical elements. Provider- and practice-level considerations comprised financial navigators and provider–patient communication on cancer care costs. Insurer- and payer-level factors involved payment models and benefit design. Employer-level factors, including health insurance availability and coverage options, are crucial for employed cancer patients. State and national policies, such as the Affordable Care Act, are also relevant. While the model[26,27] includes employer-level risk factors due to reliance on private insurance, our study in the context of China's publicly financed health care excluded employer-level factors.

The selection of potential risk factors was guided by this conceptual framework and was informed by (1) our systematic review[9] and (2) additional risk factors identified in studies of other populations that may apply to the Chinese population.[28–31] Using these criteria, 28 factors were included in the analyses (Table 1). The study findings may provide a reference for developing targeted interventions and policies to alleviate

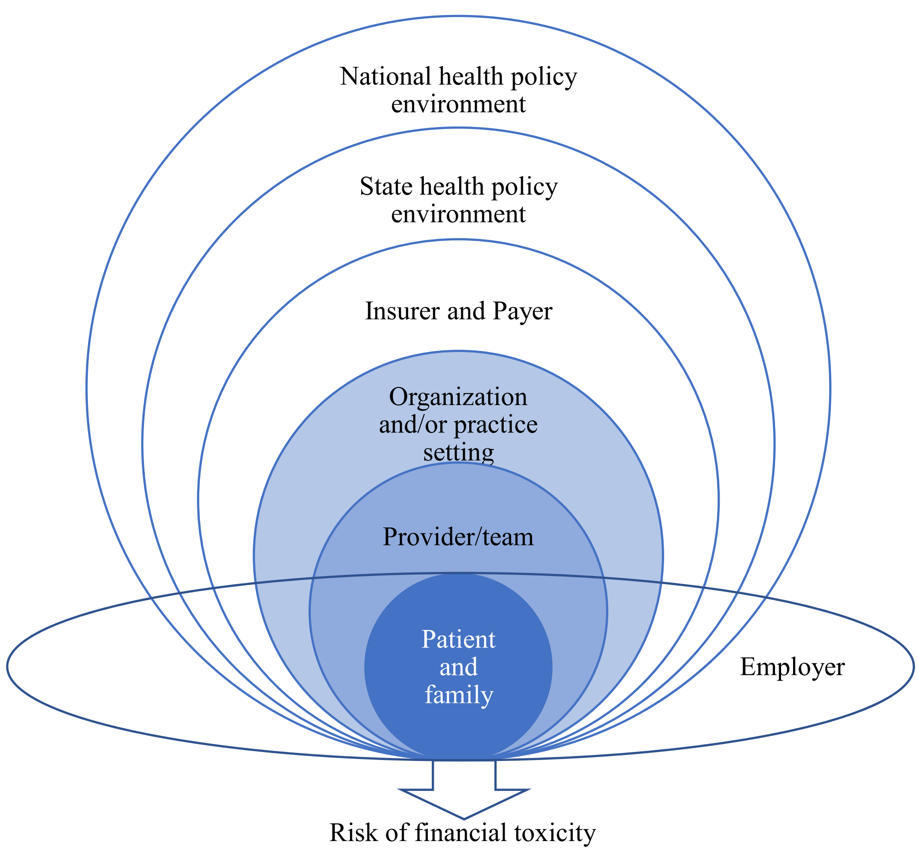

Fig. 1. Factors at multiple levels associated with financial toxicity.[26,27]

Table 1
Potential risk factors associated with financial toxicity included for analysis.

Level	Variable	
Patient level and family level	**Social demographic factors**	• Age at cancer diagnosis • Gender • Marital status • Residence • Travelling time from residence to hospital • Household size • Number of the elderly (aged 65 years and above) in the family
	Socioeconomic status	• Annual household income • Educational level • Employment status before cancer diagnosis • Patients' negative employment changes due to cancer • Family caregivers' negative employment changes due to patients' cancer
	Disease or treatment-related factors	• Cancer site • Cancer stage • Duration since cancer diagnosis • Treatment received • Length of hospital stay for cancer treatment or treatment-related side effects • Cancer recurrence • Comorbidities that need self-management
	Social support	• Emotional/informational support • Tangible support • Affectionate support • Positive social interaction
	Perceived stress	
Provider level and practice level	**Healthcare provider–patient discussion regarding cancer care costs**	
	Level of the hospital that provides treatment	
Payer level and policy level	**Social medical insurance**	
	Commercial medical insurance	

cancer-related FT in China and other countries/regions with similar healthcare systems and healthcare coverage, thus contributing to the enhanced accessibility and quality of cancer care, ultimately promoting health equities in the realm of cancer treatment.

Methods

Study design and setting

We conducted a nationwide multisite cross-sectional study in in-patient wards admitting patients with cancer in six tertiary and six secondary hospitals in three Chinese provinces from February to October 2022.

