Tohoku J. Exp. Med., 2024, **264**, 169-178

Loneliness, Spiritual Well-Being, Anxiety, Depression, and Attitude to Death of Gastrointestinal Cancer Patients Treated with Rumor Resection

Huikun Cao[1] and Heng Zhou[2]

[1]Department of Nursing, Shunyi Hospital, Beijing Hospital of Traditional Chinese Medicine, Beijing, China
[2]Department of Surgery, Shunyi Hospital, Beijing Hospital of Traditional Chinese Medicine, Beijing, China

Gastrointestinal cancer (GIC) patients with tumor resection may experience surgical complications, economic burden, and weakened social connection, which could lead to adverse psychological status. Thus, this study aimed to explore multidimensional psychological status of these patients, encompassing loneliness, spiritual well-being, anxiety, depression, and attitudes to death. Totally, 210 GIC patients with tumor resection and 50 healthy controls (HCs) were enrolled to complete the University of California Los Angeles loneliness (UCLA-LS), functional assessment of chronic illness therapy-spiritual well-being (FACIT-Sp), hospital anxiety and depression scale-anxiety/depression (HADS-A/D), and death attitude profile-revised (DAP-R) scales. UCLA-LS score was increased ($P < 0.001$), while FACIT-Sp score was decreased ($P < 0.001$) in GIC patients than HCs. Additionally, HADS-A score ($P < 0.001$), anxiety rate ($P < 0.001$), moderate to severe anxiety rate ($P < 0.001$), HADS-D score ($P < 0.001$), depression rate ($P < 0.001$), and moderate to severe depression rate ($P = 0.011$) were all elevated in GIC patients versus HCs. Concerning attitude to death, DAP-R scores for fear of death ($P < 0.001$) and death avoidance ($P < 0.001$) were increased, and the scores for neutral ($P < 0.001$) and approach ($P = 0.010$) acceptance were declined in GIC patients than HCs. Notably, female sex, unmarried status, and drinking history were independently linked with increased UCLA-LS score, but gastric cancer was independently associated with decreased UCLA-LS score (all $P < 0.050$). Neoadjuvant therapy was independently related to anxiety ($P = 0.012$). Female sex was independently correlated with depression ($P = 0.006$). In conclusion, GIC patients with tumor resection experience loneliness, anxiety, depression, and reduced spiritual well-being. They tend to fear and avoid, rather than accept death.

Keywords: anxiety and depression; attitude to death; loneliness, spiritual well-being; postoperative gastrointestinal cancer.

Tohoku J. Exp. Med., 2024 December, **264** (4), 169-178.
doi: 10.1620/tjem.2024.J065

Introduction

Gastrointestinal cancer (GIC), including gastric cancer (GC) and colorectal cancer (CRC), accounts for 15.4% of cancer incidence and 17.0% of cancer deaths globally in 2020 (Kuntz et al. 2021; Sung et al. 2021). Although surgical resection, the standard treatment, has provided survival benefit for resectable patients, many GIC patients will unavoidably encounter psychological problems after tumor resection (Benson et al. 2021, 2022; Zhou and Sun 2021; Ajani et al. 2022; Liu and Wang 2022; Li and Ma 2023). Thereby, assessing psychological status of GIC patients treated with tumor resection is necessary.

GIC patients treated with tumor resection face some surgical complications, such as postoperative bowel obstruction and anastomotic leak, which may increase anxiety and depression in postoperative GIC patients (Pinto et al. 2016; Baiocchi et al. 2019; Pallan et al. 2021). Besides, the costs of surgery, medications, and supportive treatment elevate the economic burden of GIC patients treated with tumor resection, which also elevates their anxiety and depression (Jones et al. 2020; Rice et al. 2020). Previously,

Received April 2, 2024; revised and accepted July 3, 2024; J-STAGE Advance online publication July 18, 2024

Correspondence: Heng Zhou, Department of Surgery, Shunyi Hospital, Beijing Hospital of Traditional Chinese Medicine, No. 1, Jiansheng Street, Shunyi District, Beijing 101300, China.
e-mail: zhouheng8312@163.com

some studies have reported that GIC patients treated with tumor resection experience anxiety and depression (Zhou and Sun 2021; Liu and Wang 2022; Li and Ma 2023). For instance, in a previous study, the incidence of anxiety and depression reaches 39.7% and 33.4% in postoperative GIC patients, accordingly (Li and Ma 2023). Besides, anxiety and depression gradually worsen in GIC patients treated with surgical resection after discharge (Zhou and Sun 2021; Liu and Wang 2022). Nevertheless, more clinical evidence of anxiety and depression as well as the associated factors in GIC patients treated with tumor resection are needed for validation.

Due to the unavoidable hospitalization after tumor resection, the social connection is weakened and loneliness is exacerbated in GIC patients treated with tumor resection (Camlica and Koc 2024). Moreover, loneliness is associated with anxiety and depression (Pilleron et al. 2023). Some studies notice that CRC patients treated with tumor resection frequently suffer from the feeling of loneliness (Pape et al. 2022; Sivero et al. 2022). While loneliness and its related factors in GIC patients treated with tumor resection remain unclear. Apart from loneliness, spiritual well-being is also an important aspect that affects quality of life (QoL) and death anxiety in GIC patients (Nezami et al. 2020; Yilmaz and Cengiz 2020). But only a small number of studies assess spiritual well-being of GIC patients treated with tumor resection (Clay et al. 2010; Li et al. 2012; Nezami et al. 2020; Yilmaz and Cengiz 2020). More importantly, the related factors of spiritual well-being in these patients also need further exploration.

Attitude to death may influence cancer patients' medical decisions and spirituality (Francalancia et al. 2021; Sallnow et al. 2022). Consequently, it is essential to assess attitude to death of GIC patients treated with tumor resection. Previously, several studies report that death anxiety, fear of death, and suicide ideation occur in GIC patients (Choi et al. 2014; Nezami et al. 2020; Lim et al. 2022). In one study, 18.8% of GIC women exhibit severe level of death anxiety (Nezami et al. 2020). In another study, 34.7% of GC survivors experienced suicide ideation (Choi et al. 2014). However, attitude to death is multidimensional, including fear, avoidance, and different types of acceptance (Brudek et al. 2020), which needs further investigation in GIC patients treated with tumor resection.

Hence, this study intended to explore multidimensional psychological status in GIC patients treated with tumor resection, including anxiety, depression, loneliness, spiritual well-being, and attitude to death.

Methods

Patients and healthy subjects

A total of 210 GIC patients who were treated with tumor resection between May 2021 and June 2023 were consecutively enrolled. Patients who met all of the following criteria were included: 1) were diagnosed as CRC or GC via pathological examination; 2) aged ≥ 18 years; 3) treated with tumor resection; 4) had the ability to complete the evaluation scales independently. Patients who met 1 of the following criteria were excluded: 1) had distant metastasis; 2) combined with other malignant diseases; 3) survival expectations ≤ 12 months; 4) had a history of severe neuropathy or mental illness. Fifty healthy subjects (age- and sex-matching) were enrolled as healthy controls (HCs) during the same period. The inclusion criteria were: 1) had no abnormalities on physical examination before enrollment; 2) aged ≥ 18 years; 3) could complete the evaluation scales independently. The exclusion criteria were a history of severe neuropathy or mental illness. The study was approved by the Ethics Committee. Total participants signed the informed consent form.

