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Loneliness and Its Associated Factors Among Patients with Cancer in China: A Sequential Explanatory Mixed-Methods Study

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Abstract

Loneliness is prevalent among patients with cancer in China and exerts adverse effects on both physical and mental health. This study aims to investigate the prevalence of loneliness and its associated factors, as well as to explore patients' lived experiences, to inform clinical practice. A sequential explanatory mixed-methods design was adopted, incorporating a cross-sectional survey of 240 inpatients from oncology and general surgery departments of large-scale tertiary hospitals, along with descriptive phenomenological interviews conducted with 18 patients scoring≥20 on the loneliness scale. Quantitative results revealed an average loneliness score of 19.13±6.26, with 83.8% of patients experiencing moderate to severe loneliness. Multiple regression analysis identified introversion, absence of caregivers, disease duration >3 years, low social support, depression, negative social expectations, and passive coping as significant predictors *(P<0.001*). Qualitative analysis identified three main themes—experiences of loneliness, influencing factors (internal and external), and coping strategies—comprising seven subthemes. The findings underscore the importance of identifying high-risk patients and implementing targeted interventions, encouraging emotional expression, and providing supportive channels to mitigate loneliness.

KeywordsCancer; Loneliness; Qualitative study; Quantitative study

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Introduction

Loneliness ranks among the most prevalent negative emotional experiences among patients with cancer[1]. Defined as subjective psychological distress stemming from perceived deficiencies in social relationships[2], it has been consistently demonstrated to correlate with elevated mortality rates and adverse mental health outcomes[3, 4]. Beyond its impact on physical health, loneliness may exacerbate anxiety and depressive symptoms, potentially triggering suicidal ideation in severe cases, thereby significantly impairing patients' overall quality of life[5].

Current research on cancer-related loneliness predominantly relies on quantitative methods and focuses primarily on identifying associated factors. Existing evidence indicates that loneliness is influenced by multiple domains, including psychological factors (such as anxiety and depression), cognitive factors (such as negative social expectations), social factors (such as perceived social support), coping strategies, and various demographic characteristics[6-13]. Whilst these studies provide valuable empirical evidence regarding loneliness correlates, they predominantly emphasize statistical associations between variables, offering relatively limited insights into the underlying psychological and contextual mechanisms underpinning the emergence and persistence of loneliness among

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patients with cancer.

Qualitative research has further enriched our understanding of patients' lived experiences by identifying themes such as communication barriers, physical isolation, altered self-perception, disrupted lifestyles, and shifting family roles and interpersonal dynamics[14-16]. These findings underscore the multidimensional and context-dependent nature of loneliness. However, qualitative evidence is often reported separately from quantitative findings, and comprehensive interpretative frameworks integrating measurable factors with experiential dimensions remain underdeveloped.

Despite the gradual expansion of international research on cancer-related loneliness, studies conducted within China remain relatively limited. Existing domestic research primarily focuses on elderly populations or bereaved children[17-20], with comparatively little attention directed specifically towards patients with cancer. Furthermore, empirical investigations systematically integrating quantitative and qualitative research methods within the Chinese sociocultural context are particularly scarce. Given the rapid global rise in cancer incidence[21, 22] and the growing recognition of psychosocial wellbeing as a vital component of oncological care, there is an urgent need for a more comprehensive and contextually informed understanding of loneliness among patients with cancer.

Therefore, to address these identified research gaps, this study employs a sequential explanatory mixed-methods design aiming to: (1) investigate the prevalence of loneliness and its associated factors through quantitative analysis; (2) explore the lived experiences and contextual mechanisms of Chinese patients with cancer through qualitative research. By integrating quantitative and qualitative evidence within a single research framework, this study aims to provide a more comprehensive and systematic understanding of

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cancer-related loneliness and to inform the development of targeted psychosocial interventions.

1 Methods

1.1 Study Design

This study employed a sequential explanatory mixed-methods design conducted in China, incorporating both quantitative and qualitative components.

Quantitative phase: A research framework was established based on a systematic literature review. The study protocol was refined through consultation with oncology clinicians and nursing specialists. A structured survey instrument tailored for Chinese patients was adapted and validated for Chinese patients, Standardized procedures and training ensured data reliability.

