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Original Article

When experiencing a surgery: Gastrointestinal cancer patients' longitudinal trajectories in psychological stress and their association with quality of recovery

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ABSTRACT

Objective: Surgical treatment, particularly for gastrointestinal cancer, is a burdensome prospect for many patients. Psychological stress is a common complaint; however, little is known about its patterns in perioperative patients. This study aimed to identify distinct trajectories of perioperative stress and explore antecedent factors and hospitalization outcomes among different trajectories in patients with gastrointestinal cancer.
Methods: A longitudinal study was conducted on 203 patients with gastrointestinal surgical cancer at a specialized oncology hospital in China. Psychological stress was assessed at five perioperative time points (1–3 days before surgery; 1–3 days, 4–6 days, 7–9 days after surgery, and before discharge). A growth mixture model was used to analyze the potential stress trajectories. Multinomial logistic regression was used to identify the characteristics associated with different trajectories.
Results: Three stress trajectories were identified: recovery class (RC, 60.6%), chronic class (CC, 29.5%), and deterioration class (DC, 9.9%). Compared with CC, RC exhibited a shorter length of stay and better recovery quality, and was related to employment, low illness perception, and positive coping; DC reported lower recovery quality from 7 to 9 days after surgery to discharge and was associated with poor education level, history of surgery, stoma, smoking, and preoperative insomnia.
Conclusions: Most surgical patients were insulated from stress due to psychosocial resources, and thus displayed good recovery. However, many patients had moderate stress that did not improve or worsen over the perioperative period, which still needs to be screened and provided with early stress management.

Introduction

Gastrointestinal cancer mainly occurs in the stomach and intestine and may contribute to negative emotional experiences in adults.[1] Gastrointestinal cancer treatments (eg, surgery) are accompanied by a series of mental symptoms, including a series of negative psychological outcomes such as stress, anxiety and depression.[2–4] Few studies have found that perioperative stress could aggravate postoperative physical impairment (eg, pain and fatigue), increase the risk of postoperative complications, and delay patients' postoperative recovery.[3,5,6] Beyond in-hospital recovery, there is emerging evidence that surgery-related psychological stress may also potentially trigger tumor dissemination.[3,7] Given the potential adverse effects of psychological stress, there is a need to pay more attention to managing patients' psychological stress during the short perioperative timeframe to maintain the mental health of gastrointestinal cancer patients.

Despite the short duration (days to weeks) of the perioperative timeframe, psychological stress may fluctuate greatly with rapid changes in stressors within a few days.[8,9] Previous studies have found that anxiety is prevalent in patients before surgery and gradually worsens with impending surgery and complicated preoperative preparation.[9] A longitudinal study in patients with gastrointestinal cancer reported that patients experienced severe stress 1–3 days after surgery, owing to distressing physical symptoms.[10] Similar results were found in lung cancer patients, and this distress might be maintained until 5 days after surgery.[11] Another study demonstrated that mood problems

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peaked seven days after surgery and gradually returned to low levels before discharge.[12] However, existing studies have focused on overall patient changes, masking considerable individual variability in the severity and course of psychological stress during this short period.[13,14] In fact, cancer patients who underwent surgery reported individual heterogeneity in their psychological status.[15–17] For example, Zhao, Lin[15] found that surgical patients with thyroid cancer had three classes of psychological stress (i.e., high, medium, and low) at admission. To our knowledge, few longitudinal studies have examined individual differences in the course of psychological stress during the perioperative period among patients with gastrointestinal cancer. In addition, as noted earlier, psychological stress was negatively associated with patients' hospitalization outcomes including quality of recovery and length of stay (LOS).[18] However, there is little information about the association between psychological stress heterogeneity trajectories and quality of recovery and LOS. The demonstrated relationship would help provide a direction for improving the short-term hospitalization outcomes of patients.

It may be necessary to understand the characteristics of these trajectories to screen specific people, considering the heterogeneity of psychological stress trajectories. Based on the diathesis-stress theory and previous literature, several potential factors related to psychological stress include education level, employment status, stoma, smoking, insomnia, cognitive reappraisal, and coping styles.[8,19–28] Although the above studies examined the relationship between perioperative psychological stress and some factors, their relationship with different trajectories has not been verified.

Therefore, this study involved three processes. The primary goal of this study was to identify subgroups with heterogeneous trajectories of psychological stress in patients with gastrointestinal cancer during the perioperative period. Second, we analyzed the associations between quality of recovery, LOS, and different psychological stress trajectories. Third, we explored potential factors, including demographic, clinical, and psychological variables, that may contribute to the different heterogeneous trajectories of psychological stress.