Data collection and evaluations

The baseline characteristics of the patients were col-

Table 1. Baseline characteristics.

Characteristics	GIC patients (N = 210)
Age (years), mean ± SD	58.9 ± 11.5
Age ≥ 60 years, n (%)	
No	101 (48.1)
Yes	109 (51.9)
Female, n (%)	66 (31.4)
Education degree, n (%)	
Primary school and less	52 (24.8)
Middle school	77 (36.7)
High school	47 (22.3)
University and above	34 (16.2)
Marital status, n (%)	
Married	160 (76.2)
Unmarried	50 (23.8)
Smoking history, n (%)	87 (41.4)
Drinking history, n (%)	63 (30.0)
Diagnosis of disease, n (%)	
CRC	127 (60.5)
GC	83 (39.5)
Tumor-cell differentiation, n (%)	
Well	44 (21.0)
Intermediate	113 (53.8)
Poor	53 (25.2)
TNM stage, n (%)	
I	31 (14.7)
II	110 (52.4)
III	69 (32.9)
Tumor resection, n (%)	210 (100.0)
Adjuvant therapy, n (%)	165 (78.6)
Neoadjuvant therapy, n (%)	43 (20.5)
Days from surgery to survey (days), median (range)	14.5 (1.0-31.0)

GIC; gastrointestinal cancer, SD; standard deviation, GC; gastric cancer, CRC; colorectal cancer, TNM; tumor node metastasis.

lected after enrollment. The University of California Los Angeles loneliness scale (UCLA-LS), functional assessment of chronic illness therapy-spiritual well-being scale (FACIT-Sp), hospital anxiety and depression scale (HADS)-anxiety (A), hospital anxiety and HADS-depression (D), and death attitude profile-revised (DAP-R) were completed by the patients at discharge and by HCs after enrollment.

The UCLA-LS was used to evaluate the general level of loneliness. The scale consisted of 20 items, and each item was scored on four levels (never, rarely, sometimes, often), with a maximum of four points and a minimum of one point for each level. The total score ranged from 20-80, with higher scores representing severe loneliness (Durmus and Ozturk 2022). The FACIT-Sp was used to assess the patient's mental life. The scale contained 12 items scored on a five-point Likert scale. The total score was the sum of the item scores, ranging from 0-48 points. Higher scores indicated a greater spiritual life (Machul et al. 2023). The HADS scale was used to reflect the patient's anxiety and depression. The scale included fourteen items, seven items for measuring anxiety levels, and seven items for measuring depression levels. Responses to each item were divided into four grades (0-3 points), and the total scores ranged from 0-21 for both the HADS-A and HADS-D scales. Higher scores represented higher levels of anxiety or depression. Patients were diagnosed with anxiety or depression if their scores were greater than or equal to 8, and were diagnosed with moderate to severe anxiety or depression if scores were greater than or equal to 11 (Snaith 2003). The DAP-R scale consisted of 32 items assessing patients' attitude to death in 5 dimensions (fear of death, death avoidance, neutral acceptance, approaching acceptance, and escape acceptance) (Tang et al. 2014). Each item was graded on five levels ("strongly disagree" to "strongly agree," 1-5 points). The mean score of each dimension was the final score. Whichever dimension had the highest score indicated that the patients tend towards the attitude of death represented by that dimension (Li et al. 2021).

Statistical analysis

Data were analyzed via SPSS 23.0 (IBM Corp., Armonk, New York, USA). T-tests were applied to compare scale scores between patients and HCs, and Chi-square tests were applied to compare anxiety and depression rate. Univariate and multivariate linear regression were utilized to analyze the correlation between scale scores and patients' baseline characteristics. Univariate and multivariate logistic regression were utilized to analyze which factors were correlated with the anxiety and depression of the patients. *P*-values less than 0.05 were considered statistically different.

Results

Baseline characteristics of GIC patients treated with tumor resection

The mean age of GIC patients treated with tumor resection was 58.9 ± 11.5 years and 109 (51.9%) patients were aged ≥ 60 years. There were 66 (31.4%) female patients. Regarding tumor node metastasis (TNM) stage, 31 (14.7%), 110 (52.4%), and 69 (32.9%) patients were identified as TNM stage I, II, and III, correspondingly. A total of 165 (78.6%) and 43 (20.5%) patients received adjuvant and neoadjuvant therapy, respectively. The detailed information of demographics, disease features, and therapy was listed in Table 1.

Comparison of UCLA-LS and FACIT-Sp scores between GIC patients treated with tumor resection and HCs

UCLA-LS score was increased in GIC patients treated with tumor resection compared to HCs ($P < 0.001$). The mean UCLA-LS score was 29.6 ± 5.6 and 25.0 ± 2.6 in GIC patients treated with tumor resection and HCs, respec-

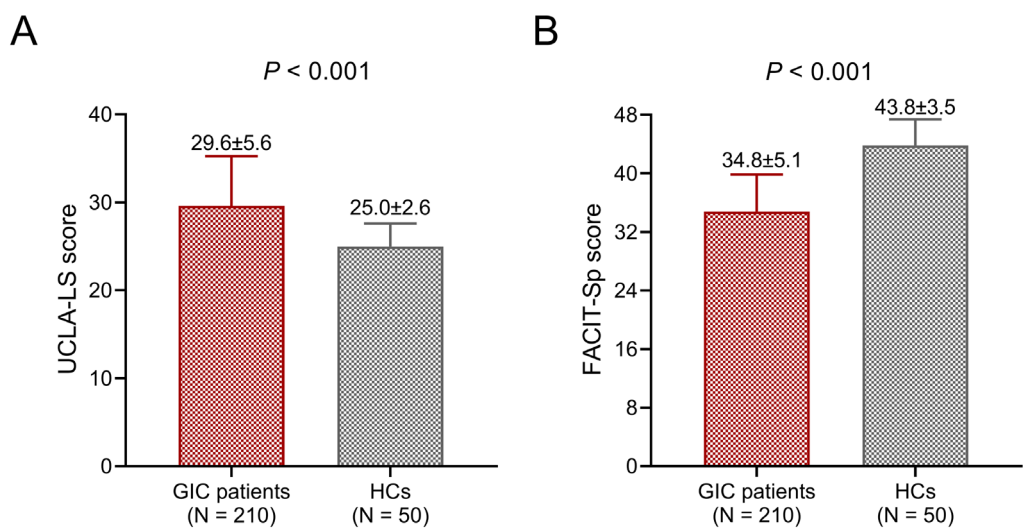

Fig. 1. Loneliness and spiritual well-being in GIC patients treated with tumor resection and HCs.
Comparison of UCLA-LS score (A) and FACIT-Sp score (B) between GIC patients treated with tumor resection and HCs.

tively (Fig. 1A). FACIT-Sp score was decreased in GIC patients treated with tumor resection than HCs ($P < 0.001$). The mean FACIT-Sp score was 34.8 ± 5.1 in GIC patients treated with tumor resection and 43.8 ± 3.5 in HCs (Fig. 1B).

