



Predictors of self-perceived burden among patients with cancer in Hebei, China

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Abstract

Introduction Cancer is the leading cause of death worldwide. Both new cancer cases and deaths are rising annually. The high cost of cancer treatment and the guilt of being dependent on family members for a long time lead to patients with cancer's self-perceived burden (SPB). Previous studies have shown that different countries, populations, and cancer stages have different SPB levels. SPB is a psychological stressor, the high SPB may affect the medical treatment process and decision-making of patients with cancer, which may cause patients to refuse treatment and seriously cause suicidal ideation.

Objective This study aimed to determine the level of SPB and its predictors among patients with cancer in the Fourth Hospital of Hebei Medical University, China.

Methods A cross-sectional study of 977 patients with cancer was recruited by simple random sampling. A self-administered questionnaire was used. Multiple linear regression was used to investigate the predictors of SPB.

Results A total of 566 respondents participated in the study, with a response rate of 58.4%. A total of 88.0% had moderate to severe SPB. The mean $\pm$ standard deviation of SPB was 67.75 ± 15.69 . The predictors of SPB were parents as caregivers, siblings as caregivers, occupational status before illness, duration of cancer, impact of cancer on the patient's mobility, treatment of cancer (radiation and chemotherapy), type of cancer, stage of cancer, and coping strategies (confrontation, resignation, and fantasy).

Conclusion The prevalence of SPB is considered high, therefore, healthcare professionals should pay high attention to reducing the SPB of patients with cancer in clinical nursing work. It is recommended that effective intervention measures be implemented to lower the suicide rate among patients with cancer ultimately.

Keywords Cancer · Self-perceived burden · Predictors · Social support · Coping strategies

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Introduction

Cancer is a significant disease that endangers human health all over the world. In recent years, with the development of global industrialization and the aggravation of human environmental pollution, the prevalence of cancer has been increasing [1]. The 2020 World Cancer Report indicated that there were approximately 19.3 million new cancer cases and around 10 million cancer-related deaths globally. Furthermore, the rate of increase in cancer cases in developing countries, ranging from 64 to 95%, was nearly twice as high as that in developed countries, which ranged from 32 to 56% [2]. Beyond all doubt, the morbidity and mortality of cancer are so high that it not only threatens the lives of patients with cancer but also causes tremendous pressure on the psychology of patients with cancer [3]. Moreover, cancer is a DNA disease [4]. Cancer has unique characteristics that can vary even in different regions of the same tumor [5]. Thus, cancer requires long-term treatment, with patients undergoing surgery, chemotherapy, radiation, and other therapies [6, 7]. In a long course of treatment, patients have to suffer from the side effects of treatment, bear high medical costs, and rely on family care, which leads to patients with cancer's self-perceived burden (SPB) [8]. To be exact, SPB refers to the psychological dependence on the caretakers in terms of economy, care, emotion, and treatment, which leads to the patients' guilt, self-blame, and burden [9].

According to previous studies, patients with cancer in different countries, different populations, and different cancer stages have different SPB levels. For instance, a study on 69 advanced patients with cancer in Canada found that 39.1% had mild SPB meanwhile 38% had moderate or severe SPB [10]. A study in Malaysia found that out of 429 urinary patients with cancer, there was 73.2% of patients with cancer had high SPB [11]. A study of 120 patients with cancer in northern China showed that 87.5% had varying degrees of SPB [12]. A recent study in Anhui Province, China reported that 76.1% of lung patients with cancer undergoing chemotherapy had moderate to severe SPB burden [13]. Another study of 329 elderly patients with cancer in southern China showed that 82.2% had SPB of varying degrees and 66.1% had moderate to severe SPB levels [14].

During cancer treatment, many patients with cancer develop death desires or suicidal thoughts for fear of burdening their caregivers [15]. Among patients who wished to die, 58% to 94% thought they were a burden to others [16]. In China, patients with cancer accounted for the majority of hospitalized suicide patients, with an incidence of 21.6% [17].

Risk factors that have been identified in previous studies were age [18, 19], gender [19, 20], residence [21], marital status [22, 23], educational level [19, 20, 24], occupational status [12, 24, 25], household income [12, 22, 26], primary

caregivers group [24, 25], medical payment methods [12, 22], duration of cancer [22, 27], stages of cancer [18, 22], types of cancer [28], treatment methods [22, 27, 29] associated with the SPB of patients with cancer.

High SPB may lead to reduced quality of life, denial of treatment, and even suicide [30–32]. Identifying high-risk groups with high SPB can attract the attention of medical workers, improve the quality of life of patients, and reduce the incidence of suicide. Therefore, it is necessary to study SPB level and its predictors among patients with cancer.

Methods

Study population

In this study, patients with cancer in the Fourth Hospital of Hebei Medical University were selected by simple random sampling method from 8th March to 15th June 2022. Inclusion criteria were patients older than 18 who had been diagnosed with cancer and were conscious and able to answer questions on the questionnaire correctly. Exclusion criteria were hospitalized patients with cancer with cognitive impairment or mental illness and patients with cancer whose diagnosis was concealed by family members.

Two mean sample size formula was used to calculate the sample size of this study [33]. By using 5% error, 80% of power, SPB level among stage III patients (37.34 ± 4.60) and stage IV patients (38.73 ± 9.23) [22], 20% non-response rate, the total sample size for this study was 970.

In accordance with the Declaration of Helsinki, all participants received written and verbal information about the purpose and design of the study before participation. The study was approved by the ethics committees of Universiti Putra Malaysia (JKEUPM-2021–785) and the Fourth Hospital of Hebei Medical University (2022 K7250). Before data collection, informed consent was obtained from the respondents. In the data collection process, respondents were told that they had the right to quit at any time. Respondents could ask the researcher if they have doubts about the questionnaire. If the respondents had low literacy or were not able to read, the researcher could help them fill out the questionnaire. The entire interview lasted less than 30 min.

Study instrument

This questionnaire consists of four parts. Section A was general information of patients, section B was the Self-Perceived Burden Scale for Patients with cancer (SPBS-CP) [34], section C was the Social Support Rating Scale (SSRS) [35] and section D was the Cancer Coping Methods Questionnaire (CCMQ) [36].

Section A: General information of the respondent There were 25 items included sociodemographic characteristics (age, gender, residence, marital status, number of children, educational level, current occupational status, occupational status before illness, personal income, household income, medical payment method, caregiver, number of caregivers, primary caregiver, age of primary caregiver, occupational status of primary caregiver, and physical condition of primary caregiver), disease-related characteristics (duration of cancer, first cancer, number of hospitalizations, number of days in hospital, impact of cancer on patient's mobility, treatment of cancer, type of cancer, stage of cancer).