Methods

Study design

A longitudinal follow-up study was conducted at a specialized oncology hospital in China between April 2020 and April 2021. Ethical approval for this study was obtained from the University Human Research Ethics Committee (Approval No. 2020-R-053).

Participants

Convenience sampling was performed. Participants who met the following inclusion criteria were included in this study: (1) diagnosed with gastrointestinal cancers by clinical pathology; (2) aged 18 years or older; (3) scheduled for surgical treatment; and (4) speaking and reading Chinese comprehensibly to complete the questionnaires. Participants were determined to be ineligible for participation if they met at least one of the following criteria: (1) presence of severe organic diseases, and (2) presence of cognitive and mental disorders. Potential participants obtained informed consent if they were willing to participate in this study.

Measurements and data collection

Demographic, clinical and psychological data were collected at baseline (1–3 days before surgery). Psychological stress and quality of recovery for follow-up assessments were conducted 1–3, 4–6, and 7–9 days after surgery and before discharge. All five data sets were collected during the perioperative period.

Demographic and clinical variables

Information about demographic details (eg, age, gender, and BMI) and clinical variables (eg, family history, cancer type, and LOS) were obtained from medical records and questionnaires.

Perceived stress scale-4 items

The Chinese 4-item perceived stress scale (PSS) was used to assess the patients' psychological stress.[29] It is a self-reported questionnaire that contains four questions with a score ranging from 0 (never) to 4 (always), which has been proven to have good reliability and validity.[29] The total score was 16, with higher scores indicating higher perceived psychological stress. In this study, the Cronbach's α of the scale at the five-time points was 0.919, 0.922, 0.907, 0.907, and 0.928, respectively.

Quality of recovery

The Chinese Quality of Recovery (QoR-15) questionnaire is a self-reported questionnaire that contains 15 questions to assess participants' mental and physical well-being within the last 24 h, which has been applied to surgical patients.[30] It comprises five dimensions: pain, physical comfort, physical independence, psychological support, and emotional state. Each question was rated from 0 (none) to 10 (extremely), and the total score ranged from 0 to 150. Higher scores indicated better recovery quality. In this study, the Cronbach's α of this scale at the five-time points was 0.648, 0.749, 0.784, 0.842, and 0.789, respectively.

Trait coping style questionnaire

The Chinese trait coping style questionnaire (TCSQ) evaluates two independent dimensions of coping: positive and negative coping styles.[31] The TCSQ comprises 20 items, including 10 positive and negative coping items, rated on a 5-point Likert scale, ranging from 1 (never) to 5 (always). Cronbach's α of the positive and negative coping style dimensions were 0.942 and 0.915, respectively.

Neuroticism subscale of the Big Five Inventory

Neuroticism from the Chinese 44-item Big Five Inventory (BFI) was used to assess neuroticism scores in this study.[32] Eight items were rated on a 5-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree). Higher scores reflected greater neuroticism. Cronbach's α for the scale in this study was 0.972.

Brief illness perception questionnaire

The Chinese brief illness perception questionnaire is scored on an 11-point scale ranging from 0 (none) to 10 (extremely), which includes eight items.[33] Three items were scored in reverse, and the total score was obtained by summing all eight items. Higher scores indicated more negative perceptions of illness. Cronbach's α for the scale in this study was 0.779.

Insomnia severity index

Chinese Insomnia Severity Index was mainly used to evaluate the degree of preoperative insomnia in this research, which is a short self-reported insomnia scale and contains seven items, each of which is divided into five grades of 0 (none) to 4 (extremely severe), with a total score of 28.[34] Higher scores indicate great severity of insomnia. The Cronbach's α in this study was 0.964.

Data analysis

Analysis was conducted using SPSS 22.0 and Mplus 7.0. First, the growth mixture model (GMM)[35] was applied to explore the subtypes of psychosocial stress trajectories in patients with gastrointestinal cancer during the perioperative period. A series of model fit indices were used to determine the optimal number of latent classes, including the Akaike information criterion (AIC), Bayesian information criterion (BIC), adjusted BIC (ABIC), Lo-Mendell-Rubin adjusted likelihood ratio test (LMR), and bootstrapped likelihood ratio test (BLRT).[36,37]

Second, descriptive statistics were calculated using frequencies (percentages) for categorical variables, and means and standard deviations for continuous variables. One-way ANOVA and chi-square tests were conducted to compare differences in demographic, clinical, and psychological variables of the identified trajectory subgroups. Additionally, one-way ANOVA and LSD tests were performed to determine the difference in the quality of recovery at the five-time points and LOS among the identified trajectories. A multinomial logistic regression analysis was performed to test the baseline predictors of each psychological stress trajectory. In terms of missing values of patients who withdrew from the follow-up assessment, the maximum likelihood robust estimation (MLR) and mean interpolation were selected. The significance level was set at $P < 0.05$.