Related factors of UCLA-LS and FACIT-Sp scores in GIC patients treated with tumor resection

Univariate linear regression analysis showed that age ≥ 60 years (yes versus (vs.) no) ($P = 0.005$), gender (female vs. male) ($P = 0.003$), and marital status (unmarried vs. married) ($P < 0.001$) were associated with increased UCLA-LS score, while diagnosis of disease (GC vs. CRC) ($P = 0.018$) was linked with decreased UCLA-LS score. By multivariate linear regression analysis, gender (female vs. male) ($B = 1.893$, $P = 0.026$), marital status (unmarried vs. married) ($B = 2.821$, $P = 0.003$), and drinking history (yes vs. no) ($B = 1.933$, $P = 0.025$) were independently related to increased UCLA-LS score. On the contrary, diagnosis of disease (GC vs. CRC) was independently associated with reduced UCLA-LS score in GIC patients treated with tumor resection ($B = -2.052$, $P = 0.041$) (Table 2).

Concerning the spiritual well-being, age ≥ 60 years (yes vs. no) ($P = 0.022$), worse tumor-cell differentiation ($P = 0.040$), and higher TNM stage ($P = 0.022$) were related to declined FACIT-Sp score. However, no factor was inde-

Table 2. Univariate and multivariate linear regression of UCLA-LS score in GIC patients.

Characteristics	UCLA-LS score									
	Univariate linear regression					Multivariate linear regression				
	B	SE	β	*P* value	VIF	B	SE	β	*P* value	VIF
Age ≥ 60 years, yes vs. no	2.166	0.765	0.192	0.005	1.000	1.007	0.809	0.090	0.215	1.221
Gender, female vs. male	2.456	0.822	0.203	0.003	1.000	1.893	0.842	0.156	0.026	1.143
Education degree, high school & university and above vs. primary school and less & middle school	−0.385	0.800	−0.033	0.631	1.000	−0.491	0.803	−0.043	0.541	1.142
Marital status, unmarried vs. married	3.204	0.888	0.243	< 0.001	1.000	2.821	0.926	0.214	0.003	1.164
Smoking history, yes vs. no	−0.763	0.789	−0.067	0.335	1.000	−1.153	0.826	−0.101	0.164	1.240
Drinking history, yes vs. no	0.998	0.848	0.081	0.241	1.000	1.933	0.855	0.158	0.025	1.149
Diagnosis of disease, GC vs. CRC	−1.880	0.786	−0.164	0.018	1.000	−2.052	0.998	−0.178	0.041	1.780
Worse tumor-cell differentiation	−0.068	0.575	−0.008	0.906	1.000	−0.349	0.569	−0.042	0.541	1.114
Higer TNM stage	0.896	0.582	0.106	0.125	1.000	0.437	0.899	0.052	0.627	2.678
Adjuvant therapy, yes vs. no	0.958	0.948	0.070	0.313	1.000	1.325	1.361	0.097	0.331	2.334
Neoadjuvant therapy, yes vs. no	−0.720	0.965	−0.052	0.456	1.000	0.381	1.205	0.027	0.752	1.767

GIC; gastrointestinal cancer, UCLA-LS; University of California Los Angeles loneliness scale, SE; standard error, VIF; variance inflation factor, GC; gastric cancer, CRC; colorectal cancer, TNM; tumor node metastasis.

Table 3. Univariate and multivariate linear regression of FACIT-Sp score in GIC patients.

Characteristics	FACIT-Sp score									
	Univariate linear regression					Multivariate linear regression				
	B	SE	β	*P* value	VIF	B	SE	β	*P* value	VIF
Age ≥ 60 years, yes vs. no	−1.596	0.693	−0.158	0.022	1.000	−1.275	0.760	−0.126	0.095	1.221
Gender, female vs. male	−0.063	0.756	−0.006	0.933	1.000	0.126	0.791	0.012	0.874	1.143
Education degree, high school & university and above vs. primary school and less & middle school	0.510	0.720	0.049	0.480	1.000	0.768	0.754	0.074	0.310	1.142
Marital status, unmarried vs. married	−1.162	0.820	−0.098	0.158	1.000	−0.877	0.870	−0.074	0.315	1.164
Smoking history, yes vs. no	0.071	0.712	0.007	0.920	1.000	0.538	0.776	0.052	0.489	1.240
Drinking history, yes vs. no	−0.692	0.764	−0.063	0.366	1.000	−1.080	0.804	−0.098	0.180	1.149
Diagnosis of disease, GC vs. CRC	0.932	0.714	0.090	0.193	1.000	1.100	0.937	0.106	0.242	1.780
Worse tumor-cell differentiation	−1.056	0.512	−0.142	0.040	1.000	−0.806	0.535	−0.108	0.133	1.114
Higer TNM stage	−1.201	0.520	−0.158	0.022	1.000	−0.301	0.844	−0.040	0.722	2.678
Adjuvant therapy, yes vs. no	−1.574	0.848	−0.128	0.065	1.000	−1.585	1.279	−0.129	0.217	2.334
Neoadjuvant therapy, yes vs. no	−0.403	0.869	−0.032	0.643	1.000	−0.800	1.132	−0.064	0.480	1.767

GIC; gastrointestinal cancer, FACIT-Sp; functional assessment of chronic illness therapy-spiritual well-being scale, SE; standard error, VIF; variance inflation factor, GC; gastric cancer, CRC; colorectal cancer, TNM; tumor node metastasis.

pendently associated with FACIT-Sp score in GIC patients treated with tumor resection (all $P > 0.050$) (Table 3).

Comparison of HADS-A and HADS-D scores between GIC patients treated with tumor resection and HCs

HADS-A score was elevated in GIC patients treated with tumor resection vs. HCs (8.9 ± 3.0 vs. 4.8 ± 2.5, $P < 0.001$) (Fig. 2A). Anxiety rate of GIC patients treated with tumor resection was higher than that of HCs (58.6% vs. 8.0%, $P < 0.001$) (Fig. 2B). In addition, the moderate to severe anxiety rate was also increased in GIC patients treated with tumor resection compared to HCs (25.7% vs. 2.0%, $P < 0.001$) (Fig. 2C). Regarding depression, HADS-D score was elevated in GIC patients treated with tumor resection compared with HCs (7.7 ± 2.6 vs. 5.1 ± 2.4, $P < 0.001$) (Fig. 2D). GIC patients treated with tumor resection had an increased depression rate compared to HCs (39.0% vs. 10.0%, $P < 0.001$) (Fig. 2E). The moderate to severe depression rate was also elevated in GIC patients treated with tumor resection compared to HCs (15.2% vs. 2.0%, $P = 0.011$) (Fig. 2F).