Section B: Self-perceived burden scale for patients with cancer (SPBS-CP) This questionnaire, utilized by Ren et al., comprises 21 items across four dimensions to measure the level of SPB. These dimensions include care burden, economic/family burden, emotional/psychological burden, and treatment burden. The Likert scale ranged from 1 to 5 points (never-1, occasionally-2, sometimes-3, often-4, always-5). The total score was 105, with ranged from 21 to 105. It is divided into four categories, in which $SPB < 30$ indicated no SPB, $30 \leq SPB < 50$ indicated mild level SPB, $50 \leq SPB < 70$ indicated moderate level SPB, and $SPB \geq 70$ indicated severe level SPB. The reliability value was 0.941, indicating good reliability.

Section C: Social support rating scale (SSRS) The questionnaire, as implemented by Xiao, consists of 10 items. It is categorized into three dimensions: objective support, encompassing 3 items, subjective support, comprising 4 items, and support utilization, which includes 3 items. Higher scores indicate higher levels of social support. The total score of 66 points, ranged from 12 to 66. It is divided into four levels. Low social support was ≤ 25 points, general social support was 26–35 points, good social support was 36–44 points, and high social support was > 45 points. The reliability value was 0.674, which is moderate reliability.

Section D: Cancer coping methods questionnaire (CCMQ) This questionnaire was adopted by Huang et al. and had 26 items comprising five dimensions: confrontation, avoidance/suppression, resignation, fantasy, and catharsis. The total score ranged from 26 to 104. Each item is rated on a scale of 4 (never-1, sometimes-2, often-3, and always-4). The higher the score of the dimension item, the more frequently the patient used the corresponding coping strategy. The reliability values of each and whole were 0.851, 0.780, 0.871, 0.801, 0.795, and 0.896, respectively, with good reliability.

The validity of all questionnaires was verified through both content and face validity assessments. Content validity was evaluated by the internal supervision team and external

supervisors on-site to ensure that the questionnaire questions had been appropriately designed and that the content met the requirements of the study. Face validity was assessed by administering the questionnaire to 30 patients outside the sample size to determine whether the questionnaire was reasonable and whether the wording was clear and easy to understand. Based on the 30 completed questionnaires, it was concluded that the questionnaire was understandable and that there had been no confusion during the process of filling it out.

Statistical analysis

Data were analyzed using SPSS 27.0 statistical software. A histogram with a normal curve was used to check the normality of the continuous data. Normally distributed data were described using mean $\pm$ standard deviation, whereas data not normally distributed were described using median (interquartile range). Categorical data were described using percentage and frequency.

Independent t-test and ANOVA were used to analyze mean differences between two or three groups. Simple linear regression was used to investigate the effect of each factor associated with SPB. All variables with $p < 0.25$ in simple linear regression were tested in multiple linear regression. Model checking such as normality of residual, homoscedasticity checking for residuals, and multicollinearity checking was done to ensure the best model was obtained. Variable with $p < 0.05$ was considered statistically significant.

Result

Out of 970 respondents, there was 566 respondents agreed to participate in this study, accounted a response rate of 58.6%. Majority of respondents aged more than 60 (268, 47.3%), male (314, 55.5%), living in rural areas (314, 55.5%), married (458, 80.9%), had more than one kid (401, 70.8%). In disease-related characteristics, duration of cancer less than 12 months (399, 70.5%), had the first cancer (416, 73.5%), had impact of cancer on patient's mobility (309, 54.6%), took surgery treatment (373, 43.1%), and at stage II of the cancer (163, 28.8%). Sociodemographic characteristics and disease-related characteristics among respondents are listed in Table 1.

Self-perceived burden level of patients with cancer

The total score of SPB was 67.75 ± 15.69 , with 45.4% having severe SPB, 42.6% having moderate SPB, 10.4% having mild SPB, and 1.6% with no SPB. The score of each dimension was successively economic/family burden,

Table 1 Sociodemographic characteristics and disease-related characteristics among respondents ($N = 566$)

Characteristics	Frequency (n) Mean $\pm$ Standard Deviation/ Median (Interquartile Range)	Percentage (%)
Sociodemographic		
Age group	56.29 $\pm$ 15.95	
< 40	121	21.4
40–60	177	31.3
> 60	268	47.3
Gender		
Male	314	55.5
Female	252	44.5
Residence		
Urban	252	44.5
Rural	314	55.5
Marital status group		
Married	458	80.9
Others (single, divorced, widowed)	108	19.1
Number of children	2 (2)	
0	45	8.0
1	120	21.2
> 1	401	70.8
Educational level group		
High school and below	411	72.6
Junior college or above	155	27.4
Current occupational status		
Employed	175	30.9
Unemployed	295	52.1
Retired	96	17.0
Occupational status before illness		
Employed	189	33.4
Unemployed	287	50.7
Retired	90	15.9
Personal income (RMB)	2,000 (3,675)	
Household income (RMB)	5,000 (4,788)	
0–3,000	138	24.4
3,001–5,000	159	28.1
> 5,000	269	47.5
Medical payment method group		
Self-paid	57	10.1
Medical insurance	509	89.9
Caregiver		
Yes	238	42.0
No	328	58.0
Number of caregivers	1.75 $\pm$ 0.94	
Children as caregivers	279	49.2
Spouses as caregivers	425	75.0
Parents as caregivers	50	8.8
Siblings as caregivers	22	3.8
No caregiver	2	0.3
Primary caregiver group		
Spouses	401	70.8
Others (children, parents, siblings, others, by myself)	165	29.2

Table 1 (continued)

Characteristics	Frequency (n) Mean $\pm$ Standard Deviation/ Median (Interquartile Range)	Percentage (%)
Age of primary caregiver (n = 564)	51.68 $\pm$ 13.63	
< 40	129	22.8
40–60	279	49.5
> 60	156	27.7
Occupational status of primary caregivers (n = 564)		
Employed	251	44.5
Unemployed	232	41.1
Retired	81	14.4
Physical condition of primary caregiver group		
Good	270	47.7
General and poor, not stated	296	52.3
Disease-related		
Duration of cancer (month)	6 (8)	
< 12	399	70.5
12–24	124	21.9
> 24	43	7.6
First cancer		
Yes	416	73.5
No	150	26.5
Number of hospitalisations (time)	2 (2)	
< 6	537	94.9
6–12	26	4.6
> 12	3	0.5
Number of days in hospital	4 (3)	
Impact of cancer on patient's mobility		
Yes	309	54.6
No	257	45.4
Treatment of cancer		
Surgery	373	65.9
Radiation	209	36.9
Chemotherapy	284	50.2
Type of cancer group		
Carcinoma	545	96.3
Others (sarcoma, leukaemia, lymphoma)	21	3.7
Stage of cancer group		
Stage I, II	248	43.8
Stage III, IV	191	33.7
Stage is unknown	127	22.4

*RMB 152.04 is equivalent to RM100 (28/06/2022)

psychological/emotional burden, nursing burden, and treatment burden, as shown in Table 2.