Results

A flowchart of this study is illustrated in Fig. 1. A total of 203 eligible participants were recruited for this study. A total of 193 participants completed the outcome assessment 1–3 days after surgery, with 179 individuals at 4–6 days after surgery, 146 individuals at 7–9 days after surgery, and 187 individuals before discharge, which reflects participant completion rates of 95%, 88%, 72%, and 92%, respectively. The reasons for the inability to follow up included patients who refused to fill in questionnaires, went out for examination and activities, withdrew, etc. Significant differences were reported in surgery methods, stoma, disease stage, and complications. There were no significant differences in terms of other baseline variables between completers and non-completers (Supplementary Table 1).

Patient and clinical characteristics

The baseline characteristics of the sample are shown in Table 1. Among all participants, the mean age of the participants was 60.82 (range 30–89 years), with 69.5% being male and 68.5% being less than junior high school. Fifty-eight percent of the population were employed and the majority did not have smoking experience (76.4%). Most of them had no family history (86.2%), complications (83.7%) or stoma (76.4%).

Latent classes of psychological stress trajectories

The fit statistics for the 1–5 class models of psychological stress are compared in Table 2. Based on the fit index criteria, the 3-class model was chosen as the best fitting solution, and the mean trajectories are presented in Fig. 2. The 3-class model revealed the lowest BIC and ABIC compared to the 2-class model, and LMT and BLRT statistically significant p-values, indicating that the predicted 3-class model provided a better fit than the 4/5-class model.

As shown in Fig. 2, the majority of participants fell into a trajectory (recovery class [RC]; $n = 123$ [60.6%]) characterized by low stress within 4–6 days after surgery, which ameliorated in subsequent follow-up visits. The second group (chronic class [CC]; $n = 60$ [29.5%]) presented with moderate psychological stress at baseline, which was steady during follow-up. Finally, the third group (deterioration class [DC]; $n = 20$ [9.9%]) initially displayed moderate psychological stress which was similar to that of the second group within 4–6 days after surgery; the magnitude worsened slightly during follow-up.

Comparisons of LOS and quality of recovery among different stress trajectories

As illustrated in Table 3, LOS ($F = 7.620$, $P = 0.001$) and recovery quality at five-time points during the perioperative period ($F = 4.789$–50.667, $P = 0.009$–0.010) differed in the three categories of psychological stress. Further LSD results revealed that in terms of LOS, participants in the RC had a shorter LOS than those in the CC ($P = 0.002$), and there was no difference between DC and CC ($P = 0.416$). Moreover, the quality of recovery of RC at all five collections was better ($P_s \leq 0.002$), but that of DC only at 7–9 days after surgery and before discharge was worse ($P_s \leq 0.001$) than the quality of recovery of CC. A graphical representation of the evolution of quality of recovery among the three groups is shown in Figure 3. Significant differences between groups at different time points are represented by the symbols "*" ($P < 0.05$ Recovery Class vs. Chronic Class) or "#" ($P < 0.05$ Deterioration Class vs. Chronic Class).

Baseline predictors of psychological stress trajectories

The results of the univariate analysis identified the following psychological variables that were significantly associated with different

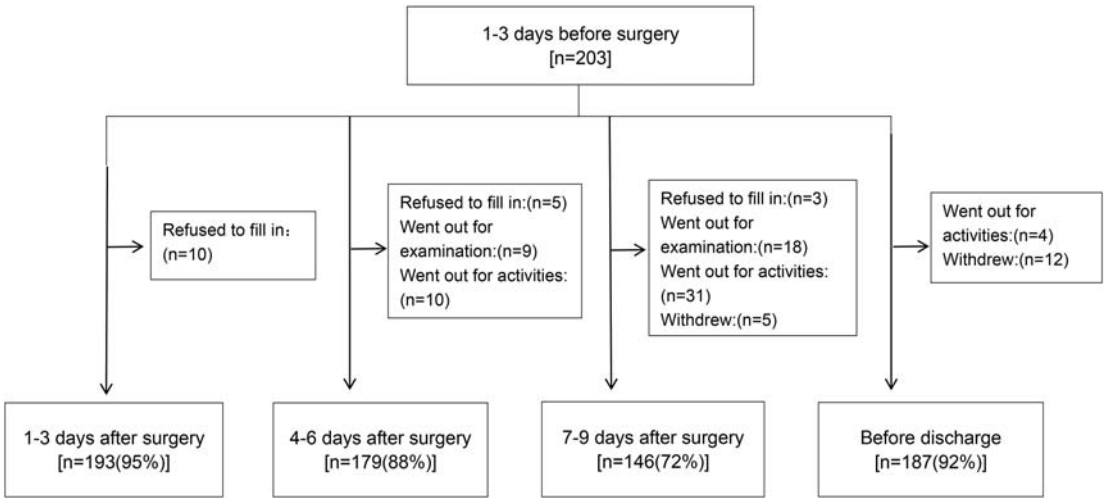

Fig. 1. Flowchart of the study.