Related factors of anxiety and depression in GIC patients treated with tumor resection

By univariate logistic regression analysis, gender (female vs. male) ($P = 0.028$), higher TNM stage ($P = 0.025$), and neoadjuvant therapy (yes vs. no) ($P = 0.020$) were associated with enhanced risk of anxiety. After adjustment, neoadjuvant therapy (yes vs. no) was independently linked with increased anxiety risk in GIC patients treated with tumor resection (odd ratio (OR): 3.751, $P = 0.012$) (Table 4).

As for depression, gender (female vs. male) ($P = 0.002$), higher TNM stage ($P = 0.003$), adjuvant therapy (yes vs. no) ($P = 0.011$), and neoadjuvant therapy (yes vs. no) ($P = 0.031$) were linked with elevated risk of depression. Moreover, gender (female vs. male) was independently correlated with increased depression risk in GIC patients treated with tumor resection (OR: 2.615, $P = 0.006$) (Table 5).

Comparison of DAP-R scores between GIC patients treated with tumor resection and HCs

DAP-R score for fear of death was increased in GIC patients treated with tumor resection compared to HCs (3.8 ± 0.6 vs. 2.9 ± 0.9, $P < 0.001$). The score for death avoidance also showed an increase in GIC patients treated with tumor resection than HCs (3.3 ± 0.7 vs. 2.7 ± 0.7, $P < 0.001$). Besides, the scores for neutral acceptance (2.4 ± 0.7 vs. 3.4 ± 1.0, $P < 0.001$) and approach acceptance (2.0 ± 0.6 vs. 2.3 ± 0.8, $P = 0.010$) were declined in GIC patients treated with tumor resection than HCs, while the score for escape acceptance was not different between them (2.8 ± 0.8 vs. 2.6 ± 1.0, $P = 0.310$) (Fig. 3).

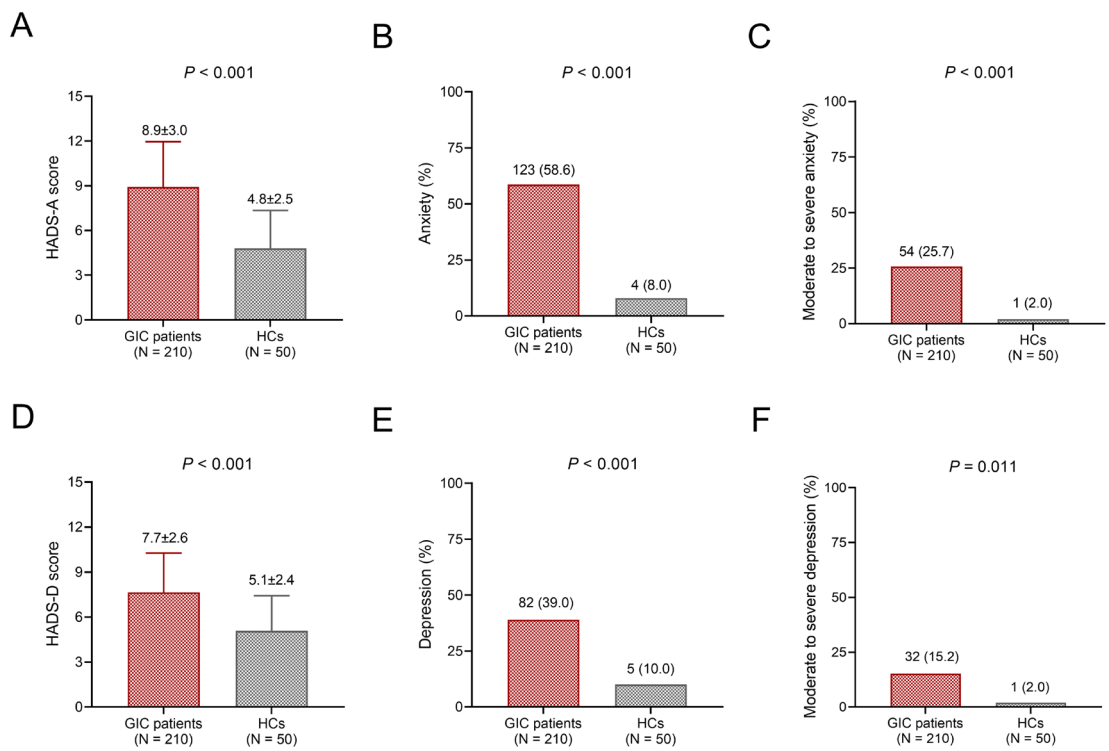

Fig. 2. Anxiety and depression in GIC patients treated with tumor resection and HCs.
Comparison of HADS-A score (A), anxiety rate (B), and moderate to severe anxiety rate (C) between GIC patients treated with tumor resection and HCs. Comparison of HADS-D score (D), depression rate (E), and moderate to severe depression rate (F) between GIC patients treated with tumor resection and HCs.

Table 4. Univariate and multivariate logistic regression of anxiety in GIC patients.

Characteristics	Anxiety					
	Univariate logistic regression			Multivariate logistic regression		
	OR	95% CI	*P* value	OR	95% CI	*P* value
Age ≥ 60 years, yes vs. no	1.626	(0.935-2.826)	0.085	1.455	(0.765-2.769)	0.253
Gender, female vs. male	2.001	(1.078-3.715)	0.028	1.773	(0.890-3.531)	0.103
Education degree, high school & university and above vs. primary school and less & middle school	0.817	(0.466-1.435)	0.482	0.647	(0.341-1.227)	0.182
Marital status, unmarried vs. married	1.909	(0.967-3.770)	0.062	1.733	(0.804-3.736)	0.161
Smoking history, yes vs. no	0.727	(0.416-1.268)	0.261	0.651	(0.337-1.257)	0.201
Drinking history, yes vs. no	1.009	(0.554-1.838)	0.976	1.370	(0.689-2.722)	0.369
Diagnosis of disease, GC vs. CRC	0.951	(0.543-1.667)	0.860	0.571	(0.256-1.276)	0.172
Worse tumor-cell differentiation	1.124	(0.749-1.685)	0.573	0.990	(0.635-1.545)	0.966
Higer TNM stage	1.619	(1.062-2.467)	0.025	1.143	(0.560-2.333)	0.713
Adjuvant therapy, yes vs. no	1.650	(0.850-3.202)	0.139	1.472	(0.502-4.317)	0.482
Neoadjuvant therapy, yes vs. no	2.430	(1.148-5.142)	0.020	3.751	(1.337-10.527)	0.012

GIC; gastrointestinal cancer, OR; odd ratio, CI; confidence interval, GC; gastric cancer, CRC; colorectal cancer, TNM; tumor node metastasis.

Table 5. Univariate and multivariate logistic regression of depression in GIC patients.