Qualitative phase: Semi-structured interviews were guided by descriptive phenomenology, drawing upon the psychological stress systems model and quantitative findings. The interview outline underwent iterative refinement through discussions with managers, team members, and clinical professionals. Eligible participants were selected to ensure diversity in age, occupation, and educational background. Pre-interview validation confirmed question clarity and appropriateness, with adjustments made to maintain rigor.

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1.2 Setting and Participants

Quantitative phase: Patients were recruited via convenience sampling from the oncology and general surgery wards of a tertiary hospital in Jilin Province (March to September 2024). Convenience sampling was adopted due to the accessibility of eligible hospitalized patients within the clinical setting. To minimize potential selection bias, standardized recruitment procedures and clearly defined

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inclusion and exclusion criteria were applied.

Inclusion criteria were: age ≥18 years; diagnosis of cancer via cytology or pathology; aware of their cancer diagnosis; ability to communicate; and voluntary participation with informed consent. Exclusion criteria included severe comorbidities or psychiatric disorders.

The sample size was estimated based on 5–10 times the number of study variables[23]. Considering a potential 10% rate of invalid or incomplete responses, the required sample size ranged from 127 to 253 participants. A total of 260 questionnaires were distributed, and 240 valid questionnaires were returned, yielding a valid response rate of 92.3%.

Qualitative phase: From the survey cohort, 18 participants were purposefully selected to ensure diversity in demographic and clinical characteristics. Participants with varying levels of loneliness were considered, with emphasis placed on those with higher loneliness scores to obtain richer experience.

Inclusion criteria were a Cancer Loneliness Scale (CLS) score ≥ 20(indicating a higher level of loneliness), willingness to participate in interviews and audio recording, and adequate communication ability. The cutoff value of ≥20 was determined according to the quantitative findings of this study, in which the mean CLS score was 19.13 ± 6.26 (range 7–35; mean 2.73 ± 0.89 per item). A score above the mean was considered indicate a higher level of loneliness.

Exclusion criteria included inability to complete extended interviews or concurrent participation in related studies. Final sample size was determined by saturation of findings. Recruitment ceased when data saturation was reached, meaning no new themes emerged.

1.3 Data Collection

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Quantitative data: A pre-survey conducted between January and February 2024 tested relevant tools and protocols. The formal survey (March to September 2024) employed self-administered or researcher-assisted questionnaires. Participants and their families were informed of the study objectives and confidentiality measures. Questionnaires were collected on-site immediately upon completion. Qualitative data: Interviews were conducted in private hospital wards and lasted approximately 30 to 45 minutes. Interviews were audio-recorded and supplemented with filed notes Participants were encouraged to freely express their experiences, with researchers maintaining neutrality to minimize bias. Transcripts were anonymized and verified with participants.

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1.4 Measures and Data Analysis

Measures

The Cancer Loneliness Scale (CLS) was developed by Adams et al[24]. and later translated and culturally adapted into Chinese by Cui et al[25]. The scale consists of 7 items rated on a 5-point Likert scale ranging from 1 (never) to 5 (always). The total score ranges from 7 to 35, with a higher score indicating a higher level of loneliness in patients. The Chinese version has demonstrated good reliability and validity among patients with cancer, with a reported Cronbach's α coefficient of 0.91.

Data Analysis

Quantitative data were double-entered and cross-checked by two independent researchers, and analyzed using SPSS 28.0. Descriptive statistics, ANOVA, correlation, and multiple linear regression were conducted ($P < 0.05$).

Qualitative data were coded using NVivo 12.0 following Colaizzi's

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phenomenological method. Integration of quantitative and qualitative findings was achieved by using qualitative interviews to explore mechanisms suggested by quantitative results.

1.5 Ethical Considerations

This study was approved by the Medical Ethics Committee of Yanbian University (Approval No. 202410150425). Informed consent was obtained from all participants prior to data collection. Anonymity was guaranteed and strict confidentiality was maintained regarding all personal information throughout the survey. All procedures were performed in accordance with the relevant guidelines outlined in the Declaration of Helsinki.