Table 1
Baseline demographic, clinical, and psychological characteristics of the total sample and three psychological stress trajectories.

Variables	Total Sample (%)	CC (%)	RC (%)	DC (%)	F/χ^2	P
	($n = 203$)	($n = 60$)	($n = 123$)	($n = 20$)		
Age (Mean ± SD, years)	60.82 ± 11.43	59.13 ± 11.19	61.82 ± 11.33	59.65 ± 12.65	1.232	0.294
BMI (Mean ± SD, kg/m^2)	23.63 ± 3.55	23.87 ± 4.34	23.47 ± 3.14	23.80 ± 3.49	0.282	0.755
Gender					0.660	0.719
Male	141 (69.5)	40 (66.7)	88 (71.5)	13 (65.0)		
Female	62 (30.5)	20 (33.3)	35 (28.5)	7 (35.0)		
Household economy					0.806	0.682
Bad	84 (41.4)	22 (36.7)	53 (43.1)	9 (45.0)		
Not bad	119 (58.6)	38 (63.3)	70 (56.9)	11 (55.0)		
Education level					7.050	0.158
Less than junior high school	139 (68.5)	47 (78.3)	82 (66.7)	10 (50.0)		
Senior high school	41 (20.2)	9 (15.0)	27 (21.9)	5 (25.0)		
College or higher	23 (11.3)	4 (6.0)	14 (11.4)	5 (25.0)		
Employment status					3.405	0.190
No	85 (41.9)	31 (51.7)	46 (37.4)	8 (40.0)		
Yes	118 (58.1)	29 (48.3)	77 (62.6)	12 (60.0)		
Exercise					1.123	0.570
No	51 (25.1)	18 (30)	28 (22.8)	5 (25.0)		
Yes	152 (74.9)	42 (70)	95 (77.2)	15 (75.0)		
Drinking					1.573	0.528
No	137 (67.5)	37 (61.7)	87 (70.7)	13 (65.0)		
Yes	66 (32.5)	23 (38.3)	36 (29.3)	7 (35.0)		
Smoking					1.627	0.446
No	155 (76.4)	46 (76.7)	96 (78.0)	13 (65.0)		
Yes	48 (23.6)	14 (23.3)	27 (22.0)	7 (35.0)		
Family history					0.035	1.000
No	175 (86.2)	52 (86.7)	106 (86.2)	17 (85.0)		
Yes	28 (13.8)	8 (13.3)	17 (13.8)	3 (15.0)		
Cancer type					4.143	0.391
Rectal cancer	65 (32.0)	17 (28.3)	42 (34.1)	6 (30.0)		
Colon cancer	40 (19.7)	12 (20.0)	21 (17.1)	7 (35.0)		
Stomach cancer	98 (48.3)	31 (51.7)	60 (48.8)	7 (35.0)		
Disease stage					1.676	0.463
I/II	104 (51.2)	27 (45.0)	65 (52.8)	12 (60.0)		
III/IV	99 (48.8)	33 (55.0)	58 (47.2)	8 (40.0)		
History of surgery					0.343	0.868
No	114 (56.2)	34 (56.7)	70 (56.9)	10 (50.0)		
Yes	89 (43.8)	26 (43.3)	53 (43.1)	10 (50.0)		
Surgery duration					0.035	0.977
< 3 h	113 (55.7)	34 (56.7)	68 (55.3)	11 (55.0)		
≥ 3 h	90 (44.3)	26 (43.3)	55 (44.7)	9 (45.0)		
Surgery methods					8.290	0.095
Open surgery	90 (44.3)	29 (48.3)	54 (43.9)	7 (35.0)		
Endoscopic surgery	113 (55.7)	31 (51.7)	69 (56.1)	13 (65.0)		
Stoma					1.627	0.446
No	155 (76.4)	46 (76.7)	96 (78.0)	13 (65.0)		
Yes	48 (23.6)	14 (23.3)	27 (22.0)	7 (35.0)		
Complication					1.774	0.410
No	170 (83.7)	47 (78.3)	106 (86.2)	17 (85.0)		
Yes	33 (16.3)	13 (21.7)	17 (13.8)	3 (15.0)		
Insomnia (Mean ± SD)	7.07 ± 6.25	7.47 ± 6.64	6.53 ± 5.78	9.25 ± 7.49	1.817	0.165
Illness perception (Mean ± SD)	40.03 ± 9.39	43.75 ± 9.25	37.57 ± 9.03	44.00 ± 6.94	11.876	< 0.001
Neuroticism (Mean ± SD)	21.14 ± 7.49	24.47 ± 7.36	19.09 ± 6.87	23.76 ± 7.52	13.097	< 0.001
Positive coping (Mean ± SD)	31.27 ± 7.16	27.65 ± 6.86	33.80 ± 6.23	26.55 ± 6.57	24.282	< 0.001
Negative coping (Mean ± SD)	25.38 ± 7.13	28.93 ± 6.70	22.94 ± 6.21	29.80 ± 7.30	22.498	< 0.001