Characteristics	Depression					
	Univariate logistic regression			Multivariate logistic regression		
	OR	95% CI	*P* value	OR	95% CI	*P* value
Age ≥ 60 years, yes vs. no	1.683	(0.960-2.951)	0.069	1.679	(0.863-3.265)	0.127
Gender, female vs. male	2.557	(1.406-4.648)	0.002	2.615	(1.322-5.176)	0.006
Education degree, high school & university and above vs. primary school and less & middle school	0.871	(0.492-1.543)	0.636	0.664	(0.343-1.284)	0.224
Marital status, unmarried vs. married	1.458	(0.767-2.772)	0.250	1.205	(0.566-2.567)	0.628
Smoking history, yes vs. no	0.719	(0.407-1.269)	0.255	0.684	(0.346-1.352)	0.275
Drinking history, yes vs. no	1.378	(0.757-2.509)	0.295	1.912	(0.949-3.854)	0.070
Diagnosis of disease, GC vs. CRC	1.051	(0.596-1.851)	0.864	0.696	(0.299-1.616)	0.399
Worse tumor-cell differentiation	1.329	(0.879-2.009)	0.178	1.226	(0.769-1.955)	0.392
Higer TNM stage	1.950	(1.253-3.036)	0.003	1.206	(0.587-2.480)	0.610
Adjuvant therapy, yes vs. no	2.710	(1.258-5.836)	0.011	2.464	(0.776-7.821)	0.126
Neoadjuvant therapy, yes vs. no	2.105	(1.069-4.147)	0.031	2.487	(0.926-6.676)	0.071

GIC; gastrointestinal cancer, OR; odd ratio, CI; confidence interval, GC; gastric cancer, CRC; colorectal cancer, TNM; tumor node metastasis.

Discussion

Loneliness, a negative factor for cognitive function and QoL, is worth attention in cancer patients (Hyland et al. 2019; Ejder and Sanlier 2023; Kyaw and Levine 2023; Camlica and Koc 2024). This study found that loneliness level was elevated in GIC patients treated with tumor resection compared to HCs, which could be explained by that these patients usually experienced inpatient treatment, which reduced social interaction and increased loneliness (Camlica and Koc 2024). Moreover, based on previous studies (Perry 1990; Grover et al. 2019), loneliness was classified into 4 levels: UCLA-LS score 20-34 was low, 35-49 was moderate, 50-64 was moderately high, and 65-80 was severe high. Therefore, although postoperative GIC patients had aggravated loneliness compared to HCs, they were classified as having a low level of loneliness. This difference did not reach clinical significance. Diminished spiritual well-being is also common in postoperative cancer patients (Frost et al. 2012; Kisch et al. 2012; Fekih-Romdhane et al. 2022). In this study, spiritual well-being was worse in GIC patients treated with tumor resection compared to HCs. The possible reason could be that: the decreased health status and increased financial burden of GIC patients treated with tumor resection elevated the distress and negative emotions that further impaired spiritual well-being in these patients (Han et al. 2020; Barata et al. 2022). According to previous studies (Liu and Gu 2019;

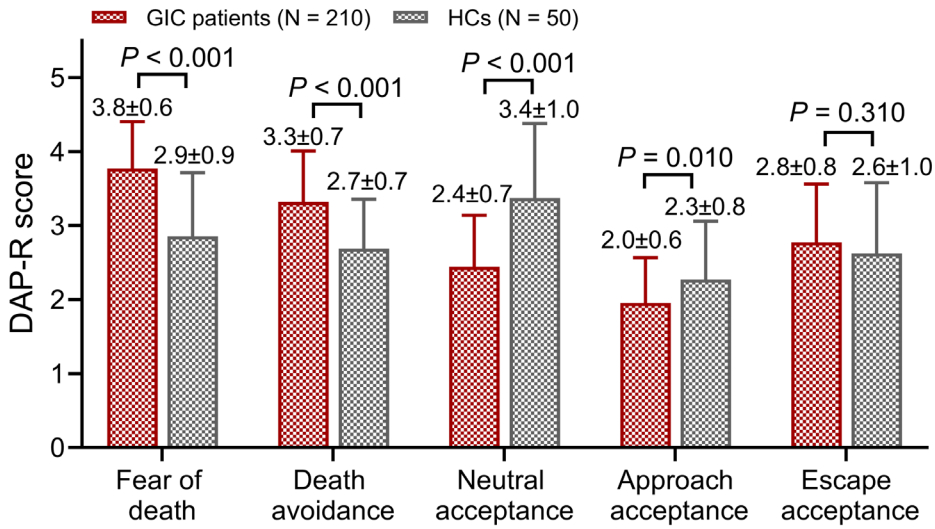

Fig. 3. Attitude to death in GIC patients treated with tumor resection and HCs.

Xu et al. 2023), FACIT-Sp (12 items) score < 24 was defined as low level of spiritual well-being, 24-35 was defined as moderate level, and > 35 was defined as high level. Thus, postoperative GIC patients in this study showed moderate level of spiritual well-being, while HCs had high level.

Concerning the related factors for loneliness and spiritual well-being, the present study found that female sex, unmarried status, and drinking history were independently correlated with increased loneliness, while diagnosis of GC was independently associated with decreased loneliness in postoperative GIC patients. Firstly, females exhibited more fluctuation in reproductive steroid hormones, a vital regulator for stress-related hypothalamo–pituitary–adrenal axis, which could lead to stress dysregulation (Albert and Newhouse 2019). On the other hand, stress could induce the feelings of loneliness (Campagne 2019). Thus, females had increased loneliness compared with males. Secondly, unmarried patients were unable to confide in their spouse, which increased their sense of loneliness (Deckx et al. 2014). Thirdly, drinking might impair the emotional regulation ability and social cognitive function of patients, and therefore, loneliness became heavier in patients with a history of drinking (Valmas et al. 2014; Besse et al. 2022). Fourthly, frequent bowel movements, clustering, urgency, and incontinence would occur in CRC patients with tumor resection and further led to feelings of shame (Pallan et al. 2021). While these events occurred less frequently in postoperative GC patients. Subsequently, the feelings of shame in CRC patients decreased their social activities, which enhanced loneliness (Pape et al. 2022; Phung and Fang 2023).

According to previous studies, the anxiety rate ranges from 34.1% to 60.0% and the depression rate ranges from 28.3% to 58.9% in postoperative GIC patients (Miranda et al. 2018; Zhou and Sun 2021; Liu and Wang 2022; Harms et al. 2023; Kovoor et al. 2023; Li and Ma 2023). In this study, the rate of anxiety and depression was 58.6% and 39.0% in GIC patients treated with tumor resection, respectively. Moreover, this study found that anxiety and depression were aggravated in GIC patients treated with tumor resection compared to HCs. The probable reasons could be: (1) GIC patients treated with tumor resection faced a decrement in physical function and some postoperative complications, which further exacerbated anxiety and depression (Pinto et al. 2016; Ho et al. 2020; Renna et al. 2022). (2) GIC patients treated with tumor resection experienced elevated loneliness in this study. Meanwhile, loneliness was positively associated with anxiety and depression (Steen et al. 2022). Furthermore, this study revealed that neoadjuvant therapy was independently linked with increased anxiety in GIC patients treated with tumor resection, the reason for which could be that: patients who received neoadjuvant therapy frequently had heavier treatment burden, which aggravated their anxiety and depression (Bath et al. 2023). While female sex was independently related to elevated depression in GIC patients treated with tumor resection, for which the explanation was in accordance with the afore-discussed contents.