Social support score and coping strategies among respondents

The mean $\pm$ SD of social support total score was 31.47 $\pm$ 6.11, subjective support was 20.48 $\pm$ 4.30, objective

support was 7.20 $\pm$ 2.24, and utilization of support was 3.70 $\pm$ 1.98. Among the 566 respondents, a total of 92(16.3%) was low social support, 313(55.3%) was general social support, 157(27.7%) was good social support and 4(0.7%) was high social support. The mean $\pm$ SD of coping strategies total score was 64.54 $\pm$ 12.37, confront was 18.90 $\pm$ 4.35, avoidance/suppression was 15.16 $\pm$ 3.76, resignation was 10.90 $\pm$ 3.89, fantasy was 10.34 $\pm$ 2.85 and catharses was

Table 2 SPB total score and each dimension score among respondents (N = 566)

SPB	Frequency (n)	Percentage (%)
	Mean $\pm$ Standard Deviation	
Economic/family burden	24.10 $\pm$ 6.44	
Care burden	13.33 $\pm$ 3.43	
Psychological/emotional burden	18.31 $\pm$ 4.92	
Treatment burden	11.99 $\pm$ 3.47	
SPB total score	67.75 $\pm$ 15.69	
No SPB	9	1.6
Mild level SPB	59	10.4
Moderate level SPB	241	42.6
Severe level SPB	257	45.4

Table 3 Social support and coping strategies total score, each dimension score and different social support degrees among respondents (N = 566)

Social support	Frequency (n)	Percentage (%)
	Mean $\pm$ Standard Deviation	
Objective support	7.20 $\pm$ 2.24	
Subjective support	20.48 $\pm$ 4.30	
Utilization of support	3.70 $\pm$ 1.98	
Total score of social support	31.47 $\pm$ 6.11	
Low social support	92	16.3
General social support	313	55.3
Good social support	157	27.7
High social support	4	0.7
Coping strategies		
Confrontation	18.90 $\pm$ 4.35	
Avoidance/suppression	15.16 $\pm$ 3.76	
Resignation	10.90 $\pm$ 3.89	
Fantasy	10.34 $\pm$ 2.85	
Catharses	9.22 $\pm$ 2.83	
Total score of coping strategies	64.54 $\pm$ 12.37	

9.22 $\pm$ 2.83. Social support and coping strategies total score, each dimension score, and different social support degrees among respondents are detailed in Table 3.

Predictors of SPB in patients with cancer

Among 32 variables, there were 13 variables significantly associated with SPB, including residence, number of children, educational level group, caregiver, parents as caregivers, age of primary caregiver, duration of cancer, first cancer, impact of cancer on your mobility, type of cancer, treatment of cancer (radiation, chemotherapy), stage of cancer group and coping strategies as shown in Table 4.

There were 21 variables with $p < 0.25$ in simple linear regression (Table 5), including age, residence, number of children, educational level group, current occupational status, occupational status before illness, personal income, caregiver, children as caregivers, parents as caregivers, sibling as caregivers, age of primary caregiver, occupational status of primary caregiver, duration of cancer, first cancer, number of hospitalization, impact of cancer on patient's mobility, type of cancer, treatment of cancer, stage of cancer, subjective support and coping strategies were tested in the multiple linear regression.

In the final model, only nine predictors of SPB, including sociodemographic characteristics (parents as caregivers, siblings as caregivers, occupational status before illness), disease-related characteristics (duration of cancer, impact of cancer on your mobility, treatment of cancer, type of cancer, stage of cancer) and coping strategies (Table 6).

Respondents whose caregivers were parents ($B = 5.488$, 95%CI: 1.405, 9.572, $p = 0.009$), unemployed before their illness ($B = 5.400$, 95%CI: 2.463, 8.337, $p < 0.001$), cancer duration of 12–24 months ($B = 3.717$, 95%CI: 1.041, 6.393, $p = 0.007$), radiotherapy group ($B = 5.518$, 95%CI: 3.114, 7.922, $p < 0.001$), chemotherapy group ($B = 4.280$, 95%CI: 2.027, 6.534, $p < 0.001$), stage III and IV ($B = 2.987$, 95%CI: 0.468, 5.506, $p = 0.020$), confrontation coping strategies ($B = 0.977$, 95%CI: 0.707, 1.247, $p < 0.001$), resignation coping strategies ($B = 0.715$, 95%CI: 0.393, 1.038, $p < 0.001$), and fantasy coping strategies ($B = 1.375$, 95%CI: 0.930, 1.819, $p < 0.001$) had higher SPB score. whereas respondents with caregivers were siblings ($B = -5.758$, 95%CI: -11.326 , -0.190 , $p = 0.043$), cancer duration of less than 12 months ($B = -4.790$, 95% CI: -8.910 , -0.670 , $p = 0.023$), cancer did not impact mobility ($B = -3.283$, 95%CI: -5.421 , -1.145 , $p = 0.003$). other cancers (sarcoma, leukemia, lymphoma) ($B = -6.643$, 95%CI: -12.245 , -1.041 , $p = 0.020$) had lower SPB score.

Discussion

In this study, 566 patients with cancer were investigated, and the mean SPB score was 67.75 $\pm$ 15.69, which was considered a moderate level. It is consistent with the results of Liu et al. (87.77 $\pm$ 24.24, moderate level) [37] and Hu et al. (79.36 $\pm$ 25.15, moderate level) [38], but it is higher than those in developed countries such as Cousineau et al. (24.7 $\pm$ 18.7) [8] and Simmons (21.41 $\pm$ 8.92) [39]. This may be linked to economic income and health insurance reimbursement, as lower baseline income and limited insurance coverage could both exacerbate SPB in cancer patients in LMICs [21].