BMI, Body mass index; CC, Chronic class; DC, Deterioration class, RC, Recovery class.

Table 2
Fit statistics of GMM with one-to-five class solutions of psychological stress trajectories.

Criterion	Parameters	AIC	BIC	aBIC	Entropy	LMR (P value)	BLRT (P value)	Class probability
1C	12	4455.700	4495.459	4457.440	–	–	–	–
2C	15	4413.866	4463.564	4416.041	0.863	0.0091	< 0.0001	0.857/0.143
3C	**18**	**4382.847**	**4442.485**	**4385.456**	**0.856**	**0.0072**	**< 0.0001**	**0.295/0.606/0.099**
4C	21	4384.241	4453.819	4387.285	0.789	0.4194	0.6000	0.299/0.104/0.526/0.071
5C	24	4387.767	4467.284	4391.246	0.824	0.2497	1.000	0.044/0.315/0.005/0.547/0.089

aBIC, Adjusted Bayesian information criterion; AIC, Akaike information criterion; BIC, Bayesian information criterion; BLRT, bootstrapped likelihood ratio tes; LMT, Lo-Mendell-Rubin adjusted likelihood ratio test.

psychological stress trajectories: illness perception ($F = 11.876$, $P < 0.001$), neuroticism ($F = 13.097$, $P < 0.001$), positive coping ($F = 24.282$, $P < 0.001$), and negative coping ($F = 22.498$, $P < 0.001$). However, the demographic and clinical characteristics differences were not significant among the different stress trajectories, and the results are presented in Table 1.

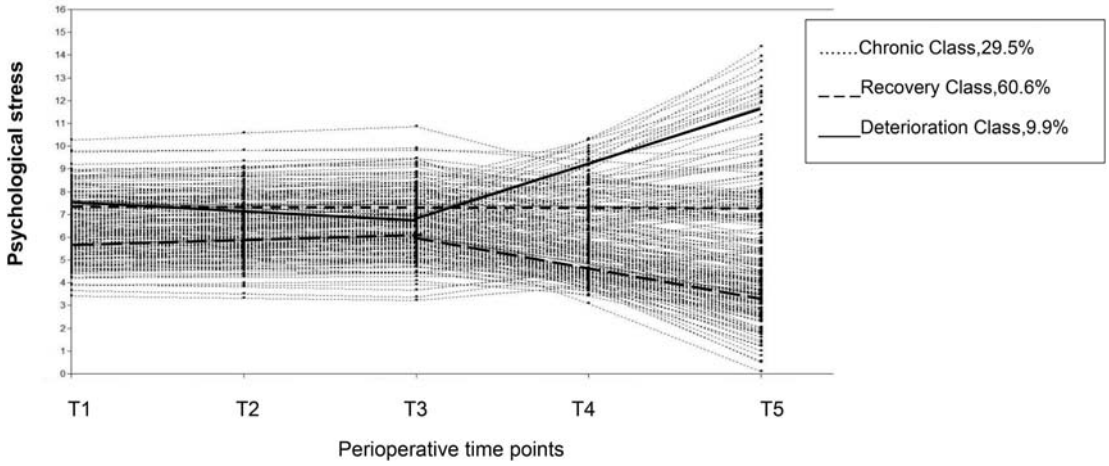

Fig. 2. Mean trajectories of psychological stress during the perioperative period. T1: 1–3 days before surgery; T2: 1–3 days after surgery; T3: 4–6 days after surgery; T4: 7–9 days after surgery; T5: before discharge.

Table 3
The difference of LOS and quality of recovery at different time points among psychological stress trajectories.