Participants

Patients were included if they were diagnosed with cancer at any site and stage, were aged 18 or older at the time of cancer diagnosis, were actively undergoing anticancer treatment for at least 2 months (or had completed initial treatment), were capable of communicating in Mandarin, and were able to comprehend the survey. Patients were excluded if they had multiple primary cancers, were receiving hospice care, were participating in treatment clinical trial, refused participation, or their family members concealed their cancer diagnosis.

Sample size

The present study was a sub-study of a main study examining factors associated with FT and quality of life and a mediation model relating quality of life and FT in patients with cancer. The sample-size determination of the main study was documented in a PhD thesis.[32] The target sample size was 1200, which is adequate to estimate the prevalence of FT with a margin of error of $\leq$ 2.8% at a significance level of 5% and to identify factors associated with FT with effect sizes as small as $f^2 = 0.0088$, with 90% power, at a significance level of 5% using multiple regression. These parameters are expected to well meet the analysis requirements of the present study. Power analyses were conducted using PASS 16 (NCSS, Kaysville, UT, USA).

Multistage stratified sampling

The stratified sampling involved four stages (Fig. 2). In stage one, three provinces were randomly selected from 27 provinces or equivalent administrative units, with each representing a high-, middle-, or low-income region. In stage two, two cities in each selected province were randomly chosen to represent high- and low-income cities. In stage three, one tertiary hospital and one secondary hospital were randomly selected from each of the six chosen cities. In stage four, participants were recruited from each selected hospital through convenience sampling, with a target of 200 participants from each of the six cities. Given that tertiary hospitals typically serve approximately five times the number of patients as secondary hospitals,[4] we aimed to recruit convenience samples of 167 and 33 participants, respectively, from each tertiary and secondary hospital.

Variables and measures

Dependent variable: FT

FT was measured using the simplified Chinese version of the COmprehensive Score for financial Toxicity (COST),[33] which comprises 12 items, with item 12 as a screening item. The prevalence of FT is calculated as the proportion of participants choosing "a little bit," "somewhat," "quite a bit," or "very much" for this item. The remaining 11 items are scored on a 5-point Likert scale ranging from 0 (not at all) to 4 (very much), reflecting experiences over the past 7 days. The total score ranges from 0 to 44, with lower scores indicating more severe FT. A cut-off score of 18.5 was used to categorize FT into two levels: high FT (COST score $\leq$ 18.5) and low FT (COST score $>$ 18.5).[34] A high FT could predict cost-related treatment nonadherence and impaired quality of life.[34] The Chinese version of the COST exhibited good internal consistency in our study (Cronbach's $\alpha = 0.809$).

Independent variables outlined in Table 1

Social support was examined using the simplified Chinese version of the Medical Outcomes Study Social Support Survey (MOS–SSS–C),[35] comprising 19 items measuring emotional/informational support, tangible support, affectionate support, and positive social interaction. Participants rate the frequency of support received since their cancer diagnosis on a 5-point scale (1–5). Dimension and overall scores were calculated by averaging item scores and converting them using the formula: converted score = (observed score − minimum possible score)/(maximum possible score − minimum possible score) × 100. Scores range from 0 to 100, with higher scores indicating increased support. The MOS–SSS–C demonstrates good internal consistency in our study, with Cronbach's α values for the dimensions and overall scale ranging from 0.781 to 0.953.

Perceived stress was assessed using the simplified Chinese version of the Perceived Stress Scale (CPSS),[36] comprising 14 items assessing the perception of life as unpredictable, unmanageable, or stressful over the past month. Participants' responses are rated on a 5-point scale (0–4), yielding a total score ranging from 0 to 56, with higher scores indicating increased perceived stress. The CPSS exhibited good internal consistency in our study (Cronbach's $\alpha = 0.911$).

Healthcare provider–patient discussion regarding cancer care costs was assessed by asking participants if any healthcare provider had