2 Results

2.1 Quantitative Findings

2.1.1 Loneliness Scores and Univariate Analysis

The prevalence of loneliness among patients with cancer was 83.8%, with a mean score of 19.13 ± 6.26 (range 7–35; mean 2.73 ± 0.89 per item). Items with the highest scores reflected feelings of emptiness, detachment, and being misunderstood, as shown in Table 1. Key predictors of elevated loneliness in univariate analysis included introverted personality, absence of primary caregiver, advanced tumor stage, prolonged disease duration, and presence of recurrence or metastasis, Detailed item scores are presented in Supplementary Table 2.

Table 1 Patients with cancer' Perceived Loneliness and Scores on Social Support, Anxiety, Depression, Negative Social Expectations, and Coping Strategies（n=240）

Items	Minimum	Maximum	Score
1. Since being diagnosed with cancer, have you felt that even your closest friends and family	1	5	2.81±1.11

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don't understand you?			
2. Do you feel that others are unable to provide you with the support you need to fight cancer?	1	5	2.67±1.23
3. Since being diagnosed with cancer, have you felt different from the people around you?	1	5	2.43±1.06
4. Do you feel like you can't talk to anyone about your thoughts on cancer?	1	5	2.55±1.15
5. Since being diagnosed with cancer, have you felt that others no longer need you?	1	5	2.73±1.18
6. Since being diagnosed with cancer, have you felt a sense of emptiness?	1	5	3.02±1.14
7. Does a cancer diagnosis make you feel disconnected from others?	1	5	2.94±1.17
Cancer Loneliness Score	7	30	19.13±6.26
Perceived Social Support Total Score	37	80	60.65±8.40
Negative social expectations surrounding cancer	5	25	16.90±4.05
Anxiety	0	15	6.01±3.47
Depression	0	19	7.09±4.47
Passive response	0	24	14.22±4.08
Respond proactively	0	24	13.72±4.40

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Table 2 Univariate Analysis of Loneliness Scores Among Patients with cancer（n=240）

Variables	Category	Frequency	（x ± *S*）	*t/F*	*P*	LSD
Gender	Male	150	19.01±5.92	-0.357	0.722	
	female	90	19.32±6.81			
Age (years)	<45	24	18.54±6.16	1.278	0.238	
	45~59	91	18.91±7.06			
	60~74	93	18.81±6.16			
	≥75	32	21.13±3.45			
Personality	Introverted	56	22.23±5.81	16.540	<0.001	①>③>②
	Extroverted	96	16.70±7.45			
	Intermediate	88	19.81±3.55			
Employment	Employed	38	20.63±4.73	1.497	0.226	
Status	Unemployed	145	18.68±6.80			

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	Retired	57	19.29±5.58			
Educational Attainment	Elementary School or Below	27	20.33±5.12	0.907	0.438	
	Junior High School	116	19.37±7.26			
	High School or Vocational School	68	18.82±3.59			
	College or Higher	29	17.76±7.67			
Per Capita Monthly Household Income (CNY)	<1000	14	17.79±6.58	0.522	0.667	
	1000~2999	136	19.15±5.93			
	3000~5000	74	19.59±6.47			
	>5000	16	18.00±7.92			
Marital Status	Married	32	18.69±6.37	0.992	0.367	
	Single/Unmarried	56	18.84±4.25			
	Divorced	96	19.68±7.06			
	Widowed	88	20.66±5.63			
Living Arrangement	Living with a spouse	112	18.72±5.25	2.023	0.092	
	Living with children	67	20.12±7.11			
	Living with spouse and children	26	16.52±7.92			
	Living alone	22	20.17±5.43			
	Other	13	20.09±1.22			
Primary Caregiver	Spouse	110	18.06±6.43	7.463	<0.001	④③>①② ④>⑤
	Children	65	18.43±6.03			
	Hired Caregiver	35	21.11±5.75			
	No Caregiver	13	26.77±3.56			
	Other	17	18.76±3.46			
Residence	Urban	160	18.58±5.07	1.686	0.095	
	Rural	80	20.24±8.06			
Disease Type	Colorectal Cancer	55	18.96±6.24	0.525	0.757	
	Liver Cancer	47	19.34±6.26			
	Stomach Cancer	44	18.68±6.13			
	Lung Cancer	42	19.71±3.22			
	Breast Cancer	33	19.94±7.94			
	Other	19	17.42±8.48			
Tumor Stage	Stage I	59	17.93±6.71	4.624	0.004	④③>②①
	Stage II	123	18.51±6.50			
	Stage III	31	21.13±4.17			
	Stage IV	27	22.26±4.63			
Duration of Illness	<1 year	161	18.24±5.95	8.764	<0.001	③>②>①
	1–3 years	44	19.32±6.29			
	>3 years	35	22.97±6.31			
Recurrence	Yes	74	20.35±6.27	2.003	0.043	