Variables	Time	CC (Mean ± SD)	RC (Mean ± SD)	DC (Mean ± SD)	*F*	*P*	Post hoc	
							RC *vs.* CC	DC *vs.* CC
QoR	1–3 days before surgery	105.20 ± 15.50	112.52 ± 12.00	105.70 ± 15.88	6.877	0.001	0.001	0.886
QoR	1–3 days after surgery	86.78 ± 19.06	94.51 ± 14.48	92.50 ± 13.17	4.789	0.009	0.002	0.164
QoR	4–6 days after surgery	93.37 ± 14.68	100.91 ± 11.59	98.90 ± 12.99	7.105	0.001	< 0.001	0.094
QoR	7–9 days after surgery	97.36 ± 11.44	103.80 ± 10.97	87.13 ± 15.06	20.554	< 0.001	0.001	0.001
QoR	Before discharge	108.81 ± 9.47	116.04 ± 8.94	94.14 ± 11.93	50.667	< 0.001	< 0.001	< 0.001
LOS		26.32 ± 11.03	22.12 ± 6.12	28.10 ± 11.66	7.620	0.001	0.002	0.416

CC, Chronic class; DC, Deterioration class; LOS, Length of stay, RC, Recovery class; QoR, Quality of recovery.

Next, all variables were included in the multiple regression analysis, and the results indicated that compared with CC, employment (OR: 1.510; 95% CI: 1.075–2.120) and positive coping (OR: 1.129; 95% CI: 1.010–1.261) were protective factors, while high illness perception (OR: 0.940; 95% CI: 0.885–0.999) was a risk factor for RC. Moreover, compared to CC, senior high school (OR: 0.012; 95% CI: 0.001–0.126), college or higher (OR: 0.091; 95% CI: 0.008–0.990), no history of surgery (OR: 0.211; 95% CI: 0.048–0.917), no stoma (OR: 0.080; 95% CI: 0.007–0.955) and no smoking (OR: 0.055; 95% CI: 0.007–0.451) were risk factors for DC. Insomnia (OR: 1.117; 95% CI: 1.008–1.238) was a protective factor against DC. That is, people with low education levels, history of surgery, stoma, smoking, or insomnia were more likely to develop DC (Table 4).

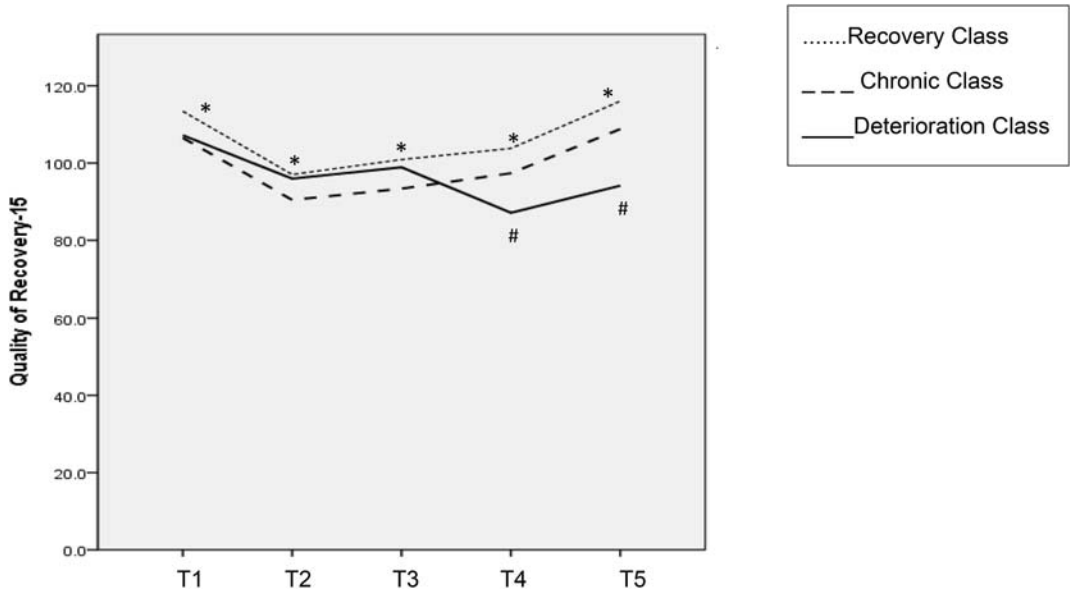

Fig. 3. Evolution of quality of recovery throughout the study for the three predicted psychological stress trajectories. T1: 1–3 days before surgery; T2: 1–3 days after surgery; T3: 4–6 days after surgery; T4: 7–9 days after surgery; T5: before discharge.

Table 4
Multinomial logistic regression[a] predicting psychological stress trajectories.