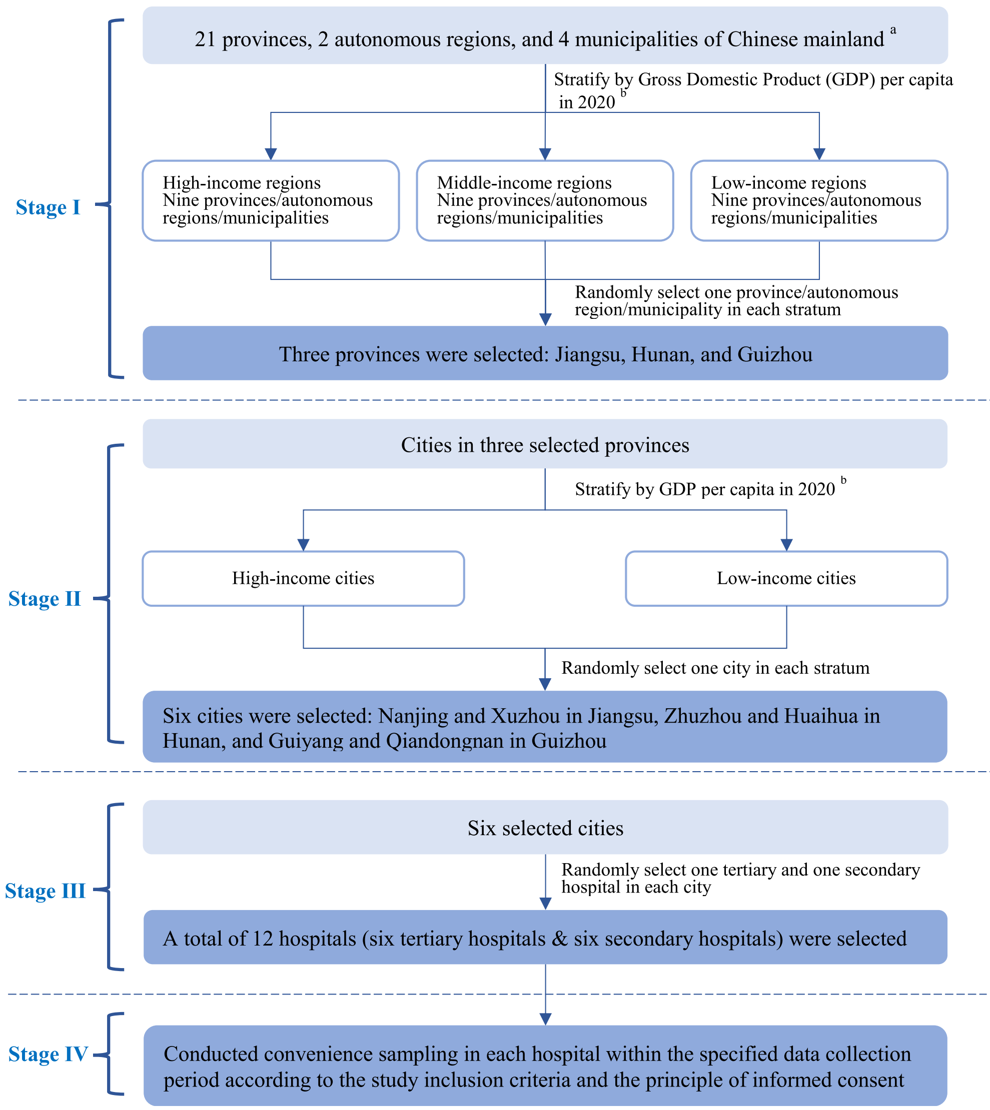

Fig. 2. Design of multistage stratified sampling. a. The Chinese mainland comprises 31 provincial-level divisions: 22 provinces, 5 autonomous regions, and 4 municipalities. However, only 27 province-level divisions were included for sampling because Xinjiang, Tibet, Inner Mongolia, and Qinghai were excluded due to their remote location, high altitude, vast geographical area, complex terrain, and small population. b. GDP per capita data were obtained from the Statistical Yearbooks of National Bureau of Statistics and the Bureau of Statistics of corresponding provinces. GDP, gross domestic product.

discussed the OOP costs of cancer care.[37] Response options comprised “discussed in detail”, “briefly discussed”, “did not discuss”, or “I don't remember”. Participants choosing “discussed in detail” were categorized as having an adequate discussion; those with any other response were classified as not having an adequate discussion.[37]

The level of hospital where participants were recruited was recorded by the data collectors, and other independent variables were collected using a self-designed questionnaire.

Data collection procedures

The principal investigator sought approval and support from nursing department directors in the selected hospitals before data collection. Data were collected in cancer-admitting in-patient wards by the principal investigators and trained data collectors. A face-to-face electronic questionnaire was administered via a quick-response code, which the participants scanned to complete the questionnaire on their smartphones; the participants were provided an iPad if needed. After reviewing the questionnaire, the participants were provided the option to complete it independently or receive verbal assistance from trained data collectors. Those who preferred assistance had questions read aloud to them and received support with response marking. To mitigate potential proxy-completion bias, the data collectors received consistent training in articulating clear and neutral questions while avoiding leading or suggestive language. A pilot test was conducted before the main survey to identify and address issues related to bias, question comprehension, and wording. A “Do not know” option was available for some disease/treatment information. If the participants selected this option, after obtaining their consent, the data collectors entrusted the department nurse with reviewing the medical records to obtain the necessary information. The participants received a small gift worth approximately 20 CNY (i.e., a towel and a pack of masks) as appreciation for their participation after completing the study.

Data analysis

Data analysis was conducted using SPSS 23.0 (IBM Corp., Armonk, NY, USA). Categorical data are presented as frequencies and percentages, and normally distributed continuous variables as means and standard deviations (SDs). The normality of continuous variables was assessed using skewness and kurtosis statistics, with absolute values ≤ 2 and ≤ 7, respectively, considered acceptable.[38] Backward multiple regression was conducted to identify risk factors associated with participants' total COST score, with a removal criterion of a P value > 0.05. Variables with a P value < 0.25 in a univariate analysis of the total COST score were chosen as candidate-independent variables for the backward multiple regression analysis.[39] Dummy variables were set for independent multi-categorical variables before entering them into the regression analysis. All tests were two-sided with a significance level of 0.05.