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or Metastasis	No	166	18.58±6.19

2.1.2 Correlational Analysis and Predictors of Loneliness

Pearson correlation analysis revealed that loneliness was negatively correlated with perceived social support (r = -0.346 to -0.554) and positive coping (r = -0.334). Conversely, it was positively correlated with anxiety (r = 0.415), depression (r = 0.402), negative social expectations (r = 0.725), and negative coping (r = 0.324) (all P < 0.01). Detailed results are presented in Appendix 1.

2.1.3 Multivariate Linear Regression Analysis of Factors Influencing Loneliness

2.1.3.1 Dumb Variable Configuration and Assignment Methods

Variables that were significant in univariate and correlation analyses were entered into the multiple linear regression model. Categorical variables were coded as dummy variables, with detailed assignments provided in Appendix 2.

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2.1.3.2 Multivariate Linear Stepwise Regression Analysis of Loneliness

The multiple linear stepwise regression identified seven significant predictors of loneliness: introverted personality, absence of a primary caregiver, disease duration >3 years, negative social expectations, perceived social support, depression severity, and negative coping. The model demonstrated good fit (F = 70.495, P < 0.001), explaining 67.1% of the variance (adjusted R^2 = 0.671). No significant multicollinearity was detected (TOL = 0.594–0.937; VIF = 1.068–1.683). The final regression equation is presented in Table

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3.

Table 3 Multivariate Linear Regression Analysis Results of Factors Influencing Loneliness in Patients with cancer

Variables	*B*	SE	*Beta*	t	*P*	TOL	VIF
(Constant)	13.808	3.092		4.446	<0.001		
Personality (Introverted)	1.717	0.567	0.116	3.030	0.003	0.937	1.068
Primary caregiver (No caregiver)	4.213	1.064	0.153	3.958	<0.001	0.927	1.079
Duration of illness (>3 years)	2.292	0.683	0.130	3.358	0.001	0.927	1.070
Perceived social support	-0.177	0.036	-0.238	-4.979	<0.001	0.604	1.656
Depression	0.212	0.060	0.151	3.540	<0.001	0.755	1.325
Negative societal expectations of cancer	0.655	0.074	0.424	8.799	<0.001	0.594	1.683
Negative coping	0.203	0.072	0.111	2.821	0.005	0.887	1.127

Note：R^2=0.680，Adjusted R^2=0.671，F=70.495，P＜0.001

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2.2 Qualitative Findings

2.2.1 Participant Characteristics

Eighteen patients with cancer were interviewed (5 males, 13 females; age range 28–72 years, mean 54.28 ± 11.31 years). Participants were numbered N1 to N18 (Appendix 3). Detailed data are provided in Appendix 3.

2.2.2 Themes and Subthemes

Three primary themes and seven subthemes were identified:

Theme 1: Experiences of Loneliness

- Uncertainty about the future: Loneliness associated with physical suffering and fear of an uncertain future.

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- Isolation and alienation: Social withdrawal and misunderstanding exacerbated feelings of isolation.
- Guilt and shame: Societal and cultural biases contributed to self-blame.

Theme 2: Factors Influencing Loneliness

- Internal: Symptom burden, emotional isolation.
- External: Social prejudice, variable support from family and friends.