Variables (reference)		RC (n = 123)		DC (n = 20)	
		B	OR (95% CI)	B	OR (95% CI)
Age		0.010	1.010 (0.973-1.049)	0.001	1.001 (0.940-1.066)
BMI		−0.930	0.911 (0.810-1.024)	0.053	1.055 (0.863-1.289)
Gender (female)	Male	−0.070	0.932 (0.343-2.535)	−1.574	0.207 (0.037-1.158)
Education level (less than junior high school)	Senior high school	−1.318	0.268 (0.058-1.228)	**−4.395*****	**0.012(0.001-0.126)**
	College or higher	−0.237	0.789 (0.153-4.068)	**−2.401***	**0.091 (0.008-0.990)**
Employment status (no)	Yes	**1.007***	**2.738(1.124-6.673)**	0.960	2.613 (0.599-11.398)
Household economy (bad)	Not bad	0.782	2.185 (0.905-5.275)	−0.089	0.915 (0.210-3.990)
Smoking (yes)	No	−0.077	0.926 (0.292-2.931)	**−2.890****	**0.055(0.007-0.451)**
Drinking (yes)	No	0.863	0.095 (0.860-6.537)	1.350	3.856 (0.591-25.154)
Exercise (yes)	No	0.177	0.715 (0.461-3.091)	−0.453	0.636 (0.134-3.006)
Family history (yes)	No	0.459	1.582 (0.511-4.900)	1.182	3.260 (0.467-22.756)
Cancer type (stomach cancer)	Rectal cancer	−0.832	0.435 (0.111-1.711)	−1.887	0.151 (0.009-2.665)
	Colon cancer	−0.388	0.678 (0.200-2.296)	1.367	3.923 (0.474-32.471)
Staging of disease (III/IV)	I/II	0.437	1.548 (0.700-3.423)	0.930	2.535 (0.648-9.915)
history of surgical (yes)	No	−0.152	0.859 (0.380-1.942)	**−1.557***	**0.211 (0.048-0.917)**
Surgery duration (≥ 3 h)	< 3 h	−0.287	0.750 (0.336-1.676)	0.111	1.118 (0.275-4.546)
Surgery style (endoscopic surgery)	Open surgery	−0.791	0.454 (0.166-1.241)	−0.467	0.627 (0.109-3.616)
Stoma (yes)	No	−0.232	0.793 (0.226-2.779)	**−2.525***	**0.080 (0.007-0.955)**
Complications (yes)	No	0.475	1.608 (0.575-4.494)	1.785	5.960 (0.777-45.732)
Insomnia	–	0.035	1.035 (0.967-1.108)	**0.110***	**1.117 (1.008-1.238)**
Illness perception	–	**−0.061***	**0.940 (0.885-0.999)**	0.016	1.016 (0.913-1.130)
Neuroticism	–	0.032	1.032 (0.935-1.139)	−0.075	0.928 (0.785-1.098)
Positive coping	–	**0.121***	**1.129 (1.010-1.261)**	−0.042	0.959 (0.795-1.157)
Negative coping	–	−0.049	0.952 (0.840-1.079)	0.091	1.096 (0.879-1.366)
Intercept	–	1.142	–	1.236	–
Log likelihood	–	258.739	–	–	–
Chi-square	–	103.474***	–	–	–
Pseudo R2	–	0.480	–	–	–

[a] Chronic Class as a reference group; DC, Deterioration class; RC, Recovery class; ***$P < 0.001$; **$P < 0.01$; *$P < 0.05$.

Discussion

This is the first longitudinal study to identify the latent heterogeneity of psychological stress trajectory among patients with gastrointestinal cancer during the perioperative period. Three distinct trajectory groups, RC, CC, and DC, were identified in this study. This is similar to previous result that surgical patients with thyroid cancer experienced three classes of psychological stress (ie, high, medium and low) during the perioperative period.[12] Specifically, approximately 60% of the sample (RC) reported low levels of psychological stress within 4–6 days after surgery and experienced a decreasing trend over time. This finding is consistent with a previous study in which most individuals with adversity manifested low-decreasing stress trajectories after surgical treatment.[38] This study and previous findings suggest that although cancer and its treatment can be stressful, most patients do not overreact to them, showing low levels of stress that gradually dissipate over the course of treatment.[13,14] However, 29.5% of patients (CC) displayed a moderate and relatively stable trajectory of psychological stress, which is consistent with the existing finding that approximately 20% of patients reported consistent stress over the treatment period.[38] This finding demonstrates that appropriate interventions should be developed to reduce psychological stress in participants with CC. Notably, this study also found that 10% of the participants (DC) displayed moderate levels of psychological stress within five days after surgery, with an increasing tendency over time, which suggested that this group is of particular concern to clinicians because of the deterioration of psychological stress. There may be some risk factors contributing to the worsening of psychological stress in this subgroup, which suggests that it is important to identify relevant risk factors in patients with high levels of psychological stress.