In terms of the prevalence of SPB in patients with cancer, 88.0% of patients with cancer had moderate or above SPB,

Table 4 Associations between sociodemographic, disease-related characteristics, social support and coping strategies with SPB among respondents (N = 566)

Characteristics	Mean $\pm$ SD	F ^a /t ^b /r ^c d value (df)	p value
Sociodemographic			
Age group		1.144(2) ^a	0.319
< 40	68.67 $\pm$ 19.67		
40–60	66.29 $\pm$ 15.50		
> 60	68.31 $\pm$ 13.66		
Gender		−0.099(564) ^b	0.921
Male	67.69 $\pm$ 15.76		
Female	67.83 $\pm$ 15.63		
Residence		−2.341(436.566) ^b	0.020*
Urban	65.97 $\pm$ 18.38		
Rural	69.18 $\pm$ 13.00		
Marital status group		0.400(564) ^b	0.689
Married	67.62 $\pm$ 15.80		
Other (single, divorced, widowed)	68.30 $\pm$ 15.25		
Number of children		3.518(2) ^a	0.030*
0	72.58 $\pm$ 16.98		
1	65.41 $\pm$ 17.22		
> 1	67.91 $\pm$ 14.95		
Educational level group		2.699(223.226) ^b	0.007*
High school and below	68.98 $\pm$ 14.17		
Junior college or above	64.49 $\pm$ 18.89		
Current occupational status		1.830(2) ^a	0.161
Employed	66.83 $\pm$ 19.12		
Unemployed	68.92 $\pm$ 12.069		
Retired	65.84 $\pm$ 18.29		
Occupational status before illness		2.158(2) ^a	0.117
Employed	66.37 $\pm$ 19.41		
Unemployed	69.10 $\pm$ 11.33		
Retired	66.37 $\pm$ 18.51		
Personal income (RMB)	3562.42 $\pm$ 5040.45	−0.039 ^c	0.353
Household income (RMB)		1.736(2) ^a	0.177
0–3000	68.01 $\pm$ 13.66		
3001–5000	69.49 $\pm$ 14.06		
> 5000	66.59 $\pm$ 17.43		
Medical payment method groups		0.517(65.058) ^b	0.607
Self-payment	68.93 $\pm$ 18.39		
Medical insurance reimbursement	67.62 $\pm$ 15.37		
Caregiver		3.520(538.558) ^b	< 0.001*
Yes	70.41 $\pm$ 14.58		
No	65.83 $\pm$ 16.20		
Number of caregivers	1.75 $\pm$ 0.94	0.023 ^d	0.577
Children as caregivers		−1.803 (551.709) ^b	0.072
No	66.59 $\pm$ 16.97		
Yes	68.95 $\pm$ 14.18		
Spouses as caregivers		−0.453(564) ^b	0.651
No	67.23 $\pm$ 15.29		
Yes	67.92 $\pm$ 15.83		
Parents as caregivers		−2.373(55.851) ^b	0.021*
No	67.19 $\pm$ 15.32		

Table 4 (continued)

Characteristics	Mean $\pm$ SD	F ^a /t ^b /r ^c d value (df)	p value
Yes	73.54 $\pm$ 18.30		
Siblings as caregivers		1.158(564) ^b	0.247
No	67.91 $\pm$ 15.61		
Yes	63.95 $\pm$ 17.44		
No caregiver		0.609(564) ^b	0.543
No	67.78 $\pm$ 15.65		
Yes	61.00 $\pm$ 32.52		
Primary caregiver group		-0.170(564) ^b	0.865
Spouses	67.68 $\pm$ 15.96		
Others (children, parents, siblings, others, by myself)	67.93 $\pm$ 15.05		
Age of primary caregiver (n = 564)		3.355(2) ^a	0.036*
< 40	67.85 $\pm$ 18.28		
40–60	66.19 $\pm$ 14.69		
> 60	70.32 $\pm$ 13.86		
Occupational status of primary caregivers (n = 564)		1.251(2) ^a	0.287
Employed	66.63 $\pm$ 17.17		
Unemployed	68.84 $\pm$ 12.82		
Retired	68.30 $\pm$ 17.89		
Physical condition of primary caregiver group		0.790(537.971) ^b	0.430
Good	67.20 $\pm$ 16.72		
General and poor, not stated	68.25 $\pm$ 14.69		
Disease-related			
Duration of cancer (month)		11.871(2) ^a	< 0.001*
< 12	66.84 $\pm$ 14.26		
12–24	72.99 $\pm$ 17.28		
> 24	61.12 $\pm$ 15.69		
Duration of cancer (month)	10.64 $\pm$ 12.26	-0.033 ^c	0.438
First cancer		-3.262(227.985) ^b	0.001*
Yes	66.36 $\pm$ 14.70		
No	71.61 $\pm$ 17.63		
Number of hospitalizations (time)		0.103(2) ^a	0.903
< 6	67.68 $\pm$ 15.40		
6–12	69.08 $\pm$ 21.34		
> 12	68.67 $\pm$ 16.50		
Number of hospitalizations (time)	2.54 $\pm$ 2.46	0.182 ^c	< 0.001*
Number of days in hospital	5.58 $\pm$ 8.49	-0.016 ^c	0.697
Impact of cancer on patient's mobility		3.374(564) ^b	< 0.001*
Yes	69.76 $\pm$ 14.98		
No	65.33 $\pm$ 16.20		
Type of cancer group		2.130(20.623) ^b	0.045*
Carcinoma	68.17 $\pm$ 15.16		
Others (sarcoma, leukemia, lymphoma)	56.95 $\pm$ 23.95		
Treatment of cancer			
Surgery		2.893(564) ^b	0.004*
No	70.39 $\pm$ 16.24		
Yes	66.39 $\pm$ 15.24		
Radiation		-5.165(483.846) ^b	< 0.001*
No	65.29 $\pm$ 16.09		
Yes	71.96 $\pm$ 14.04		
Chemotherapy		-4.875(564) ^b	< 0.001*

Table 4 (continued)

Characteristics	Mean $\pm$ SD	F ^a /t ^b /r ^c d value (df)	p value
No	64.59 $\pm$ 15.89		
Yes	70.89 $\pm$ 14.86		
Stage of cancer group		8.853(2) ^a	< 0.001*
Stage I, II	65.52 $\pm$ 18.28		
Stage III, IV	71.56 $\pm$ 14.63		
Stage is unknow	66.39 $\pm$ 9.61		
Social support			
Objective support	7.20 $\pm$ 2.24	0.034 ^d	0.422
Subjective support	20.48 $\pm$ 4.30	−0.051 ^d	0.227
Utilization of support	3.70 $\pm$ 1.98	−0.003 ^d	0.940
Total score of social support	31.47 $\pm$ 6.11	−0.024 ^d	0.562
Coping strategies			
Confrontation	18.90 $\pm$ 4.35	0.248 ^d	< 0.001*
Avoidance/suppression	15.16 $\pm$ 3.76	0.267 ^d	< 0.001*
Resignation	10.90 $\pm$ 3.89	0.324 ^d	< 0.001*
Fantasy	10.34 $\pm$ 2.85	0.366 ^d	< 0.001*
Catharses	9.22 $\pm$ 2.83	0.306 ^d	< 0.001*

*Variable with $p < 0.05$, a is ANOVA test, b is independent t test, c is Spearman correlation, d is Pearson correlation

which was higher than that in the studies of Liu et al. (76.1%) [13] and Lu et al. (70.45%) [40]. This may be because the study population is different where their study only focused on a single cancer population, while this study included different cancer types. Therefore, psychological assessment of patients with high cancer malignancy and psychological support for patients with high SPB is recommended [41].