Attitude to death, including fear of death, death avoidance, neutral acceptance, approaching acceptance, and escape acceptance, would undergo changes in cancer patients (Tang et al. 2014; Ozen et al. 2020; Xia et al. 2023). For instance, one study shows that fear of death, death avoidance, and approach acceptance of death is elevated, while neutral acceptance of death is decreased in urological cancer patients compared with HCs (Xia et al. 2023). Another study reveals that 52.8% of cancer patients feel fear, worry, and anxious to death (Ozen et al. 2020). This study found that GIC patients treated with tumor resection had elevated fear of death and death avoidance, as well as diminished neutral and approach acceptance compared to HCs. The probable explanation could be: (1) The

changed gastrointestinal function, surgical complications, and elevated psychological stress promoted fear of death and death avoidance in GIC patients treated with tumor resection. (2) The occurrence of cancer and the subsequent treatment facilitated patients to appreciate life, desire a longer life, and resist accepting death, thereby, neutral and approach acceptance of death were reduced in GIC patients treated with tumor resection. (3) The recovery and social support prevented patients from seeing death as an escape from cancer. Therefore, escape acceptance of death was similar between GIC patients treated with tumor resection and HCs.

The median (range) days from surgery to survey of CRC patients who received tumor resection were 14.5 (1.0-31.0) days. Previously, one study disclosed that the duration from surgery to discharge was not linked with postoperative anxiety or depression in patients with lung cancer undergoing surgical resection (Park et al. 2016). It was speculated that days from surgery to survey might not affect anxiety or depression in cancer patients, while it needed more evidence to validate. Moreover, the influence of days from surgery to survey on loneliness and spiritual well-being remains uncertain yet, which warrants further investigation.

Some limitations were unavoidable in the current study. Firstly, this study was a single-center study, leading to selective bias. Secondly, the longitudinal changes of psychological evaluations were not assessed in the current study in GIC patients treated with tumor resection, which needed further exploration. Thirdly, the number of HCs was not consistent with that of GIC patients treated with tumor resection, which might enlarge the difference of variance between patients and HCs.

In summary, GIC patients treated with tumor resection experience anxiety and depression, as well as increased loneliness to some extent and reduced spiritual well-being. Moreover, evaluation of risk factors suggests that female patients, unmarried patients, patients with a drinking history, CRC patients, and patients with neoadjuvant therapy require more intense care to avoid adverse psychological status in clinical practice. Notably, GIC patients treated with tumor resection generally have increased fear and diminished acceptance of death.

Conflict of Interest

The authors declare no conflict of interest.

References

Ajani, J.A., D'Amico, T.A., Bentrem, D.J., Chao, J., Cooke, D., Corvera, C., Das, P., Enzinger, P.C., Enzler, T., Fanta, P., Farjah, F., Gerdes, H., Gibson, M.K., Hochwald, S., Hofstetter, W.L., et al. (2022) Gastric Cancer, Version 2.2022, NCCN Clinical Practice Guidelines in Oncology. *J. Natl. Compr. Canc. Netw.*, **20**, 167-192.

Albert, K.M. & Newhouse, P.A. (2019) Estrogen, Stress, and Depression: Cognitive and Biological Interactions. *Annu. Rev. Clin. Psychol.*, **15**, 399-423.

Baiocchi, G.L., Giacopuzzi, S., Marrelli, D., Reim, D., Piessen, G., Matos da Costa, P., Reynolds, J.V., Meyer, H.J., Morgagni, P., Gockel, I., Lara Santos, L., Jensen, L.S., Murphy, T., Preston, S.R., Ter-Ovanesov, M., et al. (2019) International consensus on a complications list after gastrectomy for cancer. *Gastric Cancer*, **22**, 172-189.

Barata, A., Hoogland, A.I., Small, B.J., Acevedo, K.I., Antoni, M.H., Gonzalez, B.D., Jacobsen, P.B., Lechner, S.C., Tyson, D.M., Meade, C.D., Rodriguez, Y., Salsman, J.M., Sherman, A.C., Sutton, S.K. & Jim, H.S.L. (2022) Spiritual well-being, distress and quality of life in Hispanic women diagnosed with cancer undergoing treatment with chemotherapy. *Psychooncology*, **31**, 1933-1940.

Bath, N.M., Sarna, A., Palettas, M., Monsour, C., Stevens, L., Santry, H., Ejaz, A., Kim, A., Pawlik, T. & Cloyd, J.M. (2023) Characterizing treatment burden during neoadjuvant therapy for patients with gastrointestinal cancer: A mixed methods analysis. *J. Surg. Oncol.*, **128**, 393-401.

Benson, A.B., Venook, A.P., Al-Hawary, M.M., Arain, M.A., Chen, Y.J., Ciombor, K.K., Cohen, S., Cooper, H.S., Deming, D., Farkas, L., Garrido-Laguna, I., Grem, J.L., Gunn, A., Hecht, J.R., Hoffe, S., et al. (2021) Colon Cancer, Version 2.2021, NCCN Clinical Practice Guidelines in Oncology. *J. Natl. Compr. Canc. Netw.*, **19**, 329-359.

Benson, A.B., Venook, A.P., Al-Hawary, M.M., Azad, N., Chen, Y.J., Ciombor, K.K., Cohen, S., Cooper, H.S., Deming, D., Garrido-Laguna, I., Grem, J.L., Gunn, A., Hecht, J.R., Hoffe, S., Hubbard, J., et al. (2022) Rectal Cancer, Version 2.2022, NCCN Clinical Practice Guidelines in Oncology. *J. Natl. Compr. Canc. Netw.*, **20**, 1139-1167.

Besse, R., Whitaker, W.K. & Brannon, L.A. (2022) Reducing Loneliness: The Impact of Mindfulness, Social Cognitions, and Coping. *Psychol. Rep.*, **125**, 1289-1304.

Brudek, P., Sekowski, M. & Steuden, S. (2020) Polish Adaptation of the Death Attitude Profile-Revised. *Omega (Westport)*, **81**, 18-36.

Camlica, T. & Koc, Z. (2024) Loneliness, Social Support Level, Quality of Life and Symptom Management Among Turkish Oncology Patients. *Omega* (*Westport*), **89**, 1345-1365.

Campagne, D.M. (2019) Stress and perceived social isolation (loneliness). *Arch. Gerontol. Geriatr.*, **82**, 192-199.

Choi, Y.N., Kim, Y.A., Yun, Y.H., Kim, S., Bae, J.M., Kim, Y.W., Ryu, K.W., Lee, J.H., Noh, J.H. & Sohn, T.S. (2014) Suicide ideation in stomach cancer survivors and possible risk factors. *Support. Care Cancer*, **22**, 331-337.