Ethical considerations

This study received approval from the Survey and Behavioral Research Ethics Committee, the Chinese University of Hong Kong (IRB No. SBRE-21-0403), and written informed consent was obtained from all participants.

Results

Recruitment results and participant characteristics

We approached 1602 potentially eligible participants, of whom 1242 agreed to participate, and 1208 completed the survey (response rate: 97.3%) (Fig. 3). Thirty-four participants dropped out of the study without submitting the electronic questionnaire, citing reasons such as feeling tired and unwilling to continue ($n = 20$), needing to leave for an examination ($n = 8$), and the arrival of visitors ($n = 6$).

Our cohort had a mean age of 53.53 years (SD = 11.74) at cancer diagnosis and a balanced sex distribution (51.3% male). The most common diagnosis was lung cancer (22.0%), 50.7% had advanced cancer, and 78.9% had been diagnosed with cancer within the past 2 years. Almost all participants (99.4%) were covered by social medical insurance. The mean perceived stress score was 25.75 (SD = 8.78), and mean scores for emotional/informational support, tangible support, affectionate support, and positive social interaction were 60.37 ± 16.41, 71.63 ± 16.85, 67.34 ± 15.50, and 63.77 ± 18.10, respectively. The participants' characteristics are presented in Table 2.

Financial toxicity

The mean COST score among participants was 20.53 (SD = 6.70). The prevalence of FT was 82.6% (95% confidence interval [CI]: 80.5%, 84.8%). Notably, 40.9% of participants reported high FT (i.e., COST score ≤ 18.5) (95% CI: 38.1%, 43.7%).

Risk factors associated with FT

Table 2 presents 23 candidate-independent variables (i.e., $P < 0.25$ in the univariate analyses) for the multivariate analysis. Backward multiple regression revealed that younger age at cancer diagnosis, unmarried status, low annual household income, negative impact of cancer on participants' or family caregiver's work, advanced cancer stage, long hospital stay for cancer treatment or treatment-related side-effects, inadequate cost discussions with healthcare providers, tertiary hospital treatment, lack of social medical insurance or having URRBMI, lack of commercial medical insurance, high perceived stress, and low emotional/informational support were associated with FT (Table 3). These variables explained 39.4% of the total variance in participants' COST scores ($R^2 = 0.394$, $F = 55.3$, $P < 0.001$). No considerable multicollinearity existed among the independent variables as all variance inflation factor values were below 5. The normality of the residuals was confirmed through a histogram and P–P plot (see Appendix A).

The age at cancer diagnosis was positively associated with COST scores, with each additional year resulting in a 0.034-point increase ($P = 0.019$), indicating less severe FT. Unmarried participants ($B = -1.159$, $P = 0.029$) or those with an annual household income of 70,000 CNY or less ($B = -2.591$, $P < 0.001$) had lower average COST scores (i.e., more severe FT) than their counterparts who were married or had an annual household income of more than 70,000 CNY. COST scores were also lower for those whose cancer diagnosis negatively impacted their employment status ($B = -2.702$, $P < 0.001$) or their family caregivers' work ($B = -1.085$, $P = 0.001$) than for their unaffected counterparts. Participants with stage IV cancer ($B = -0.945$, $P = 0.003$) or with hospital stays longer than 65 days ($B = -1.826$, $P < 0.001$) exhibited lower COST scores than their counterparts with stage I/II/III cancer or with hospital stays not exceeding 65 days, respectively.