Among the four dimensions of SPB, the economic burden dimension is higher than the other three dimensions. Similar to the findings of Liu et al., it is evident that the economic burden significantly affects the SPB [42]. In China, medical insurance does not relieve the financial pressure of patients with cancer. Imported chemotherapeutic drugs or targeted drugs used by patients with cancer will also bring a severe economic burden to patients with cancer and their families [43]. The second is the psychological burden. The physical pain of patients with cancer, the side effects caused by treatment, and the guilt caused by long-term dependence on family members unintentionally aggravate the SPB of patients with cancer [44]. The low scores for care and treatment in this study may be because 96% of patients with cancer have long-term caregivers, and patients with cancer do not have to worry about being unattended. Despite the side effects of surgery, chemoradiotherapy, or the loss of specific organs, the patients with cancer's mobility was not severely affected.

Respondents with parents as caregivers had higher SPB scores than respondents with non-parents as caregivers,

which may be because after suffering from cancer, patients feel they can not only take care of their parents but also need their parents to take care of them. Moreover, they may think cancer is incurable and they cannot be filial to their parents in the future, leading to their high SPB score [38]. However, also in the caregiver group, respondents with non-siblings as caregivers had higher SPB score than respondents with siblings as caregivers. The main reason may be that siblings as peers can better comfort patients, reduce their psychological burden, and thus reduce SPB [24, 25].

Among respondents' occupational status before illness, unemployed respondents before illness had higher SPB score than those employed before illness, which may be mainly related to the economic burden. Unemployed patients have no savings, increasing the economic burden after cancer. Thus, the SPB increased. However, this variable is the first ever studied.

From the perspective of disease-related characteristics, the SPB score of the respondents with cancer duration of 12–24 months was higher than that of the respondents with cancer duration of less than 12 months and more than 24 months, which may be because the patients in this period were undergoing long-term chemotherapy treatment after surgery [13, 29].

The respondents with the impact of cancer on mobility have a higher SPB score than those without the impact of cancer on mobility, which may be because impaired mobility

Table 5 Sociodemographic, disease-related characteristics, social support, and coping strategies among respondents associated with SPB score using simple linear regression (N = 566)

Variable	Unadjusted Coefficient (B)	Standard Error	95%CI (Lower and Upper Bound)		p value
Age					
< 40	Ref				
40–60	−2.381	1.815	−6.016	1.254	0.199
> 60	−0.363	1.718	−3.739	3.012	0.833
Gender					
Male	Ref				
Female	0.131	1.328	−2.478	2.740	0.921
Residence					
Urban	Ref				
Rural	3.209	1.322	0.614	5.805	0.015*
Marital status group					
Married	Ref				
Other (single, divorced, widowed)	0.672	1.680	−2.628	3.972	0.689
Number of children					
0	Ref				
1	−7.169	2.731	−12.534	−1.805	0.009*
> 1	−4.665	2.456	−9.490	0.159	0.058
Educational level group					
High school and below	Ref				
Junior college or above	−4.493	1.468	−7.377	−1.608	0.002*
Current occupational status					
Employed	Ref				
Unemployed	2.084	1.495	−0.825	5.021	0.164
Retired	−0.991	1.990	−4.900	2.919	0.619
Occupational status before illness					
Employed	Ref				
Unemployed	2.736	1.467	−0.146	5.618	0.063
Retired	0.002	2.006	−3.938	3.941	0.999
Personal income (RMB) × 100	0.016	0.013	−0.010	0.041	0.229
Household income (RMB)					
0–3000	Ref				
3001–5000	−1.476	1.823	−2.105	5.058	0.419
> 5000	−1.423	1.641	−4.647	1.800	0.386
Medical payment method groups					
Self-payment	Ref				
Medical insurance	−1.309	2.193	−5.617	2.999	0.551
Caregiver					
Yes	Ref				
No	−4.581	1.323	−7.181	−1.982	< 0.001*
Number of caregivers	0.391	0.702	−0.987	1.770	0.557
Children as caregivers					
No	Ref				
Yes	2.368	1.317	−0.218	4.954	0.073
Spouses as caregivers					
No	Ref				
Yes	0.691	1.526	−2.307	3.688	0.651
Parents as caregivers					
No	Ref				
Yes	6.348	2.311	1.809	10.887	0.006*

Table 5 (continued)

Variable	Unadjusted Coefficient (B)	Standard Error	95%CI (Lower and Upper Bound)		p value
Siblings as caregivers					
No	Ref				
Yes	−3.952	3.412	−10.653	2.750	0.247
No caregiver					
No	Ref				
Yes	−6.777	11.123	−28.623	15.070	0.543
Primary caregiver group					
Spouses	Ref				
Others (children, parents, siblings, others, by myself)	0.246	1.453	−2.607	3.100	0.865
Age of primary caregiver (n = 564)					
< 40	Ref				
40–60	−1.473	1.579	−4.574	1.628	0.351
> 60	2.654	1.753	−0.790	6.097	0.131
Occupational status of primary caregivers (n = 564)					
Employed	Ref				
Unemployed	2.251	1.426	−0.549	5.052	0.115
Retired	1.711	2.002	−2.222	5.644	0.393
Physical condition of primary caregiver group					
Good	Ref				
General and poor, not stated	1.050	1.321	−3.645	1.545	0.427
Duration of cancer (month)					
< 12	Ref				
12–24	6.152	1.583	3.042	9.262	< 0.001*
> 24	−5.723	2.472	−10.578	−0.868	0.021*
Duration of cancer (month)	−0.042	0.054	−0.148	0.064	0.438
First cancer					
Yes	Ref				
No	5.253	1.479	2.347	8.159	0.001*
Number of hospitalizations (time)					
< 6	Ref				
6–12	1.393	3.156	−4.806	7.593	0.659
> 12	0.983	9.100	−16.891	18.858	0.914
Number of hospitalizations (time)	0.727	0.267	0.203	1.251	0.007*
Number of days in hospital	0.041	0.078	−0.111	0.194	0.594
Impact of cancer on patient's mobility					
Yes	Ref				
No	−4.429	1.313	−7.008	−1.850	< 0.001*
Type of cancer group					
Carcinoma	Ref				
Others (sarcoma, leukemia, lymphoma)	−11.216	3.461	−18.014	−4.419	0.001*
Treatment of cancer					
Surgery					
No	Ref				
Yes	−4.000	1.383	−6.715	−1.284	0.004*
Radiation					
No	Ref				
Yes	6.673	1.339	4.043	9.303	< 0.001*