Theme 3: Coping Strategies

- Concealing Illness: Withholding diagnosis to avoid pity or misunderstanding.
- Seeking Empathy: Actively seeking emotional support from family, friends, or peers.

Detailed data are provided in Table 4.

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Table 4 Themes Identified in Qualitative Analysis of Loneliness

Theme	Sub-theme	Category
Experiences of loneliness	Uncertainty about the future	
	Isolation and social distancing	
	Depression and feelings of shame	
Factors influencing loneliness	Internal factors	Symptom burden
		Emotional loneliness
	External factors	Social stigma
		Support from family and friends
Coping strategies for loneliness	Concealing the illness	
	Seeking empathy and understanding	

2.3 Integration of Quantitative and Qualitative Findings

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Quantitative results identified key predictors of loneliness, while qualitative data provided rich insights into patients' experiences and coping strategies. For instance, introverted patients with limited social support not only scored higher on loneliness scales but also described emotional withdrawal and reluctance to seek help. Negative social expectations and stigma highlighted in interviews reinforced the statistical association between social prejudice and loneliness. This integration supports a multidimensional understanding of cancer-related loneliness, encompassing personal, disease-related, psychological, and social factors.

3 Discussion

3.1 Loneliness Among Patients with Cancer Remains High

This study found that patients with cancer scored 19.13 ± 6.26 on loneliness scales, with a prevalence rate of 83.8%, indicating moderately elevated loneliness. These findings align with previous research on similar hospitalized populations[26, 27]. Compared to community survivors reported by Zhan et al[28], the prevalence in this study was slightly lower, potentially reflecting the additional social support accessible to hospitalized patients under intensive care[29].

Qualitative interviews confirmed the pervasiveness of loneliness, revealing its complex emotional dimensions, including uncertainty about the future, isolation, and guilt. Non-verbal expressions such as crying, sighing, and prolonged silences underscored the profound distress experienced. These findings align with previous phenomenological studies on the emotional burden of loneliness in patients with cancer[14, 16].

3.2 Factors Associated with Loneliness

3.2.1 Personal Factors

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Introverted patients reported higher levels of loneliness, aligning with prior research linking introversion to social withdrawal and emotional isolation[30]. Qualitative data indicated these patients were less inclined to seek support and more inclined to manage stress independently, thereby exacerbating loneliness.

Depression scores positively correlated with loneliness, reflecting a reciprocal relationship wherein depressive symptoms reduce social engagement and intensify isolation[13, 31]. Similarly, negative social expectations and maladaptive coping strategies were associated with heightened loneliness, suggesting that patients' anticipatory beliefs about social interactions and reliance on negative coping mechanisms amplify psychological distress[32, 33].

3.2.2 Disease-Related Factors

Loneliness increases with tumor stage and disease duration, consistent with prior research[12, 34]. Patients with advanced disease face both physical limitations—including pain, fatigue, and treatment side effects—and heightened psychological stressors such as fear of mortality, which reduce social engagement and weaken support networks. Prolonged illness also places sustained strain on family support systems over time, contributing to persistent loneliness.

3.2.3 Social Factors

Social support emerges as a crucial buffer against loneliness. Patients reporting stronger family support experienced lower loneliness, while limited friendship support reflected diminished social interaction among older patients. The presence of a primary carer significantly alleviated loneliness, underscoring the role of sustained emotional and practical support[6]. Qualitative data

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indicated that social prejudice and perceived stigmatization led to self-isolation, emphasizing the necessity of addressing both structural and interpersonal loneliness.

3.3 Integration of Quantitative and Qualitative Findings

Comprehensive analysis indicates loneliness is multidimensional, influenced by personal, disease-related, and social factors. Quantitative predictors such as introversion, depression, negative social expectations, and limited social support are mirrored in qualitative themes including isolation, emotional suppression, and reliance on coping strategies. This integration reinforces the conceptual understanding of loneliness within psychological stress systems frameworks, demonstrating how stressors interact with individual characteristics and social environments to influence psychological outcomes.