This study also investigated LOS and recovery quality differences at five-time points among the three trajectories. Compared with CC, patients in RC exhibited a better quality of recovery at five points and shorter LOS. In comparison, those in DC reported worse recovery quality from 7 to 9 days after surgery to discharge. Previous studies have found that stress can slow the wound healing process and induce postoperative pain, which is related to worse quality of recovery.[39,40] Kitagawa, Yasui-Furukori[18] found that depression increased the LOS of malignancy patients undergoing thoracic surgery. It is likely that psychological stress could affect neuroendocrine responses and immune function, leading to discrepancies in cortisol levels and immune cell (eg, natural killer [NK] cells) activity among individuals with different levels of stress.[41,42] We speculate that decreased cortisol levels and better immune function in RC throughout the perioperative period than in CC contribute to better physical rehabilitation including quality of recovery and LOS. Higher cortisol levels and lower NK-cell activity in DC from 7 to 9 days after surgery to discharge than CC might entail insulin resistance, hyperglycemia, and immune dysfunction, increasing the risk of infection, and leading to worse quality of recovery.[5,19,43]

This study identified a series of factors that contribute to stress trajectories. Among demographic characteristics, compared to CC, employment was a protective factor for RC, and poor education level was a protective factor for DC. These findings are consistent with previous studies in which employment and education levels seemed to be predictors of psychological stress in cancer patients.[44,45] Interestingly, we also found that individuals who reported smoking experience were more likely to enter DC, which might result from the fact that they usually regard smoking as a stress-coping strategy, while forced abstinence from cigarettes accompanying surgery deprives them of this strategy and might not effectively cope with stress.[27] As for the clinical variables, in agreement with the existing literature, stoma, history of surgery, and preoperative insomnia were associated with DC.[8,19,45–47] Probably, these patients might have a poorer physical condition and recover more slowly, resulting in higher psychological stress than those without the above characteristics who underwent surgery simultaneously.[47] In addition, the results found that some modifiable psychological factors including positive coping and low illness perception were associated with RC. According to the common-sense model of self-regulation theory, patients with positive illness perception and positive coping are sufficiently confident about disease treatment and recovery, and could confront the disease with an optimistic attitude.[25,28,48] In summary, identifying patients with a higher risk of developing psychological stress before surgery and providing personalized mental health surveillance and tailored

interventions contribute to preventing perioperative psychological stress.

The findings of this study may have implications for clinical practice. Highlighting substantial individual psychological stress variability in response to surgical treatment and verifying the effect of a heterogeneous stress trajectory on short-term hospitalization outcomes could offer a new direction for perioperative management of patients with gastrointestinal cancer and provide theoretical support for promoting enhanced recovery after surgery (ERAS). In addition, identifying distinct groups of patients with different characteristics will facilitate the development of targeted interventions for high-risk patients.

Limitations

This study had some limitations that require consideration. First, there was an absence of data on psychological stress during follow-up, which may have affected our analysis results even if the GMM could handle this kind of data. Second, the selection of measurement time points may not fully reflect the changes in psychological stress during the perioperative period. Third, the influencing factors selected were the baseline characteristics. Some perioperative time-varying variables may be related to psychological stress experienced by patients during the perioperative period.

Conclusions

This study focused on perioperative patients with gastrointestinal cancer, characterizing them into, "RC," "CC," and "DC" based on psychological stress, and illustrated the short-term hospitalization outcomes and determinants related to different stress trajectories. In terms of psychological stress during the perioperative period, although most patients showed gradual improvement because of the protection of psychological resources, some did not. Some even worsened owing to the existence of risk factors. Given that patients' stress levels directly determine how well they recover from surgery, early screening, and stress management are of great significance for the perioperative recovery of specific patients.

Authors' contributions

Gaorong Lv: Conceptualization, data curation, formal analysis, investigation, writing−original draft, and writing−review editing. Di Zhao, Guopeng Li, and Meiling Qi: Data curation, investigation, methodology, and writing−review and editing. Xiaoling Dong and Ping Li: Conceptualization, funding acquisition, methodology, project administration, supervision, and writing−review and editing.

Ethical considerations

This study was obtained from the University Human Research Ethics Committee (Approval No. 2020-R-053).

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.apjon.2022.04.003.

Declaration of competing interest

None declared.

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