Clay, K.S., Talley, C. & Young, K.B. (2010) Exploring Spiritual Well-Being among Survivors of Colorectal and Lung Cancer. *J. Relig. Spiritual. Soc. Work*, **29**, 14-32.

Deckx, L., van den Akker, M. & Buntinx, F. (2014) Risk factors for loneliness in patients with cancer: a systematic literature review and meta-analysis. *Eur. J. Oncol. Nurs.*, **18**, 466-477.

Durmus, M. & Ozturk, Z. (2022) The Effect of COVID-19 Outbreak on Older Adults' Hopelessness, Loneliness and Spiritual Well-Being in Turkey. *J. Relig. Health*, **61**, 851-865.

Ejder, Z.B. & Sanlier, N. (2023) The relationship between loneliness, psychological resilience, quality of life and taste change in cancer patients receiving chemotherapy. *Support. Care Cancer*, **31**, 683.

Fekih-Romdhane, F., Riahi, N., Achouri, L., Jahrami, H. & Cheour, M. (2022) Social Support Is Linked to Post-Traumatic Growth among Tunisian Postoperative Breast Cancer Women. *Healthcare* (*Basel*), **10**, 1710.

Francalancia, J., Mavrogiorgou, P., Juckel, G., Mitrovic, T., Kuhle, J., Naegelin, Y., Kappos, L. & Calabrese, P. (2021) Death Anxiety and Attitudes towards Death in Patients with Multiple Sclerosis: An Exploratory Study. *Brain Sci.*, **11**, 964.

Frost, M.H., Johnson, M.E., Atherton, P.J., Petersen, W.O., Dose, A.M., Kasner, M.J., Burger, K.N., Sloan, J.A. & Pipe, T.B. (2012) Spiritual well-being and quality of life of women with ovarian cancer and their spouses. *J. Support. Oncol.*, **10**,

72-80.
Grover, S., Verma, M., Singh, T., Dahiya, N. & Nehra, R. (2019) Loneliness and its correlates amongst elderly attending non-communicable disease rural clinic attached to a tertiary care centre of North India. *Asian J. Psychiatr.*, **43**, 189-196.
Han, C.J., Gigic, B., Schneider, M., Kulu, Y., Peoples, A.R., Ose, J., Kolsch, T., Jacobsen, P.B., Colditz, G.A., Figueiredo, J.C., Grady, W.M., Li, C.I., Shibata, D., Siegel, E.M., Toriola, A.T., et al. (2020) Risk factors for cancer-related distress in colorectal cancer survivors: one year post surgery. *J. Cancer Surviv.*, **14**, 305-315.
Harms, J., Kunzmann, B., Bredereke, J., Harms, L., Jungbluth, T. & Zimmermann, T. (2023) Anxiety in patients with gastrointestinal cancer undergoing primary surgery. *J. Cancer Res. Clin. Oncol.*, **149**, 8191-8200.
Ho, M., Ho, J.W.C., Fong, D.Y.T., Lee, C.F., Macfarlane, D.J., Cerin, E., Lee, A.M., Leung, S., Chan, W.Y.Y., Leung, I.P.F., Lam, S.H.S., Chu, N., Taylor, A.J. & Cheng, K.K. (2020) Effects of dietary and physical activity interventions on generic and cancer-specific health-related quality of life, anxiety, and depression in colorectal cancer survivors: a randomized controlled trial. *J. Cancer Surviv.*, **14**, 424-433.
Hyland, K.A., Small, B.J., Gray, J.E., Chiappori, A., Creelan, B.C., Tanvetyanon, T., Nelson, A.M., Cessna-Palas, J., Jim, H.S.L. & Jacobsen, P.B. (2019) Loneliness as a mediator of the relationship of social cognitive variables with depressive symptoms and quality of life in lung cancer patients beginning treatment. *Psychooncology*, **28**, 1234-1242.
Jones, S.M.W., Nguyen, T. & Chennupati, S. (2020) Association of Financial Burden With Self-Rated and Mental Health in Older Adults With Cancer. *J. Aging Health*, **32**, 394-400.
Kisch, A., Lenhoff, S., Zdravkovic, S. & Bolmsjo, I. (2012) Factors associated with changes in quality of life in patients undergoing allogeneic haematopoietic stem cell transplantation. *Eur. J. Cancer Care* (*Engl*), **21**, 735-746.
Kovoor, J.G., Jacobsen, J.H.W., Stretton, B., Bacchi, S., Gupta, A.K., Claridge, B., Steen, M.V., Bhanushali, A., Bartholomeusz, L., Edwards, S., Asokan, G.P., Asokan, G., McGee, A., Ovenden, C.D., Hewitt, J.N., et al. (2023) Depression after stoma surgery: a systematic review and meta-analysis. *BMC Psychiatry*, **23**, 352.
Kuntz, S., Krieghoff-Henning, E., Kather, J.N., Jutzi, T., Hohn, J., Kiehl, L., Hekler, A., Alwers, E., von Kalle, C., Frohling, S., Utikal, J.S., Brenner, H., Hoffmeister, M. & Brinker, T.J. (2021) Gastrointestinal cancer classification and prognostication from histology using deep learning: Systematic review. *Eur. J. Cancer*, **155**, 200-215.
Kyaw, K.T. & Levine, A. (2023) Association of Loneliness with Cognitive Functions. *J. Prev. Alzheimers Dis.*, **10**, 903-908.
Li, C.C., Rew, L. & Hwang, S.L. (2012) The relationship between spiritual well-being and psychosocial adjustment in Taiwanese patients with colorectal cancer and a colostomy. *J. Wound Ostomy Continence Nurs.*, **39**, 161-169; quiz 170-161.
Li, J. & Ma, C. (2023) Anxiety and depression during 3-year follow-up period in postoperative gastrointestinal cancer patients: prevalence, vertical change, risk factors, and prognostic value. *Ir. J. Med. Sci.*, **192**, 2621-2629.
Li, L., Lv, J., Zhang, L., Song, Y., Zhou, Y. & Liu, J. (2021) Association between attitude towards death and spiritual care competence of Chinese oncology nurses: a cross-sectional study. *BMC Palliat. Care*, **20**, 150.
Lim, C.Y.S., Laidsaar-Powell, R.C., Young, J.M., Solomon, M., Steffens, D., Blinman, P., O'Loughlin, S. & Zhang, Y.; advanced-CRC survivorship authorship group; Butow, P. (2022) Fear of Cancer Progression and Death Anxiety in Survivors of Advanced Colorectal Cancer: A Qualitative Study Exploring Coping Strategies and Quality of Life. *Omega* (*Westport*), 302228221121493.
Liu, D. & Gu, Y. (2019) Spiritual health and its influencing factors in primary liver cancer patients. *Chinese Journal of Modern Nursing*, **25**, 1809-1812.
Liu, P. & Wang, Z. (2022) Postoperative anxiety and depression in surgical gastric cancer patients: their longitudinal change, risk factors, and correlation with survival. *Medicine* (*Baltimore*), **101**, e28765.
Machul, M., Bredle, J., Jurek, K. & Dobrowolska, B. (2023) Psychometric Properties of the Polish Version of the FACIT-Sp-12: Assessing Spiritual Well-Being Among Patients with Chronic Diseases. *Med. Sci. Monit.*, **29**, e941769.
Miranda, D.O., Anatriello, E., Azevedo, L.R., Cordeiro, J.F.C., Peria, F.M., Floria-Santos, M. & Pereira-da-Silva, G. (2018) Elevated serum levels of proinflammatory cytokines potentially correlate with depression and anxiety in colorectal cancer patients in different stages of the antitumor therapy. *Cytokine*, **104**, 72-77.
Nezami, N., Dashti, F., Alilu, L. & Heidari, S. (2020) Comparing relationship between spiritual well-being and death anxiety among women with breast and cervical cancers and women with gastric and colorectal cancers. *J. Educ. Health Promot.*, **9**, 263.
Ozen, B., Ceyhan, O. & Buyukcelik, A. (2020) Hope and perspective on death in patients with cancer. *Death Stud.*, **44**, 412-418.
Pallan, A., Dedelaite, M., Mirajkar, N., Newman, P.A., Plowright, J. & Ashraf, S. (2021) Postoperative complications of colorectal cancer. *Clin. Radiol.*, **76**, 896-907.
Pape, E., Decoene, E., Debrauwere, M., Van Nieuwenhove, Y., Pattyn, P., Feryn, T., Pattyn, P.R.L., Verhaeghe, S. & Van Hecke, A.; Belgian LARS collaborative group (2022) The trajectory of hope and loneliness in rectal cancer survivors with major low anterior resection syndrome: A qualitative study. *Eur. J. Oncol. Nurs.*, **56**, 102088.
Park, S., Kang, C.H., Hwang, Y., Seong, Y.W., Lee, H.J., Park, I.K. & Kim, Y.T. (2016) Risk factors for postoperative anxiety and depression after surgical treatment for lung cancerdagger. *Eur. J. Cardiothorac. Surg.*, **49**, e16-21.
Perry, G.R. (1990) Loneliness and coping among tertiary-level adult cancer patients in the home. *Cancer Nurs.*, **13**, 293-302.
Phung, V.D. & Fang, S.Y. (2023) Body Image Issues in Patients With Colorectal Cancer: A Scoping Review. *Cancer Nurs.*, **46**, 233-247.
Pilleron, S., Sun, V., Ayala, A.P., Haase, K.R., Arthur, E.K., Kenis, C., Roggendorf, S., Krok-Schoen, J.L., Trevino, K., Schmidt, H., Hannan, M., Nikita, N., Monginot, S., Navarrete, E. & Puts, M. (2023) Loneliness in older adults living with cancer: A scoping review of the quantitative and qualitative evidence on behalf of the International Society of Geriatric Oncology Nursing and Allied Health Interest Group. *J. Geriatr. Oncol.*, **14**, 101519.
Pinto, A., Faiz, O., Davis, R., Almoudaris, A. & Vincent, C. (2016) Surgical complications and their impact on patients' psychosocial well-being: a systematic review and meta-analysis. *BMJ Open*, **6**, e007224.
Renna, M.E., Shrout, M.R., Madison, A.A., Alfano, C.M., Povoski, S.P., Lipari, A.M., Carson, W.E., 3rd, Malarkey, W.B. & Kiecolt-Glaser, J.K. (2022) Depression and anxiety in colorectal cancer patients: Ties to pain, fatigue, and inflammation. *Psychooncology*, **31**, 1536-1544.
Rice, D.R., Farooq, A., Hyer, J.M., Paredes, A.Z., Bae, J., Tsilimigras, D.I. & Pawlik, T.M. (2020) Health expenditures and financial burden among patients with major gastrointestinal cancers relative to other common cancers in the United States. *Surgery*, **167**, 985-990.
Sallnow, L., Smith, R., Ahmedzai, S.H., Bhadelia, A., Chamberlain, C., Cong, Y., Doble, B., Dullie, L., Durie, R., Finkelstein, E.A., Guglani, S., Hodson, M., Husebo, B.S., Kellehear, A., Kitzinger, C., et al. (2022) Report of the Lancet Commission on the Value of Death: bringing death back into life. *Lancet*,