The study' s findings have certain implications for Clinical Practice. Effective interventions should target multiple dimensions: at the psychological level, Healthcare professionals should identify depressive symptoms and support patients in adopting adaptive coping strategies, including participation in peer support and expressive interventions[35, 36]. At the social support level, Clinicians should facilitate family involvement, promote carer education, and encourage participation in broader social networks to alleviate loneliness. Online and community support groups can provide platforms for social interaction and mutual aid. At the social cognitive, Public education campaigns can reduce stigma, enhance societal understanding, and foster environments conducive to social reintegration.

4 Limitations

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This study has several limitations. Firstly, the cross-sectional design precludes causal inference. Secondly, the hospital-based sample may not represent community-dwelling patients. Thirdly, while rich in content, qualitative interviews may be subject to recall and social desirability biases. Finally, the sequential design limited integration between quantitative and qualitative phases, suggesting that future studies employing fully integrated mixed-methods designs may yield stronger conceptual insights.

5 Conclusion

Patients with cancer commonly experience loneliness, a complex and distressing emotional state. Drawing upon the psychological stress systems model, this study categorizes factors influencing loneliness into four domains:

- Personal factors—personality traits, emotional isolation, coping styles, and negative societal expectations.
- Disease factors—tumor stage, disease duration, symptom burden, and recurrence or metastasis.
- Psychological factors—anxiety and depression.
- Social factors—social support and perceived stigma.

Clinical practice should prioritize high-risk patients and deliver targeted interventions. Encouraging emotional expression, guiding patients towards adaptive coping strategies such as seeking support, and providing timely psychological interventions can help reduce loneliness and enhance overall well-being.

Data availability

The datasets generated and analysed during the current study are not publicly available due to privacy and ethical restrictions on patient data, but are available from the corresponding author upon

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reasonable request.

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Author Contributions

Drafting the article and interpretation of analysis results: Xue Wang and Yanping Li; data acquisition: Xue Wang, Aiping Zhang and Lei Zhang; data analysis: Xue Wang and Yanping Li; manuscript preparation and revision: Zhao Liu and Cancan Han; conception and design of the study, interpretation of analysis results and final approval of the version to be submitted: Meixiang Jin and Yinji Jin.

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Declarations

Competing interests

The authors declare no competing interests

Ethics approval

This study was approved by the Approval to conduct the study was obtained from the study university and the Institutional Review Board (Approval no. 202410150425).

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Table 1 Patients with cancer' Perceived Loneliness and Scores on Social Support, Anxiety, Depression, Negative Social Expectations, and Coping Strategies（n=240）

Items	Minimum	Maximum	Score
1. Since being diagnosed with cancer, have you felt that even your closest friends and family don't understand you?	1	5	2.81±1.11
2. Do you feel that others are unable to provide you with the support you need to fight cancer?	1	5	2.67±1.23
3. Since being diagnosed with cancer, have you felt different from the people around you?	1	5	2.43±1.06
4. Do you feel like you can't talk to anyone about your thoughts on cancer?	1	5	2.55±1.15
5. Since being diagnosed with cancer, have you felt that others no longer need you?	1	5	2.73±1.18
6. Since being diagnosed with cancer, have you felt a sense of emptiness?	1	5	3.02±1.14
7. Does a cancer diagnosis make you feel disconnected from others?	1	5	2.94±1.17
Cancer Loneliness Score	7	30	19.13±6.26
Perceived Social Support Total Score	37	80	60.65±8.40
Negative social expectations surrounding cancer	5	25	16.90±4.05
Anxiety	0	15	6.01±3.47
Depression	0	19	7.09±4.47
Passive response	0	24	14.22±4.08
Respond proactively	0	24	13.72±4.40

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Table 2 Univariate Analysis of Loneliness Scores Among Patients with cancer（n=240）