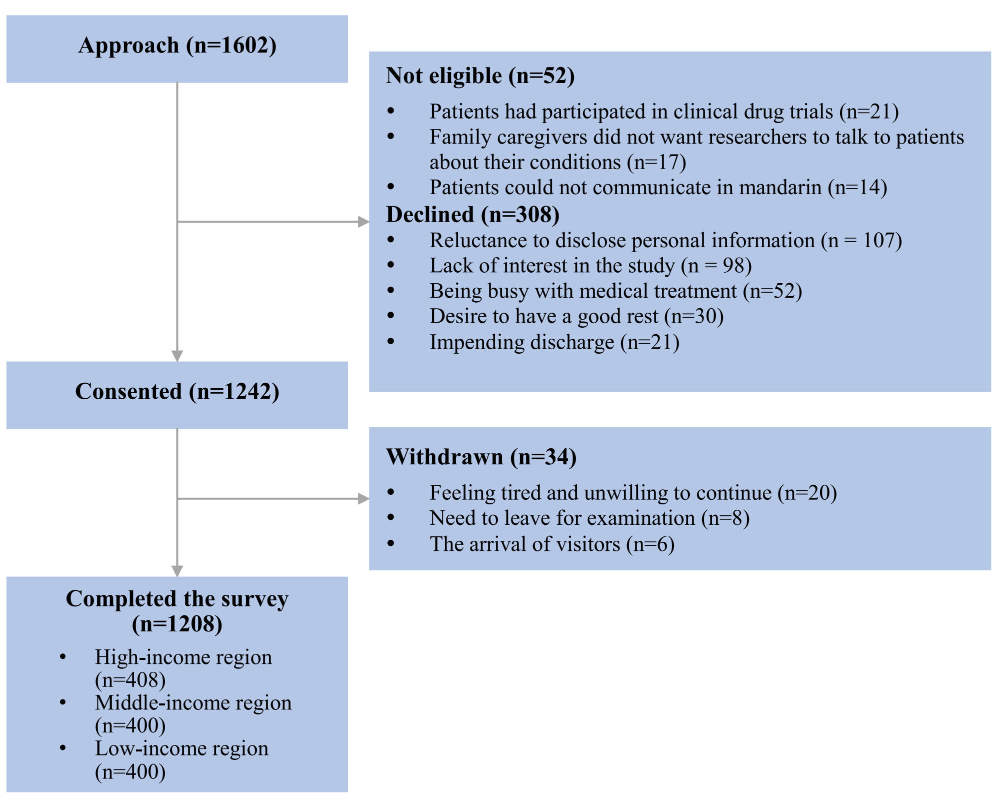

Fig. 3. Participants recruitment results.

Table 2
Participants characteristics and univariate analyses of the association between financial toxicity and those characteristics ($N = 1208$).

Characteristics	*n* (%)	COST score, Mean (SD)	*t/t'/F/H/r*	*P*-value
***Hospital level**			$t' = -4.149$	< 0.001
Tertiary hospital	1008 (83.4)	20.22 (6.85)		
Secondary hospital	200 (16.6)	22.11 (5.67)		
***Age at cancer diagnosis (years)** [mean = 53.53, SD = 11.74]	–	–	$r = 0.130$	< 0.001
Gender			$t = 0.357$	0.721
Female	588 (48.7)	20.60 (6.52)		
Male	620 (51.3)	20.47 (6.88)		
***Marital status**			$t = 4.382$	< 0.001
Married	1093 (90.5)	20.81 (6.62)		
Single/divorced/widowed	115 (9.5)	17.95 (6.98)		
***Residence**			$t' = -10.394$	< 0.001
Rural area	695 (57.5)	18.86 (6.18)		
Urban area	513 (42.5)	22.80 (6.73)		
***Travel time from residence to treating hospital (hours)**			$t' = 7.299$	< 0.001
≤ 1.50	742 (61.4)	21.60 (6.87)		
> 1.50	466 (38.6)	18.84 (6.06)		
***Household size**			$t' = 3.074$	0.002
1–3	448 (37.1)	21.32 (7.12)		
≥ 4	760 (62.9)	20.07 (6.40)		
Having elderlies in the family			$t = 0.757$	0.449
No	572 (47.4)	20.69 (6.77)		
Yes	636 (52.6)	20.39 (6.65)		
***Annual household income (Chinese yuan)**			$t = -14.067$	< 0.001
≤ 70,000	646 (53.5)	18.19 (6.11)		
> 70,000	562 (46.5)	23.23 (6.34)		
***Educational level**			$H = 94.896$	< 0.001
Primary school or below	373 (30.9)	18.46 (5.84)		
Middle school (junior or senior) or technical secondary school	617 (51.1)	20.53 (6.55)		
Junior college or above	218 (18.0)	24.08 (7.03)		
Employment status before cancer diagnosis[a]			$H = 157.064$	< 0.001
Employed	508 (42.1)	20.63 (6.71)		
Farmer	314 (26.0)	17.18 (5.20)		
Unemployed	143 (11.8)	21.41 (6.01)		
Retired	243 (20.1)	24.15 (6.74)		
***The negative influence of cancer on patients' work**			$t = 9.536$	< 0.001
No	386 (32.0)	23.12 (6.61)		
Yes	822 (68.0)	19.32 (6.39)		
***The negative influence of cancer on caregivers' work**			$t' = 7.727$	< 0.001
No	452 (37.4)	22.46 (6.96)		
Yes	756 (62.6)	19.38 (6.27)		
***Cancer site**			$F = 2.999$	0.004
Lung	266 (22.0)	20.58 (6.80)		
Colorectal	174 (14.4)	20.62 (7.21)		
Head and neck	168 (13.9)	19.66 (6.77)		
Breast	149 (12.3)	22.07 (6.56)		
Gastrointestinal (excluding colorectal)	148 (12.3)	20.07 (6.69)		
Gynecological	130 (10.8)	19.08 (6.04)		
Hematological	94 (7.8)	21.68 (5.85)		
Others[b]	79 (6.5)	21.04 (6.74)		
***Cancer stage**			$H = 24.234$	< 0.001
I/II/III	564 (46.7)	21.45 (6.49)		
IV	613 (50.7)	19.58 (6.67)		
Unknown	31 (2.6)	22.77 (8.34)		
Cancer course (years)			$t = 0.462$	0.644
≤ 2	953 (78.9)	20.58 (6.67)		
> 2	255 (21.1)	20.36 (6.82)		
***Treatment received**			$t = 1.403$	0.161
Single therapy	134 (11.1)	21.30 (6.88)		
Combination therapy	1074 (88.9)	20.44 (6.68)		
***Length of hospital stay for cancer treatment or treatment-related side effects (days)**			$t' = 6.045$	< 0.001
≤ 65	626 (51.8)	21.64 (6.88)		
> 65	582 (48.2)	19.35 (6.30)		