Table 5 (continued)

Variable	Unadjusted Coefficient (B)	Standard Error	95%CI (Lower and Upper Bound)		p value
Chemotherapy					
No	Ref				
Yes	6.306	1.293	3.765	8.846	< 0.001*
Stage of cancer group					
Stage I, II	Ref				
Stage III,IV	6.040	1.490	3.113	8.967	< 0.001*
Stage is unknow	0.866	1.689	-2.452	4.183	0.608
Social support					
Objective support	0.236	0.294	-0.341	0.814	0.422
Subjective support	-0.186	0.153	-0.487	0.116	0.227
Utilization of support	-0.025	0.333	-0.678	0.628	0.940
Total score of social support	-0.063	0.108	-0.275	0.150	0.562
Coping strategies					
Confrontation	0.895	0.147	0.606	1.184	< 0.001*
Avoidance/suppression	1.113	0.169	0.781	1.445	< 0.001*
Resignation	1.305	0.161	0.989	1.620	< 0.001*
Fantasy	2.009	0.215	1.587	2.432	< 0.001*
Catharses	1.698	0.222	1.261	2.134	< 0.001*
Total score of coping strategies	0.539	0.048	0.444	0.634	< 0.001*

*Variable with $p < 0.05$, Ref is reference category, CI is confidence interval

means that patients with cancer need to rely on caregivers for everything in daily life, increasing the burden of caregivers. Patients feel self-blame, which aggravates SPB. This variable has been studied for the first time. For patients with a high score in this variable, medical workers are advised to make exercise plans for patients and exercise appropriately.

In type of cancer group, respondents with carcinoma had higher SPB than others (sarcoma, leukemia, lymphoma), which may be related to the survival rate of cancer. For example, the five-year survival rate was 81.8% for leukemia [45], 48% for colon cancer [46], 39% for liver cancer [47], and the five-year survival rate of lung cancer is 19.7% [48]. If the malignancy of cancer is high, the survival rate will be low, and patients with cancer are afraid of death so SPB will increase.

In treatment of cancer group, patients with radiotherapy or chemotherapy had higher SPB score than patients with surgery, possibly because surgery is used in patients with early cancer, and radiotherapy or chemotherapy is used in patients with more advanced and inoperable cancer. In addition, the treatment cycle of radiotherapy or chemotherapy is long, patients need to be hospitalized frequently, and there are many side effects. Therefore, respondents who choose chemoradiotherapy have a high SPB [22, 27, 29].

In stage of cancer, this study proved that respondents at stage III and IV had higher SPB score than that at stage I

and II. This may be because the cure rate for early cancers is higher than for patients with advanced cancers. For example, for breast patients with cancer, there was a 100% survival rate for stage I, 91.9% for stage II, 78.8% for stage III, and 34.2% for Stage IV [49].

Among the coping strategies, the respondents with a higher fantasy coping strategies score had a higher SPB score, which may be because patients with fantasy coping strategies put their hopes in superstition and thought that they could not be treated, leading to the increase in SPB [50].

The sample was collected at a specific time (the COVID-19 outbreak), which resulted in a low response rate. The post-hoc power analysis showed that the power of the study was 94.1%, suggesting that the study had enough power to detect a statistically significant effect. The sample was selected only from the Fourth Hospital of Hebei Medical University and cannot be generalized to the cancer population.

Limitation: The respondents were only recruited from the Fourth Hospital of Hebei Medical University and cannot represent the whole country. This study is a cross-sectional study, which can only represent the SPB of patients with cancer in a specific period and cannot represent the SPB of patients with cancer in other disease periods.

Table 6 Predictors associated with SPB score among respondents using multiple linear regression ($N = 566$)

Variable	Adjusted Coef- ficient (B)	Standard Error	95%CI (Lower and Upper Bound)		p value
Parents as caregivers					
No	Ref				
Yes	5.488	2.079	1.405	9.572	0.009*
Siblings as caregivers					
No	Ref				
Yes	−5.758	2.835	−11.326	−0.190	0.043*
Occupational status before illness					
Employed	Ref				
Unemployed	5.400	1.495	2.463	8.337	< 0.001*
Retired	2.388	1.737	−1.024	5.799	0.170
Duration of cancer (month)					
< 12	Ref				
12–24	3.717	1.362	1.041	6.393	0.007*
> 24	−4.790	2.097	−8.910	−0.670	0.023*
Impact of cancer on your mobility					
Yes	Ref				
No	−3.283	1.089	−5.421	−1.145	0.003*
Type of cancer group					
Carcinoma	Ref				
Others (sarcoma, leu- kemia, lymphoma)	−6.643	2.852	−12.245	−1.041	0.020*
Treatment of cancer					
Radiation					
No	Ref				
Yes	5.518	1.224	3.114	7.922	< 0.001*
Chemotherapy					
No	Ref				
Yes	4.280	1.147	2.027	6.534	< 0.001*
Stage of cancer group					
Stage I, II	Ref				
Stage III,IV	2.987	1.282	0.468	5.506	0.020*
Stage unknow	−0.817	1.531	−3.825	2.191	0.594
Coping strategies					
Confrontation	0.977	0.138	0.707	1.247	< 0.001*
Resignation	0.715	0.164	0.393	1.038	< 0.001*
Fantasy	1.375	0.226	0.930	1.819	< 0.001*
Intercept	20.153	3.719			

*Variable with $p < 0.05$. Ref: reference category. CI: confidence interval. R^2 was 37.6%. ANOVA test, $p < 0.001$. Homoscedasticity checking for residuals. Backward variable selection method was used. Normality of residual, homoscedasticity checking for residuals and multicollinearity checking were checked

Conclusion

In conclusion, the prevalence of SPB is high, where the average SPB score is at a moderate level, this indicates that this scenario is worrying. This burden is not only widespread but also serious, warranting immediate attention. Patients experience a high degree of SPB, making it crucial for medical staff to understand its impact on their mental health. Healthcare

workers, particularly those in oncology and palliative care, must be trained in the psychological dynamics of self-perceived burden to better identify at-risk patients. Providers should be equipped to detect signs of psychological distress that may not be immediately apparent but could increase the risk of self-harm or suicide. Furthermore, targeted interventions are needed to address the psychological needs of patients with cancer, particularly those showing high levels

of self-perceived burden. These interventions may include psychological counseling, social support systems, and mental health monitoring as part of a comprehensive care approach. By identifying and managing high-risk patients, healthcare workers can help reduce the likelihood of suicide and improve the overall quality of life for patients with cancer.

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Author contributions BYL, PYL, and CS wrote the main manuscript text. QXZ and KL prepared tables 1–6. All authors reviewed the manuscript.

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Data availability Data supporting the findings of this study are available upon request from the corresponding author. These data are not publicly available due to privacy or ethical constraints.