399, 837-884.
Sivero, L., Bottone, M., Siciliano, S., Volpe, S., Maione, R., Chini, A., Pollastro, M., Iovino, S. & Sivero, S. (2022) Post-operative oncological and psychological evaluation of patients with colostomy for colorectal cancer. *Ann. Ital. Chir.*, **93**, 435-438.
Snaith, R.P. (2003) The Hospital Anxiety And Depression Scale. *Health Qual Life Outcomes*, **1**, 29.
Steen, O.D., Ori, A.P.S., Wardenaar, K.J. & van Loo, H.M. (2022) Loneliness associates strongly with anxiety and depression during the COVID pandemic, especially in men and younger adults. *Sci. Rep.*, **12**, 9517.
Sung, H., Ferlay, J., Siegel, R.L., Laversanne, M., Soerjomataram, I., Jemal, A. & Bray, F. (2021) Global Cancer Statistics 2020: GLOBOCAN Estimates of Incidence and Mortality Worldwide for 36 Cancers in 185 Countries. *CA Cancer J. Clin.*, **71**, 209-249.
Tang, L., Zhang, L., Li, Y., Zhou, L., Cui, J., Meng, X & Zhao, J. (2014) Validation and reliability of a Chinese version death attitude profile-revised (DAP-R) for nurses. *Journal of Nursing Science*, **29**, 64-66.
Valmas, M.M., Mosher Ruiz, S., Gansler, D.A., Sawyer, K.S. & Oscar-Berman, M. (2014) Social cognition deficits and associations with drinking history in alcoholic men and women. *Alcohol. Clin. Exp. Res.*, **38**, 2998-3007.
Xia, C., Zhao, X., Li, B., Qi, B. & Hong, Y. (2023) Loneliness, spiritual well-being, and death perception, as well as their risk factors in urological cancer patients. *Braz J. Med. Biol. Res.*, **56**, e12915.
Xu, S., Yuan, Z., Cheng, X., Xu, Y. & Li, X. (2023) Revision of the Chinese version of the Functional Assessment of Chronic Illness Therapy-Spiritual Well-Being and its application in maintenance hemodialysis patients. *Nursing Research*, **37**, 2001-2005.
Yilmaz, M. & Cengiz, H.O. (2020) The relationship between spiritual well-being and quality of life in cancer survivors. *Palliat. Support. Care.*, **18**, 55-62.
Zhou, L. & Sun, H. (2021) The longitudinal changes of anxiety and depression, their related risk factors and prognostic value in colorectal cancer survivors: a 36-month follow-up study. *Clin. Res. Hepatol. Gastroenterol.*, **45**, 101511.