(continued on next page)

Table 2 (*continued*)

Characteristics	*n* (%)	COST score, Mean (SD)	*t*/*t*'/*F*/*H*/*r*	*P*-value
***Cancer recurrence**			$t = 2.766$	0.006
No	981 (81.2)	20.79 (6.73)		
Yes	227 (18.8)	19.43 (6.47)		
Comorbidities			$t = 0.054$	0.957
No	752 (62.3)	20.54 (6.67)		
Yes	456 (37.7)	20.52 (6.77)		
***Social medical insurance**			$t' = -13.614$	< 0.001
No social medical insurance/ Urban and rural resident basic medical insurance[c]	699 (57.9)	18.42 (5.98)		
Urban employee basic medical insurance	509 (42.1)	23.43 (6.55)		
***Commercial medical insurance**			$t' = -5.556$	< 0.001
No	1035 (85.7)	20.04 (6.39)		
Yes	173 (14.3)	23.48 (7.71)		
***Adequate cost discussions with health providers**			$t = -7.061$	< 0.001
No	763 (63.2)	19.51 (6.63)		
Yes	445 (36.8)	22.28 (6.46)		
***Perceived stress** [mean = 25.75, SD = 8.78]	–	–	$r = -0.370$	< 0.001
***Emotional/informational support** [mean = 60.37, SD = 16.41]	–	–	$r = 0.291$	< 0.001
***Tangible support** [mean = 71.63, SD = 16.85]	–	–	$r = 0.179$	< 0.001
***Affectionate support** [mean = 67.34, SD = 15.50]	–	–	$r = 0.192$	< 0.001
***Positive social interaction** [mean = 63.77, SD = 18.10]	–	–	$r = 0.243$	< 0.001

COST, The COmprehensive Score for financial Toxicity; SD, standard deviation.
*Candidate-independent variable for multivariate analysis ($P < 0.25$ in univariate analyses).
[a] In the univariate analysis, 'employment status before cancer diagnosis' and 'the impact of cancer on the patient's employment status' were potential factors influencing FT ($P < 0.25$). However, there was a strong multicollinearity between both. The study primarily focused on the association between 'the impact of cancer on the patient's employment status' and FT. Therefore, 'employment status before cancer diagnoses' was excluded from the subsequent regression model.
[b] Other cancer types included brain/central nervous system cancer ($n = 20$), sarcoma ($n = 15$), prostate cancer ($n = 12$), bladder cancer ($n = 10$), kidney cancer ($n = 6$), skin cancer ($n = 6$), testicular cancer ($n = 3$), mesothelioma ($n = 2$), bone cancer ($n = 2$), ureteral cancer ($n = 1$), thymoma ($n = 1$), and melanoma of mucosal ($n = 1$).
[c] Among the 699 participants in this group, 7 did not have social medical insurance.

Participants who had inadequate cost discussions with healthcare providers ($B = -1.227$, $P < 0.001$) were treated in tertiary hospitals ($B = -1.598$, $P < 0.001$), lacked social medical insurance coverage or were covered by URRBMI ($B = -1.936$, $P < 0.001$), or lacked commercial medical insurance ($B = -1.503$, $P = 0.001$) had lower COST scores than their counterparts with adequate cost discussions with their healthcare providers, who were treated in secondary hospitals or were covered by UEBMI, or who had commercial medical insurance, respectively. Perceived stress level was negatively associated with the COST score, with a 1-point increase in perceived stress resulting in a 0.166-point decrease in COST score ($P < 0.001$). Conversely, the emotional/informational support level was positively associated with the COST score, with each additional support point resulting in a 0.042-point increase in the COST score ($P < 0.001$).

Discussion

Our study revealed a high prevalence of FT (82.6%; 95% CI: 80.5%, 84.8%) among Chinese patients with cancer, exceeding 51% reported in a meta-analysis that pooled data from 16 studies primarily conducted in developed countries.[40] This disparity highlights the impact of variations in healthcare systems, economic levels, and cultural backgrounds between developed and developing countries. It is crucial to acknowledge that China, as a developing country, faces unique challenges in its healthcare landscape. Additionally, our study observed a notable proportion of participants with high FT (40.9%; 95% CI: 38.1%, 43.7%), indicating a considerable portion of Chinese patients with cancer encountering challenges such as cost-related treatment nonadherence and impaired quality of life. Our findings emphasize the widespread prevalence of cancer-related FT within the Chinese cancer-patient population, contributing to discernible disparities in access to cancer care and ensuing health-related outcomes. The results underscore the need for early assessment of cancer-related FT in vulnerable patients and advocate for tailored policies and multidimensional interventions addressing the specific context of Chinese cancer patients.