Code availability Not applicable.

Declarations

Ethics approval The study was approved by the ethics committees of Universiti Putra Malaysia (JKEUPM-2021–785) and the Fourth Hospital of Hebei Medical University (2022 K7250).

Competing interests None of the authors has any potential financial conflicts of interest related to this manuscript.

References

- Manisalidis I, Stavropoulou E, Stavropoulos A, Bezirtzoglou E (2020) Environmental and health impacts of air pollution: a review. *Front Public Health* 8:14. <https://doi.org/10.3389/fpubh.2020.00014>
- WHO (2020) WHO report on cancer: setting priorities, investing wisely and providing care for all. In Geneva: World Health Organization; https://doi.org/10.1007/978-3-662-11496-4_24 Accessed 15 October 2022
- Niedzwiedz CL, Knifton L, Robb KA, Katikireddi SV, Smith DJ (2019) Depression and anxiety among people living with and beyond cancer: a growing clinical and research priority. *BMC Cancer* 19(1):943. <https://doi.org/10.1186/s12885-019-6181-4>
- Torgovnick A, Schumacher B (2015) DNA repair mechanisms in cancer: development and therapy. *Frontiers in genetics*, 6(APR): 1–15. <https://doi.org/10.3389/fgene.2015.00157>
- Hiley CT, Swanton C (2014) Spatial and temporal cancer evolution: causes and consequences of tumour diversity. *Clin Med (Lond)* 14(6):33–37. <https://doi.org/10.7861/clinmedicine.14-6-s33>
- Collado L, Brownell I (2019) The crippling financial toxicity of cancer in the United States. *Cancer Biol Ther* 20(10):1301–1303. <https://doi.org/10.1080/15384047.2019.1632132>
- 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: a cancer journal for clinicians*, 68(2): 53–165. <https://doi.org/10.3322/caac.21443>
- Cousineau N, McDowell I, Hotz S, Hébert P (2003) Measuring chronic patients' feelings of being a burden to their caregivers. *Med Care* 41(1):110–118. <https://doi.org/10.1097/00005650-200301000-00013>
- McPherson CJ, Wilson KG, Murray MA (2007) Feeling like a burden: exploring the perspectives of patients at the end of life. *Soc Sci Med* 64(2):417–427. <https://doi.org/10.1016/j.socscimed.2006.09.013>
- Wilson KG, Curran D, McPherson CJ (2005) A burden to others: a common source of distress for the terminally ill. *Cogn Behav Ther* 34(2):115–123. <https://doi.org/10.1080/16506070510008461>
- Ting CY, Teh GC, Yu KL, Alias H, Tan HM, Wong LP (2020) Self-perceived burden and its associations with health-related quality of life among urologic cancer patients. *European journal of cancer care*, 29(4). <https://doi.org/10.1111/ecc.13248>
- Qian H, Zhou YQ, Liu Y, Xiao JQ, Shen X, Jiao YH (2013) Investigation of self-perceived burden and its influencing factors among cancer patients. *Chinese nursing management* 13(4):42–45. <https://doi.org/CNKI:SUN:GLHL.0.2013-04-016>
- Liu GX, Zhang H, Meng Y (2019) The relationship between self-perceived burden and disease perception, disease uncertainty and mental resilience in patients with lung cancer undergoing chemotherapy. *Chinese journal of mental health* 33(11):816–821. <https://doi.org/10.3969/j.issn.1000-6729.2019.11.004>
- Zuo Y, Niu ME, Yue LL (2021) A survey on the self-perceived burden of elderly cancer patients in rural areas. *Contemp Nurse* 28(9):128–133. <https://doi.org/10.19792/j.cnki.1006-6411.2021.26.046>
- McFarland DC, Walsh L, Napolitano S, Morita J, Jaiswal R (2019) Suicide in patients with cancer: identifying the risk factors. *Oncology (Williston Park, N.Y.)*, 33(6): 221–226.
- Liu ST, Wang LJ (2015) Epidemiological characteristics of suicide among inpatients in general hospitals. *Chinese journal of social medicine* 32(04):272–274. <https://doi.org/CNKI:SUN:GWSY.0.2015-04-007>
- Wu ME, Hu DY, Ding XP, Yu T, Teng F (2021) A meta-analysis of the incidence of suicidal ideation in Chinese cancer inpatients. *Journal of nursing* 36(12):94–97. <https://doi.org/CNKI:SUN:HLXZ.0.2021-12-027>
- Hao JY, Liu SY (2018) Self-perceived burden and influencing factors of lung cancer patients. *Today nurse* 25(5):88–91. <https://doi.org/CNKI:SUN:DDHS.0.2018-02-042>
- Luo T, Xie RZ, Huang YX, Gong XH, Qin HY, Wu YX (2021) Self-perceived burden and influencing factors in patients with cervical cancer administered with radiotherapy. *World journal of clinical cases*, 9(17): 4188–4198. <https://doi.org/10.12998/wjcc.v9.i17.4188>
- Wang WL, He YJ, Zhou HL, Chen QP, Shen YH, Guan JH (2017) The correlation between self-perceived burden and family closeness and adaptability in patients with advanced cancer. *Chinese journal of practical nursing* 33(36):2801–2806. <https://doi.org/CNKI:SUN:SYHL.0.2017-36-001>
- Ehsan AN, Wu CA, Minasian A et al (2023) Financial Toxicity Among Patients With Breast Cancer Worldwide: A Systematic Review and Meta-analysis. *JAMA Netw Open* 6(2):e2255388. <https://doi.org/10.1001/jamanetworkopen.2022.55388>
- Zhang CC, Feng Y, Sha J (2018) Current situation and influencing factors of self-perceived burden in elderly patients with cancer. *Chinese journal of modern nursing* 24(12):1419–1421. <https://doi.org/CNKI:SUN:HLJH.0.2018-12-017>
- Xiao M, Yi YL, Wei BB (2020) The effect of self-management efficacy on self-perceived burden of lung cancer patients undergoing chemotherapy. *Nurs Res* 34(5):835–841. <https://doi.org/CNKI:SUN:SXHZ.0.2020-05-023>