Variables	Category	Frequency	（x ± S）	t/F	P	LSD
Gender	Male	150	19.01±5.92	-0.357	0.722	
	female	90	19.32±6.81			
Age (years)	<45	24	18.54±6.16	1.278	0.238	
	45~59	91	18.91±7.06			
	60~74	93	18.81±6.16			
	≥75	32	21.13±3.45			
Personality	Introverted	56	22.23±5.81	16.540	<0.001	①>③>②
	Extroverted	96	16.70±7.45			
	Intermediate	88	19.81±3.55			
Employment	Employed	38	20.63±4.73	1.497	0.226	
Status	Unemployed	145	18.68±6.80			
	Retired	57	19.29±5.58			
Educational	Elementary School or	27	20.33±5.12	0.907	0.438	
Attainment	Below					
	Junior High School	116	19.37±7.26			
	High School or	68	18.82±3.59			
	Vocational School					
	College or Higher	29	17.76±7.67			
Per Capita	<1000	14	17.79±6.58	0.522	0.667	
Monthly	1000~2999	136	19.15±5.93			
Household	3000~5000	74	19.59±6.47			
Income	>5000	16	18.00±7.92			
(CNY)						
Marital	Married	32	18.69±6.37	0.992	0.367	
Status	Single/Unmarried	56	18.84±4.25			
	Divorced	96	19.68±7.06			
	Widowed	88	20.66±5.63			
Living	Living with a spouse	112	18.72±5.25	2.023	0.092	

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Arrangement	Living with children	67	20.12±7.11			
	Living with spouse and children	26	16.52±7.92			
	Living alone	22	20.17±5.43			
	Other	13	20.09±1.22			
Primary Caregiver	Spouse	110	18.06±6.43	7.463	<0.001	④③>①② ④>⑤
	Children	65	18.43±6.03			
	Hired Caregiver	35	21.11±5.75			
	No Caregiver	13	26.77±3.56			
	Other	17	18.76±3.46			
Residence	Urban	160	18.58±5.07	1.686	0.095	
	Rural	80	20.24±8.06			
Disease Type	Colorectal Cancer	55	18.96±6.24	0.525	0.757	
	Liver Cancer	47	19.34±6.26			
	Stomach Cancer	44	18.68±6.13			
	Lung Cancer	42	19.71±3.22			
	Breast Cancer	33	19.94±7.94			
	Other	19	17.42±8.48			
Tumor Stage	Stage I	59	17.93±6.71	4.624	0.004	④③>②①
	Stage II	123	18.51±6.50			
	Stage III	31	21.13±4.17			
	Stage IV	27	22.26±4.63			
Duration of Illness	<1 year	161	18.24±5.95	8.764	<0.001	③>②>①
	1–3 years	44	19.32±6.29			
	>3 years	35	22.97±6.31			
Recurrence or Metastasis	Yes	74	20.35±6.27	2.003	0.043	
	No	166	18.58±6.19			

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Table 3 Multivariate Linear Regression Analysis Results of Factors Influencing Loneliness in Patients with cancer

Variables	*B*	SE	*Beta*	t	*P*	TOL	VIF
(Constant)	13.808	3.092		4.446	<0.001		
Personality (Introverted)	1.717	0.567	0.116	3.030	0.003	0.937	1.068
Primary caregiver (No caregiver)	4.213	1.064	0.153	3.958	<0.001	0.927	1.079
Duration of illness (>3 years)	2.292	0.683	0.130	3.358	0.001	0.927	1.070
Perceived social support	-0.177	0.036	-0.238	-4.979	<0.001	0.604	1.656
Depression	0.212	0.060	0.151	3.540	<0.001	0.755	1.325
Negative societal expectations of cancer	0.655	0.074	0.424	8.799	<0.001	0.594	1.683
Negative coping	0.203	0.072	0.111	2.821	0.005	0.887	1.127

Note：R^2=0.680，Adjusted R^2=0.671，F=70.495，P＜0.001

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Table 4 Themes Identified in Qualitative Analysis of Loneliness

Theme	Sub-theme	Category
Experiences of loneliness	Uncertainty about the future	
	Isolation and social distancing	
	Depression and feelings of shame	
Factors influencing loneliness	Internal factors	Symptom burden
		Emotional loneliness
	External factors	Social stigma
		Support from family and friends
Coping strategies for loneliness	Concealing the illness	
	Seeking empathy and understanding	

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