Our study confirmed some previously reported risk factors for FT among patients with cancer,[6,9,14–21,24,25,29] including younger age at diagnosis, unmarried status, lower annual household income, negative impact of cancer on participants' and family caregiver's work, advanced cancer stage, longer hospital stay for cancer treatment or treatment-related side-effects, lack of social medical insurance or having URRBMI, and lack of commercial medical insurance.

A notable finding was that our study illustrated the negative impact of the perceived stress level on FT, which is consistent with previous findings in Western populations.[30] This association may be explained by stress and coping theory,[41,42] which states that extreme stress can rapidly deplete an individual's resources, resulting in physiological or psychological dysfunction. In our study, participants with elevated perceived stress scores probably experienced prolonged exposure to stressful environments over a 1-month period. This compromised their ability to

Table 3
Multiple linear regression on the risk factors associated with COST score ($N = 1208$).

	Unstandardized Coefficients		t	P-value	Collinearity statistics	
	B	SE			Tolerance	VIF
Constant	21.440	1.334	16.074	< 0.001		
Age at cancer diagnosis (years)	0.034	0.015	2.346	0.019	0.775	1.290
Marital status						
Married (reference)						
Single/divorced/widowed	−1.159	0.531	−2.181	0.029	0.939	1.065
Annual household income (Chinese yuan)						
> 70,000 (reference)						
≤ 70,000	−2.591	0.339	−7.637	< 0.001	0.796	1.256
Whether cancer affects patients' work						
No (reference)						
Yes	−2.702	0.380	−7.120	< 0.001	0.728	1.373
Whether cancer affects caregivers' work						
No (reference)						
Yes	−1.085	0.325	−3.336	0.001	0.921	1.085
Cancer stage						
I/II/III (reference)						
IV	−0.945	0.319	−2.961	0.003	0.896	1.116
Unknown	1.706	0.972	1.755	0.079	0.966	1.035
Length of hospital stay for cancer treatment or treatment-related side effects (days)						
≤ 65 (reference)						
> 65	−1.826	0.312	−5.843	< 0.001	0.936	1.069
Adequate cost discussions with health providers						
Yes (reference)						
No	−1.227	0.325	−3.777	< 0.001	0.928	1.077
Hospital level						
Secondary hospital (reference)						
Tertiary hospital	−1.598	0.418	−3.827	< 0.001	0.947	1.056
Social medical insurance						
UEBMI (reference)						
No social medical insurance/URRBMI	−1.936	0.354	−5.465	< 0.001	0.746	1.341
Commercial medical insurance						
Yes (reference)						
No	−1.503	0.448	−3.358	0.001	0.928	1.077
Perceived stress	−0.166	0.019	−8.923	< 0.001	0.854	1.171
Emotional/informational support	0.042	0.010	4.209	< 0.001	0.858	1.165

Final model: $R = 0.627$; $R^2 = 0.394$; *adjusted* $R^2 = 0.386$; $F = 55.310$; $P < 0.001$.
B, unstandardized regression coefficient; COST, The COmprehensive Score for financial Toxicity; SE, standard error of the unstandardized regression coefficient; UEBMI, urban employee basic medical insurance; URRBMI, urban and rural resident basic medical insurance; VIF, variance inflation factor.

cope with stressors, including financial challenges, contributing to more severe FT. This suggests that alleviating perceived stress may relieve the FT of cancer patients.

We also identified an association between severe FT and low emotional/informational support, marking a novel contribution to the field. Although studies have linked low social support with high FT,[20] we investigated specific domains of social support. Information support empowers cancer patients to make informed treatment decisions, enhancing their cost management and fostering a sense of control. Emotional support contributes to alleviating negative emotions related to cancer-care costs. Patients typically rely on family and friends as primary sources of social support.[43] However, family caregivers may lack the knowledge and skills to provide emotional and information support.[44] Healthcare providers, particularly nurses, play a vital role due to their continuous and close contact with patients.

Apart from patient-/family- and payer-/policy-level factors, our study identified two provider-/practice-level factors. Inadequate cost discussions with healthcare providers were associated with more severe FT than adequate discussions. Patient–healthcare provider discussions about treatment costs are crucial for shared clinical decision-making in cancer care.[37] Such discussions inform patients about available treatment options,[37,45] better preparing them emotionally and financially for substantial expenses, and helping them avoid low-value OOP costs.[46] The American Society of Clinical Oncology emphasizes that patient–clinician communication about cancer costs is crucial for high-quality care.[47] In the current Chinese context, cost discussions are primarily conducted by doctors and typically involve conversations with patients' family members rather than the patients themselves. These discussions occur in specific circumstances, such as before surgery or when self-funded medications are required. Notably, there are no official guidelines or standardized protocols governing cost discussions in China.[48] Specific details regarding when to initiate these discussions and the content to be covered have not been established.