24. Ye SC, Liu M (2018) Related factors survey of self-perceived burden of cancer patients and effect of supportive psychotherapy. *China medical journal* 15(31):176–180. <https://doi.org/CNKI:SUN:YYCY.0.2018-31-044>
25. Zhi XX, Meng AF, Mao CM, Bao TT (2015) Investigation of burden perception of cancer patients during in-hospital chemotherapy. *Chinese nursing education* 12(3):220–223. <https://doi.org/CNKI:SUN:ZHHU.0.2015-03-024>
26. Chen J, Tao X (2016) Investigation and analysis of self-perceived burden of cancer patients. *Journal of everyone healthy* 10(11):294–295. <https://doi.org/10.3969/j.issn.1009-6019.2016.11.398>
27. Wang HZ, Ye WX, Chen LN (2016) Analysis of self-perceived burden and its influencing factors in inpatients with lung cancer. *China's health industry*, 13(4): 64–66, 111. <https://doi.org/10.16659/j.cnki.1672-5654.2016.04.064>
28. Bai H, Lu LK (2017) Self-perceived burden of middle-aged cancer patients undergoing chemotherapy and its related influencing factors. *Chinese medicine* 12(7):1108–1111. <https://doi.org/10.3760/cma.j.issn.1673-4777.2017.07.041>
29. Zhang C, Gao R, Tai J et al (2019) The relationship between self-perceived burden and posttraumatic growth among colorectal cancer patients: the mediating effects of resilience. *Biomed Res Int* 2019:6840743. <https://doi.org/10.1155/2019/6840743>
30. Libert Y, Borghgraef C, Beguin Y et al (2017) Factors associated with self-perceived burden to the primary caregiver in older patients with hematologic malignancies: an exploratory study. *Psychooncology* 26(1):118–124. <https://doi.org/10.1002/pon.410>
31. Gudat H, Ohnsorge K, Streeck N, Rehmann-Sutter C (2019) How palliative care patients' feelings of being a burden to others can motivate a wish to die. *Moral challenges in clinics and families. Bioethics*, 33(4): 421–430. <https://doi.org/10.1111/bioe.12590>
32. Wilson KG, Dalglish TL, Chochinov HM et al (2016) Mental disorders and the desire for death in patients receiving palliative care for cancer. *BMJ Support Palliat Care* 6(2):170–177. <https://doi.org/10.1136/bmjspcare-2013-000604>
33. Lemeshow S, Hosmer DW, Klar J, Lwanga SK (1990) Adequacy of sample size in health studies. In John Wiley & Sons Ltd. Baffins Lane, Chichester west sussex P019 1 UD, England (Vol. 47, Issue 1). <https://doi.org/10.2307/2532527>
34. Ren YY, Liu HX, Tian XL (2013) Screening of items of self-perceived burden scale for cancer patients and formation of test version. *Journal of nursing* 28(5):25–27. <https://doi.org/CNKI:SUN:HLXZ.0.2013-05-013>
35. Xiao SY (1994) Theoretical basis and research application of social support rating scale. *Journal of clinical psychiatry* (02). <https://doi.org/CNKI:SUN:lcjs.0.1994-02-019>
36. Huang XW, Guo BJ, Wang XL, Zhang Y, Lv BX (2007) Compilation and evaluation of cancer response questionnaire. *Chinese journal of mental health* (08): 517–520, 525. <https://doi.org/CNKI:SUN:lcjs.0.1994-02-019>
37. Liu H, Hu JL, Huang Y, Ye SC, Wang HF (2017) Study on the correlation between self-perceived burden and coping style of cancer patients. *People's liberation army nursing journal* 34(22):33–36. <https://doi.org/10.3969/j.issn.1008-9993.2017.22.007>
38. Hu X, Lu GH, Lu JQ, Zhang YX, Zhang XJ, Liang Y (2022) Correlation analysis between self-perceived burden and quality of life in young and middle-aged cancer patients. *Contemp Nurse* 29(4):25–19. <https://doi.org/10.19793/j.cnki.1006-6411.2022.12.007>
39. Simmons LA (2007) Self-perceived burden in cancer patients: validation of the self-perceived burden scale. *Cancer Nurs* 30(5):405–411. <https://doi.org/10.1097/01.NCC.0000290816.37442.af>
40. Lu F, Wang Y, Zhang HJ (2018) Self-perceived burden of bladder cancer patients and its influencing factors. *The western medicine* 30(9):1383–1386. <https://doi.org/10.3969/j.issn.1672-3511.2018.09.029>
41. Lu GH, Xiao Y, Du C, Li GY (2015) Effective research of social psychological supportive nursing to improve self-perceived burden in cancer patients receiving chemotherapy. *Cancer prevention and treatment* 28(4):209–213. <https://doi.org/10.3969/j.issn.1674-0904.2015.04.006>
42. Liu L, Li HX, Zhao YQ (2019) Relationship between family functioning and self-perceived burden of esophageal cancer patients. *Tianjin nursing* 27(2):176–179. <https://doi.org/CNKI:SUN:TJFN.0.2019-02-014>
43. Xu B, Hu L, Cheng Q, Winnie SKW (2022) A systematic review of financial toxicity among cancer patients in China. *Asia Pac J Oncol Nurs* 9(8):100071. <https://doi.org/10.1016/j.apjon.2022.04.010>
44. Zheng H, Deng N (2020) The effect of comprehensive nursing on self-perceived burden and quality of life of patients with advanced cancer. *Modern clinical medicine* (06): 441–443, 476. <https://doi.org/10.11851/j.issn.1673-1557.2020.06.014>
45. Veisani Y, Khazaei S, Delpisheh A (2018) 5-year survival rates based on the type of leukemia in Iran, a meta-analysis. *Caspian journal of internal medicine*, 9(4): 316–324. <https://doi.org/10.22088/cjim.9.4.316>
46. Zhan TC, Zhang DK, Peng TF, Zhao J, Li M, Gu J (2016) The prognosis of colorectal cancer-the analysis of statistics of 1321 cases from a single clinic center in China. *Journal of practical oncology* 31(4):353–356. <https://doi.org/10.13267/j.cnki.syzlzz.2016.04.014>
47. Tan N, Zheng HP, Ou C (2019) Analysis of postoperative survival rate and the prognostic factors of primary liver cancer patients after radical resection. *Modern cancer medicine* 27(5):826–829. <https://doi.org/10.3969/j.issn.1672-4992.2019.05.027>
48. Zheng RS, Sun KX, Zhang SW (2019) Analysis on the prevalence of malignant tumors in China in 2015. *Chinese journal of oncology* 41(1):19–28. <https://doi.org/10.3760/cma.j.issn.0253-3766.2019.01.005>
49. Mangone L, Mancuso P, Bisceglia I, Braghiroli B, Ferrari F, Vicentini M, Giorgi Rossi P (2021) Five-year relative survival by stage of breast and colon cancers in Italy. *Tumori* 107(4):318–324. <https://doi.org/10.1177/0300891620964565>
50. Li HP, Wang DB, Yang YJ, Zhang QN (2014) The correlation between self-perceived burden and social support and coping style in elderly cancer patients. *Chin J Gerontol* 34(5):1345–1347. <https://doi.org/CNKI:SUN:ZLXZ.0.2014-05-088>

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