Another provider-/practice-level factor was that more severe FT was observed among cancer patients treated in tertiary hospitals than in secondary hospitals, a novel finding in the Chinese context. The Chinese hierarchical medical system includes primary, secondary, and tertiary medical institutions. Discrepancies in reimbursement rates, with higher-level hospitals having lower rates,[9] may contribute to increased FT in tertiary settings. Despite lower reimbursement rates, patients often prefer tertiary hospitals due to the experienced staff and advanced equipment, leading to overcrowding[49] and potentially reducing the ability and willingness of staff to communicate with patients due to time constraints.[50] A lack of communication between patients and healthcare providers may also contribute to increased FT for patients treated in tertiary hospitals.

Implications for nursing practice and research

This study's findings call for targeted actions and collaborative interventions. Policymakers are urged to enhance health insurance benefits, especially for individuals under the URRBMI program, acknowledging their financial constraints and reliance on public support. In clinical practice, doctors play a crucial role in minimizing patients' FT by optimizing hospital stays without compromising treatment, and nurses are pivotal in evaluating and addressing patients' support needs.

Unified efforts are essential among governments, healthcare institutions, non-governmental organizations, educational institutions, and healthcare providers to promote early cancer diagnosis through awareness campaigns, accessible screening programs, and educational initiatives. Collaboration is needed among policymakers, employers, and healthcare providers to facilitate patients' return to work, particularly for younger individuals. Collaboration between the government, insurance companies, and regulatory authorities is crucial for developing commercial medical insurance. Promoting tiered diagnosis and treatment can potentially alleviate FT discrepancies between patients at tertiary and secondary hospitals,[51] but this would require more government investment in secondary hospitals to strengthen their cancer diagnosis and treatment capacities and technical and talent support from tertiary hospitals.

Our findings also have implications for future research. Future studies addressing FT could consider components focused on managing perceived stress. This holistic approach recognizes the inter-relationship between psychological well-being and FT, offering a comprehensive strategy to enhance the overall quality of life of individuals undergoing cancer treatment. Moreover, future research should explore facilitating cancer patients' return to work. Additionally, contributing to the knowledge base on the optimal timing, content, duration, mode, and providers of cancer-care cost discussions is crucial. This will enable the development of high-quality cost discussions tailored to the unique needs of Chinese cancer patients.

Limitations

Several limitations of this study must be acknowledged. First, the cross-sectional design did not allow the assessment of causal relationships, emphasizing the need for well-designed longitudinal studies. Second, the use of patient-reported outcome data potentially introduced recall bias. Finally, four hard-to-access regions were excluded from our sampling frame; the findings may not be generalizable to such remote regions of China.

Conclusions

This study illuminates the widespread prevalence of FT among Chinese patients with cancer, contributing to discernible disparities in access to cancer care and subsequent health-related outcomes. The risk factors associated with cancer-related FT encompasses multiple levels, including patient/family, provider/practice, and payer/policy levels. These findings prompt a critical call to action for targeted interventions and policies. There is an urgent need for collective efforts by patients, healthcare providers, policymakers, and insurers to safeguard the financial security and well-being of individuals undergoing cancer treatment in China, ultimately promoting health equities in the realm of cancer treatment.

Ethics statement

The study was approved by the Survey and Behavioral Research Ethics Committee, the Chinese University of Hong Kong (IRB No. SBRE-21-0403). All participants provided written informed consent.

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CRediT author contribution statement

Binbin Xu: Conceptualization, Methodology, Validation, Formal analysis, Investigation, Data curation, Writing – original draft, Writing – review and editing, Project administration. **Winnie K.W. So**: Conceptualization, Methodology, Validation, Writing – review and editing, Supervision. **Kai Chow Choi**: Conceptualization, Methodology, Validation, Formal analysis, Writing – review and editing. **Yu Huang, Mei Liu, Lanxiang Qiu, Jianghong Tan, Hua Tao, Keli Yan & Fei Yang**: Resources, Writing – review and editing. All authors have read and approved the final version of the article, and the corresponding author had final responsibility for the decision to submit for publication. The corresponding author attests that all listed authors meet authorship criteria and that no others meeting the criteria have been omitted.

Declaration of competing interest

All authors have no conflicts of interest to declare. The two authors, Professor Winnie K.W. So, and Dr. Kai Chow Choi, serve as the editorial board members of the *Asia-Pacific Journal of Oncology Nursing.* The article underwent the standard review procedures of the journal, with the peer review process managed independently from Professor So and their research groups.

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Data availability statement

The data that support the findings of this study are available on reasonable request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

Declaration of Generative AI and AI-assisted technologies in the writing process

No AI tools/services were used during the preparation of this work.

Appendix A. Supplementary data

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